



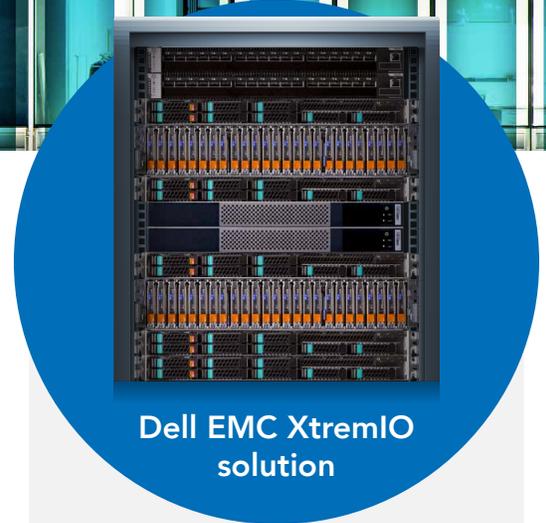
Make room for more virtual desktops with fast storage

Dell EMC XtremIO storage with PowerEdge servers can support a large number of desktops in a small footprint while saving storage space

For virtual desktop infrastructure (VDI) to be worth your while, it should give a large number of users a responsive experience, be easy for IT staff to administer, and minimize ongoing costs.

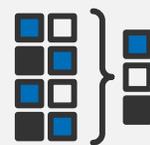
The Dell EMC™ XtremIO® solution (Dell EMC PowerEdge™ FX2s modular enclosures with FC630 server modules, Dell Networking 4048-ON switch modules, Brocade® Connectrix® DS-6620B switches, Emulex® LPe31000-series HBAs by Broadcom®, and Dell EMC XtremIO storage) is a robust VDI platform that can support a large number of virtual desktops while taking up little datacenter space, which can help keep ongoing datacenter expenses low. It offers the flexibility to host either full or linked clones thanks to inline compression and deduplication technologies that help maximize available storage space. Our hands-on tests showed that the Dell EMC XtremIO solution sped deploying and recomposing operations—which refresh desktops to reflect changes from a master VM—saving admins time and getting desktops to users more quickly.

The Dell EMC XtremIO solution offers a powerful VDI platform that can meet the needs of virtual desktop users and admins alike.



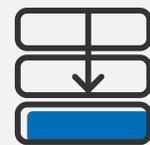
6,000 users

for either linked or full clones



Up to 16:1 deduplication ratio

to maximize storage space



Fits in just 35U
of rack space

The power of the Dell EMC XtremIO solution for VDI

A powerful VDI solution based on strong storage infrastructure can help eliminate many of the problems that can plague VDI in sub-par deployments. Users demand a snappy desktop experience and also have large capacity requirements, both of which stress the underlying storage and bog down user experience—if it's not up to the task.

We put the Dell EMC XtremIO solution to the test deploying both linked and full clones to see how it would fare in a large VDI deployment of 6,000 users. For detailed information about our test hardware, see [Appendix A](#). See [Appendix B](#) for more detailed test results. For our step-by-step test methodology, see [Appendix C](#).

Two ways to deliver desktops: Linked clones vs. full clones

Organizations can deploy either full or linked clones to their users. *Linked clones*, which remain linked to a parent VM, conserve disk space, but don't offer users as much autonomy. *Full clones*, which become independent VMs after the initial cloning operation, give users full control over their desktops, but take up more storage space.

Some organizations deploy a mix of these options to meet the needs of a varied user base. The Dell EMC XtremIO array's deduplication technology means that it can support either or a mix, with the same desktop density, for maximum flexibility in one small package.

The Dell EMC XtremIO solution supported 6,000 users with ease

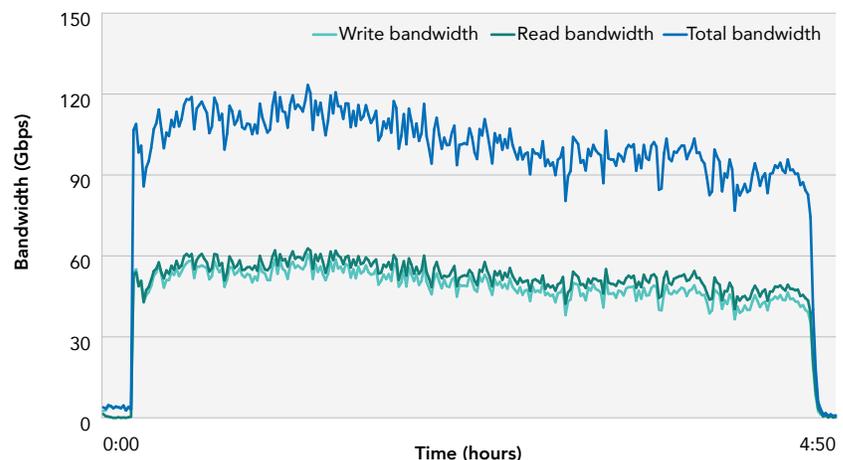
Get your linked clone or full clone desktops up and running quickly

At the start of a VDI deployment, administrators must create the desktops for end users. In large deployments like the 6,000-user case we tested, storage can sometimes lag behind and create huge delays during such a daunting task.

But not the Dell EMC XtremIO solution. We found that it handled initial deployment of 6,000 virtual desktops smoothly and quickly—with high bandwidth, high input/output operations per second (IOPS), and low latency—for full and linked clones, which means it can help get your desktop users up and running fast.



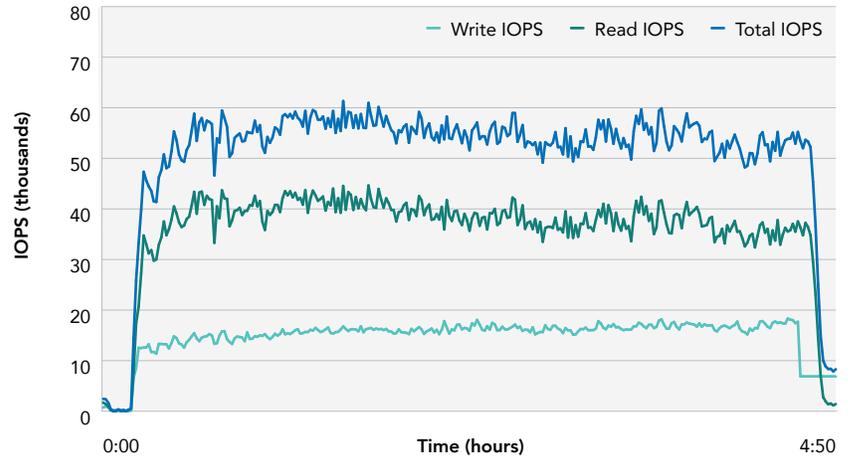
Bandwidth during full clone deployment



It took only 4 hours 50 minutes to deploy 6,000 full-clone desktops. High bandwidth, which peaked at 123.4 Gbps, shows that the XtremIO storage can deliver advantages for VM cloning operations in VDI deployments. XtremIO clones from metadata stored in-memory, which can enable this fast virtual desktop deployment.

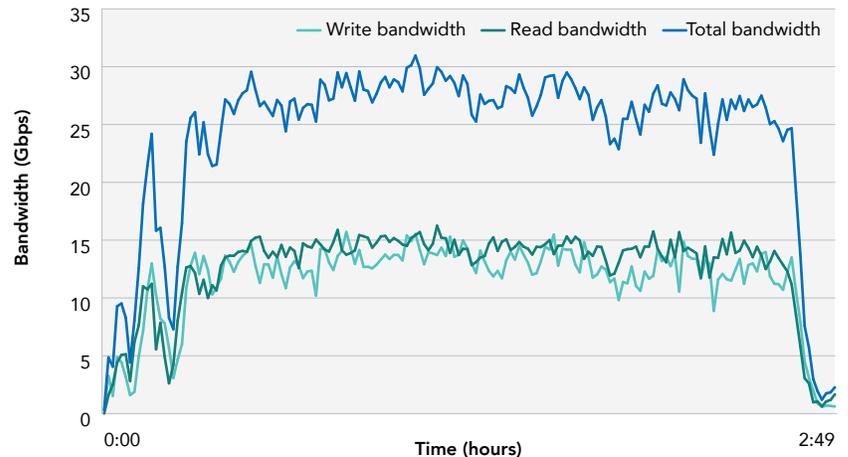
IOPS measure storage performance and show how many reads and writes the disks can perform per second. Both a high number of IOPS and low latency (wait times) indicate that the storage can handle a given workload with solid performance for end users. During deployment, the solution handled consistently high IOPS, and latency averaged just 2.63ms for full clones.

IOPS during full clone deployment



The Dell EMC XtremIO solution deployed 6,000 linked clones in only 2 hours 49 minutes. As with the full-clone deployment, the linked-clone deployment had high bandwidth—a peak of 31.0 Gbps—high IOPS, and a low average latency of just 1.16ms.

Bandwidth during linked clones deployment



IOPS during linked clones deployment

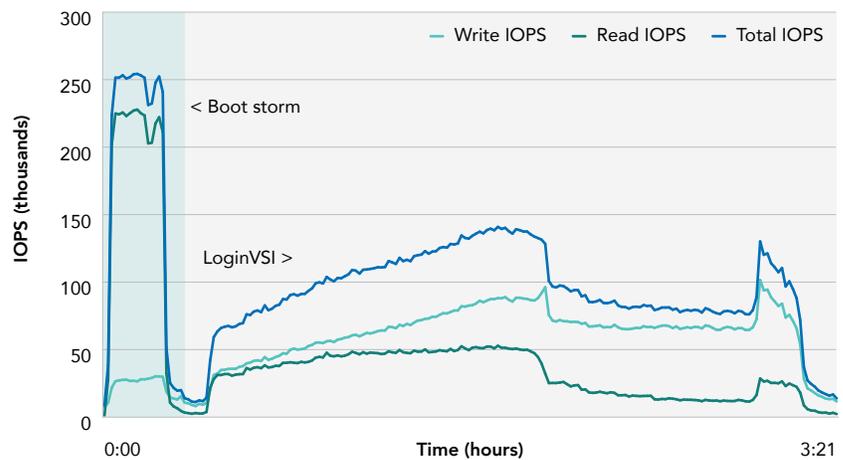


Responsive storage with high IOPS even under stress

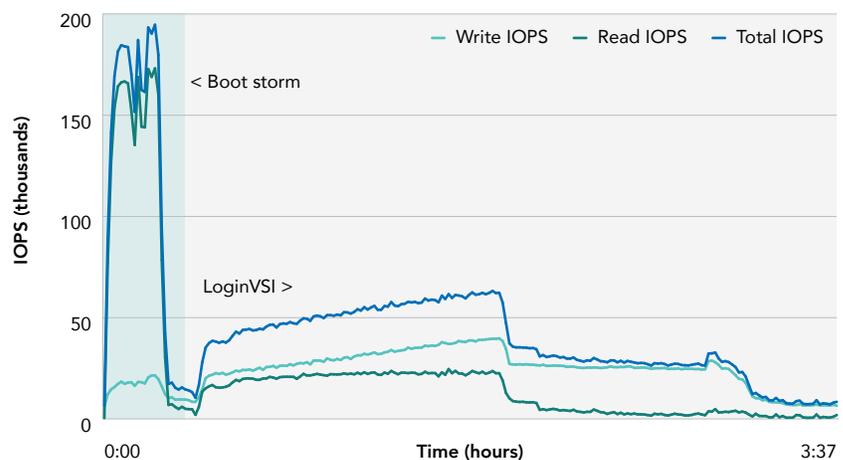


Another task that stresses a VDI platform is a boot storm. This is where a large number of users boot their desktops around the same time, likely at the start of a typical working day. Handling 6,000 users logging on at once was no problem for the Dell EMC XtremIO solution, which processed a large number of IOPS at low latencies to get users to their desktops—linked or full—quickly. During the boot storm, latencies averaged 0.70ms for linked clones and 0.80ms for full clones.

IOPS during linked clones boot storm and Login VSI test run



IOPS during full clones boot storm and Login VSI test run



The Login VSI benchmark reports IOPS during a boot storm for 6,000 users. See [Appendix C](#) for details.

Speedy storage for VDI

The Dell EMC XtremIO is an all-flash array that supports up to 25 400GB SSDs in a single X-Brick® to handle heavy workloads that require fast performance. According to Dell EMC, the XtremIO array can improve operational efficiency, encourage business agility, and scale linearly with both performance and capacity to let you easily add storage as your VDI environment grows. It uses the latest compression and deduplication technologies to help keep your data footprint manageable.

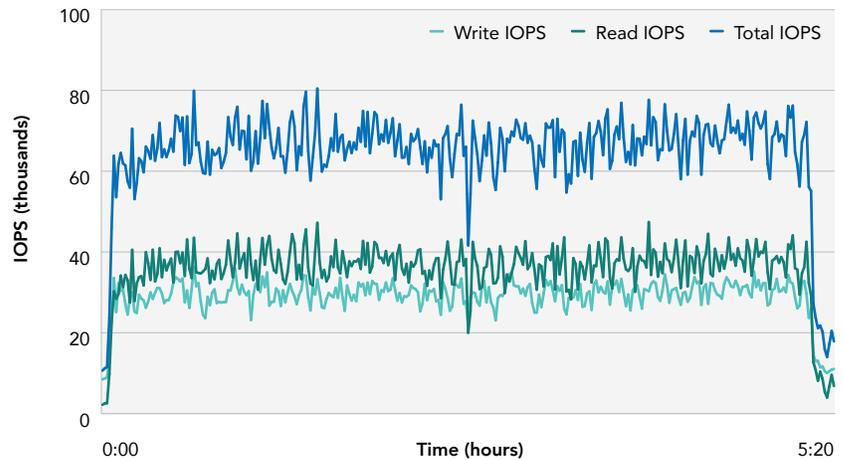
To learn more, visit www.emc.com/en-us/storage/xtremio/benefits.htm

XtremIO performs deduplication and compression inline and in-memory, which speeds up the processes, and no additional space is consumed on disk as only unique data is stored on the SSDs. This can also speed cloning operations from metadata. High bandwidth numbers, such as a peak of 123.4 Gbps during full clone deployment, illustrate the advantage of VM cloning in VDI environments running on XtremIO.

Save admin time with quick desktop recomposition for linked clones

Linked clones give administrators the ability to make changes to all desktops at once (the nature of full clones does not allow this). If a new software version is available, for example, an administrator can make that change to the parent VM and replicate that change to all linked clones. This simultaneous update is called desktop recomposition, and we found that the Dell EMC XtremIO solution could let admins recompose 6,000 desktops quickly and easily so they can move on to other tasks. During recomposition, latency averaged just 0.80ms.

IOPS during linked clones recomposition



Cut down your use of expensive datacenter space

Datacenter space is expensive, and is often charged per square foot. The Dell EMC XtremIO solution's small footprint can help keep these costs low, which can be a feat for large VDI deployments. Built with Dell EMC PowerEdge FX2s modular enclosures with FC630 compute and networking modules, the Dell EMC XtremIO solution fits into just 35U of datacenter space. That means it can support an impressive 6,000 users without taking up even one full rack in the datacenter. The Dell EMC solution has the power to support a large VDI user base without contributing to costly server sprawl. Save that space for your other datacenter initiatives.

Compact performance

The Dell EMC PowerEdge FX2s is a modular server platform that can combine servers, storage, and networking into a single 2U chassis. The two-socket FC630 server block packs up to

- 24 memory DIMMs
- 8 SSDs
- dual- and quad-port 10Gb and quad-port 1Gb select network adapters

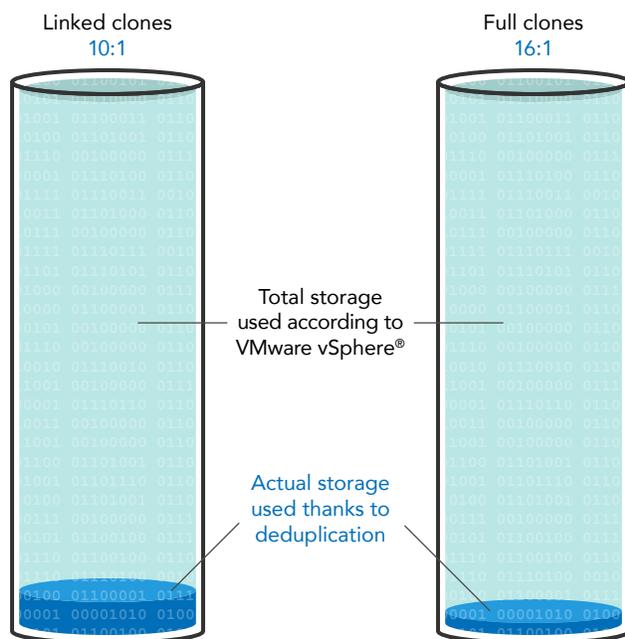
into a half-width sled, providing the power to run virtual desktop platforms such as the one we tested.

To learn more, visit www.dell.com/us/business/p/poweredge-fx/pd

Save storage space through deduplication

Giving users their own centrally located desktops means they have to be stored somewhere. This task falls to the storage solution. Whether you want to use linked or full clones, Dell EMC XtremIO can help reduce storage space for your large VDI deployment by using inline deduplication and compression. Inline deduplication dramatically reduces the amount of data you need to store on your array by eliminating redundant data in real time and instead saving only new and changed data. By completing the process inline, meaning before the data gets to the array, Dell EMC XtremIO storage can also reduce the heavy bandwidth usage typically associated with backing up data. Deduplication is what allows the Dell EMC XtremIO solution to support full clones, which take up significantly more storage space than linked clones. The Dell EMC XtremIO

Deduplication ratios show how much space an array saves by eliminating redundant data



arrays delivered impressive deduplication ratios for both linked and full clones. Inline compression reduces the size of data blocks before they are written to storage by applying mathematical algorithms to encode their information more efficiently. Some data can be compressed dramatically, while other data cannot be compressed at all. In our tests, the overall compression ratio we observed was 1.5:1 for full clones and 1.6:1 for linked clones.

Storage fabric using Brocade Gen 6 hardware

In our tests, we used Connectrix DS-6620B switches, built on Brocade Gen 6 hardware, known as the Dell EMC Connectrix B-Series Gen 6 Fibre Channel by Brocade. The Connectrix B Series provides out-of-the box tools for SAN monitoring, management, and diagnostics that simplify administration and troubleshooting for administrators.

Brocade Fibre offers Brocade Fabric Vision™ Technology, which can provide further visibility into the storage network with monitoring and diagnostic tools. With Monitoring and Alerting Policy Suite (MAPS), admins can proactively monitor the health of all connected storage using policy-based monitoring.

Brocade offers another tool to simplify SAN management for Gen 6 hardware: Connectrix Manager Converged Network Edition (CMCNE). This tool uses an intuitive GUI to help admins automate repetitive tasks and further simplify SAN fabric management in the datacenter.

To learn more about what Brocade Gen 6 has to offer, visit www.brocade.com

Storage networking adapters using Emulex Gen 6 HBAs

We used Emulex-branded Fibre Channel Host Bus Adapters (HBAs) by Broadcom in our testing. According to Broadcom, Emulex HBAs are designed to address the performance, reliability, and management requirements of modern networked storage systems that utilize high performance and low latency SSDs.

The Emulex Dynamic Multi-core architecture applies all ASIC resources to any port that needs it, which can improve performance and port utilization efficiency. The adapters are NVMe over Fabrics-enabled and support NVMe over Fabrics and SCSI concurrently.

To learn more about Emulex Gen 6 Host Bus Adapters, visit www.broadcom.com/products/storage/fibre-channel-host-bus-adapters/



For a large VDI deployment, the Dell EMC XtremIO solution delivered

Before you make the plunge, take into consideration every aspect of your VDI project: user experience, admin time, storage capacity, and ongoing costs related to datacenter space. Our experiences with Dell EMC PowerEdge FX2s enclosures outfitted with PowerEdge FC630 compute modules and Dell EMC XtremIO arrays show that this solution is a compelling one for VDI deployments. The Dell EMC XtremIO solution supported 6,000 virtual desktops with a good user experience, offered flexibility by supporting both full and linked clones, recomposed the desktops quickly and easily, and reduced data dramatically through inline deduplication and compression. And it did all this in less than a single rack of datacenter space, to keep server sprawl in check and costs down.

On February 5, 2017, we finalized the hardware and software configurations we tested. Updates for current and recently released hardware and software appear often, so unavoidably these configurations may not represent the latest versions available when this report appears. For older systems, we chose configurations representative of typical purchases of those systems. We concluded hands-on testing on February 14, 2017.

Appendix A: System configuration information

Servers under test

| Server configuration information | Dell EMC PowerEdge FC630 |
|--|-------------------------------|
| BIOS name and version | Dell 2.2.5 |
| Operating system name and version/build number | VMware® ESXi™ 6.5.0 4564106 |
| Date of last OS updates/patches applied | 01/01/17 |
| Power management policy | Maximum Performance |
| Processor | |
| Number of processors | 2 |
| Vendor and model | Intel® Xeon® E5-2698 v4 |
| Core count (per processor) | 20 |
| Core frequency (GHz) | 2.20 |
| Stepping | B0 |
| Memory module(s) | |
| Total memory in system (GB) | 512 |
| Number of memory modules | 16 |
| Vendor and model | Samsung® M393A4K40BB1-CRC |
| Size (GB) | 32 |
| Type | PC4-19200 |
| Speed (MHz) | 2,400 |
| Speed running in the server (MHz) | 2,400 |
| Local storage | |
| Number of drives | 1 |
| Drive vendor and model | Dell G9917 SD card |
| Drive size (GB) | 16 |
| Drive information (speed, interface, type) | Class 10 SD |
| Network adapter #1 | |
| Vendor and model | Cavium NetXtreme® II BCM57810 |
| Number and type of ports | 2 x 10GbE |
| Driver version | bnx2x |

| Server configuration information | | Dell EMC PowerEdge FC630 |
|----------------------------------|------------------------|--------------------------|
| Network adapter #2 | | |
| Vendor and model | Emulex LPe31002-M6 | |
| Number and type of ports | 2 x 16Gb Fibre Channel | |
| Driver version | lpfc | |

Server enclosure

| Server enclosure configuration information | | Dell EMC PowerEdge FX2s |
|--|--------------------------------|-------------------------|
| Number of management modules | 1 | |
| Management module firmware revision | 1.40 | |
| KVM module firmware | 1.0 | |
| Midplane version | 1.0 | |
| First type of I/O module | | |
| Vendor and model number | Dell EMC PowerEdge FN 410S IOM | |
| I/O module firmware revision | 9.10(0.1) | |
| Number of modules | 2 | |
| Occupied bay(s) | A1, A2 | |
| Power supplies | | |
| Vendor and model number | Dell 0W1R7VA00 | |
| Number of power supplies | 2 | |
| Wattage of each (W) | 2,000 | |

Login VSI Launcher servers

| Server configuration information | | Dell EMC PowerEdge M620 |
|--|---------------------------|-------------------------|
| BIOS name and version | Dell 2.5.4 | |
| Operating system name and version/build number | VMware ESXi 6.5.0 4564106 | |
| Date of last OS updates/patches applied | 01/01/17 | |
| Power management policy | Maximum Performance | |
| Processor | | |
| Number of processors | 2 | |
| Vendor and model | Intel Xeon E5-2660 | |
| Core count (per processor) | 8 | |
| Core frequency (GHz) | 2.20 | |
| Stepping | C2 | |

| Server configuration information | | Dell EMC PowerEdge M620 |
|--|------------------------------|-------------------------|
| Memory module(s) | | |
| Total memory in system (GB) | 192 | |
| Number of memory modules | 12 | |
| Vendor and model | Samsung M393B2G70BH0-YH9 | |
| Size (GB) | 16 | |
| Type | PC3-10600 | |
| Speed (MHz) | 1,333 | |
| Speed running in the server (MHz) | 1,333 | |
| Local storage | | |
| Number of drives | 2 | |
| Drive vendor and model | Seagate® ST9146852SS | |
| Drive size (GB) | 146 | |
| Drive information (speed, interface, type) | 15K, SAS, HDD | |
| Network adapter | | |
| Vendor and model | Cavium NetXtreme II BCM57810 | |
| Number and type of ports | 2 x 10GbE | |
| Driver version | bnx2x | |

Login VSI Launcher server enclosure

| Server enclosure configuration information | | Dell EMC PowerEdge M1000e |
|--|----------------------|---------------------------|
| Number of management modules | 1 | |
| Management module firmware revision | 5.20 | |
| KVM module firmware | 01.00.01.01 | |
| First type of I/O module | | |
| Vendor and model number | Force10 MXL 10/40GbE | |
| I/O module firmware revision | 1.0 | |
| Number of modules | 4 | |
| Occupied bay(s) | A1, B1, A2, B2 | |
| Second type of I/O module | | |
| Vendor and model number | Brocade M5424 | |
| I/O module firmware revision | 11 | |
| Number of modules | 2 | |
| Occupied bay(s) | B1, B2 | |

| Server enclosure configuration information | | Dell EMC PowerEdge M1000e |
|--|---------------------|---------------------------|
| Power supplies | | |
| Vendor and model number | Dell 0W1R7VA00 | |
| Number of power supplies | 2 | |
| Wattage of each (W) | 2,000 | |
| Cooling fans | | |
| Vendor and model number | Dell YK776 Rev. A00 | |
| Number of fans | 8 | |

Storage solution

| Storage configuration information | | Dell EMC XtremIO X-Brick |
|--|--------------------------|--------------------------|
| Controller firmware revision | 4.0.4-41 | |
| Number of storage controllers | 4 | |
| Number of storage shelves | 2 | |
| Number of drives per shelf | 25 | |
| Drive vendor and model number | Hitachi HUSMM114 CLAR400 | |
| Drive size (GB) | 400 | |
| Drive information (speed, interface, type) | 12Gb SAS, SSD | |

FC SAN storage network infrastructure

| Switch configuration information | | Dell EMC Connectrix DS-6620B |
|----------------------------------|-------------------|------------------------------|
| Firmware version | 8.0.0 | |
| Licensed features | Enterprise Bundle | |
| Number of ports | 48 | |
| SFP | 48 x 32Gbps | |

VMware Horizon virtual desktop VMs

| VM configuration | |
|---|---------------------------|
| Operating system | Windows 10 Enterprise x86 |
| VMware virtual machine hardware version | 11 |
| vCPUs | 1 socket / 2 cores |
| RAM | 1.5 GB |
| Network adapters | 1 x VMXNET3 |
| Virtual disk | 24 GB |

Appendix B: Detailed test results

VSImax v4 benchmark results

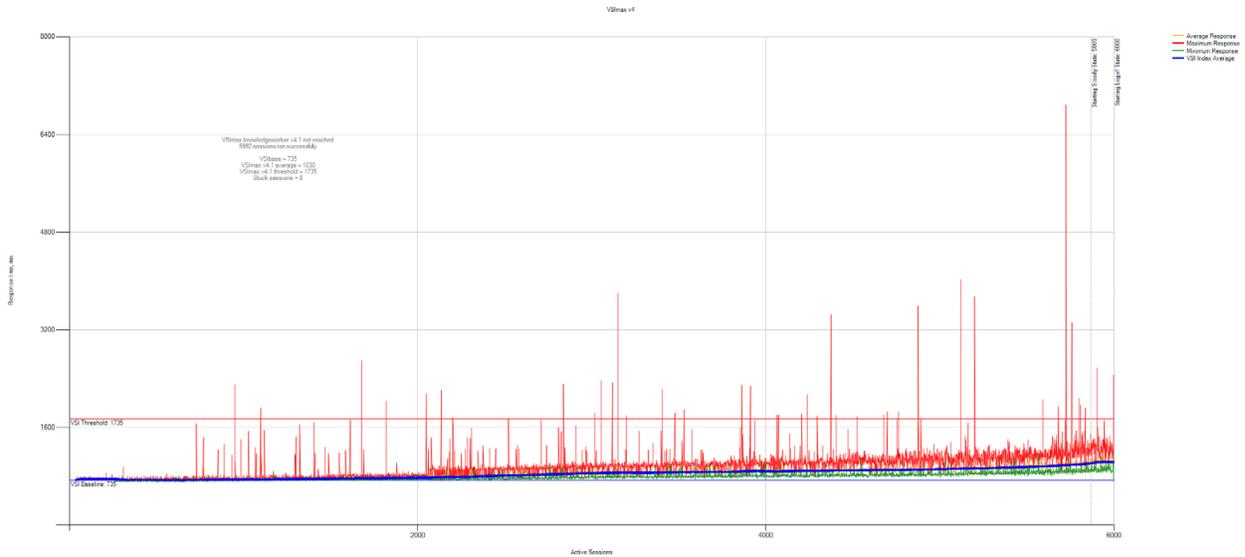


Figure 1: VSImax v4 response times for 6,000 linked clones

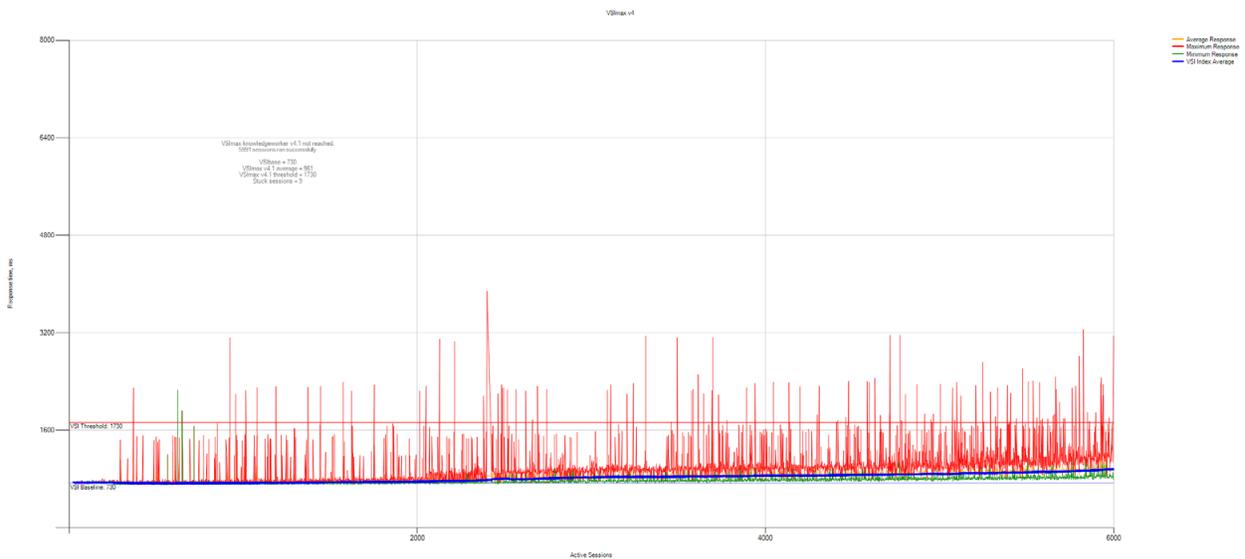


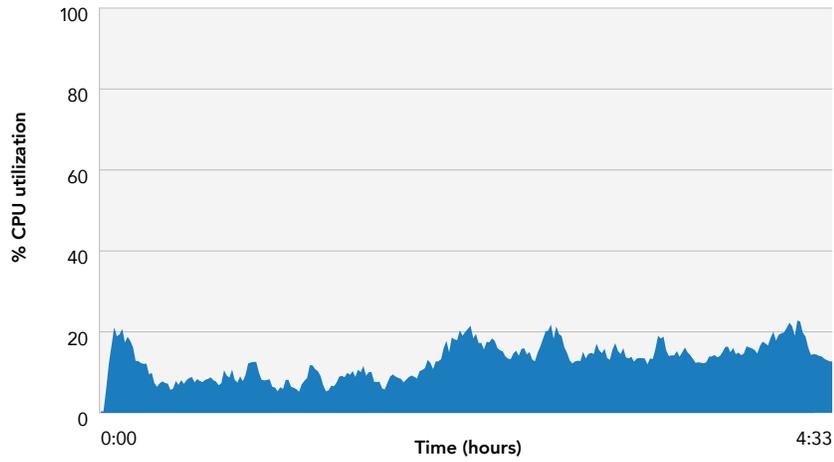
Figure 2: VSImax v4 response times for 6,000 full clones

Average latency during deployment, boot storm and Login VSI, and recompose

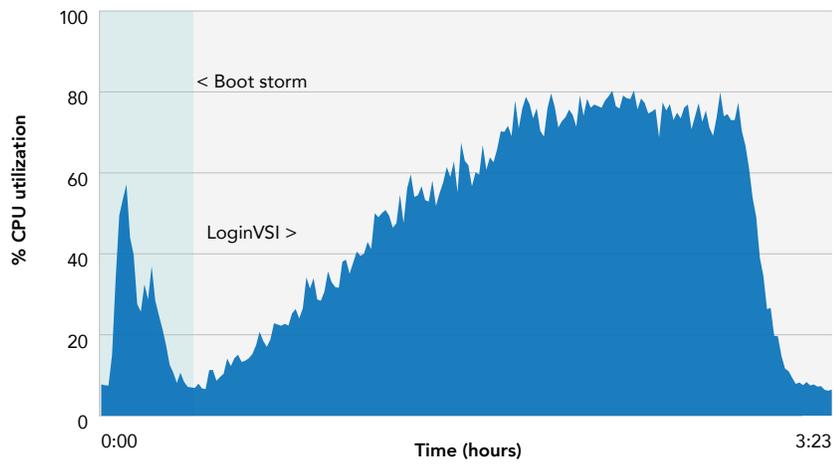
| Average latency | Linked clones | Full clones |
|------------------------|---------------|-------------|
| Deploy | 1.16 ms | 2.63 ms |
| Boot storm + Login VSI | 0.70 ms | 0.80 ms |
| Recompose | 0.80 ms | N/A |

CPU utilization

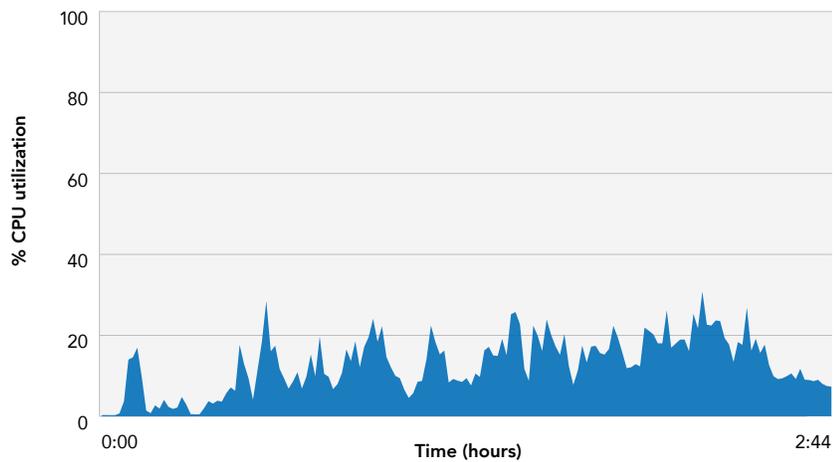
CPU utilization during full clone deployment



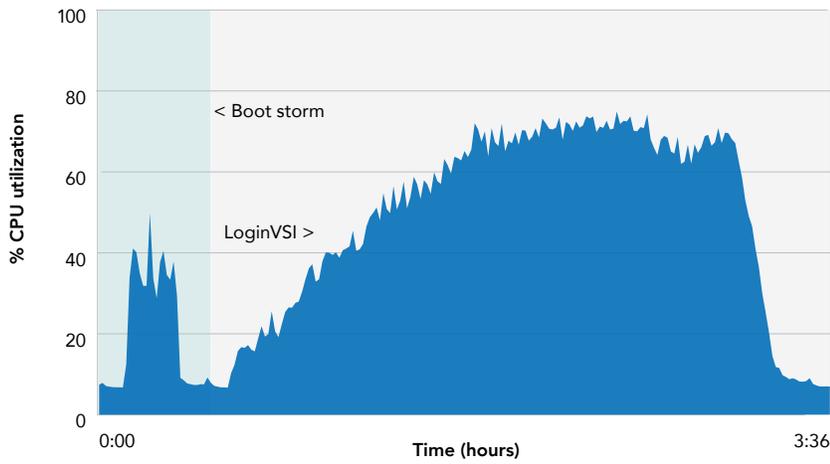
CPU utilization during full clones boot storm and Login VSI test run



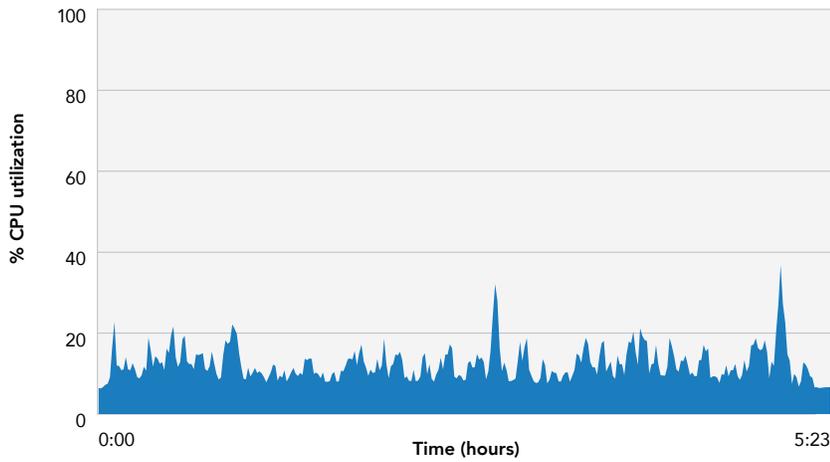
CPU utilization during linked clones deployment



CPU utilization during linked clones boot storm and Login VSI test run

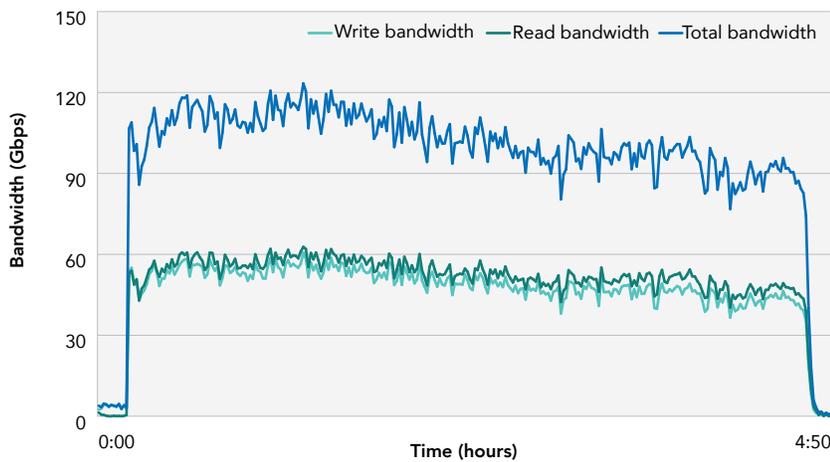


CPU utilization during linked clones recomposition

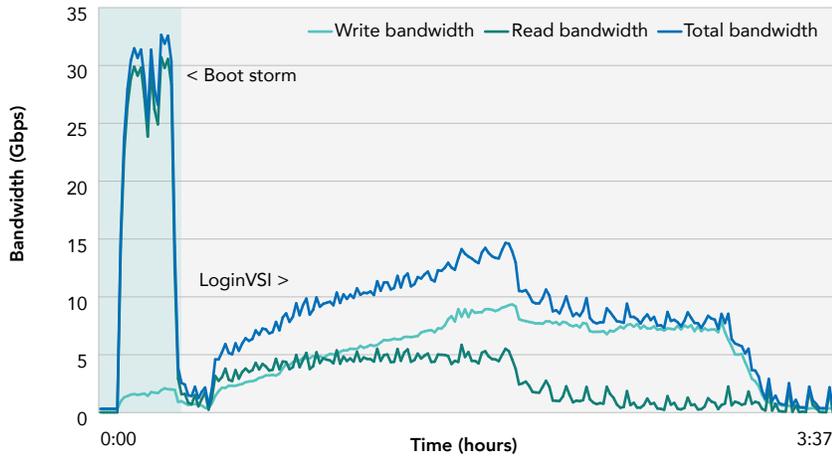


Bandwidth

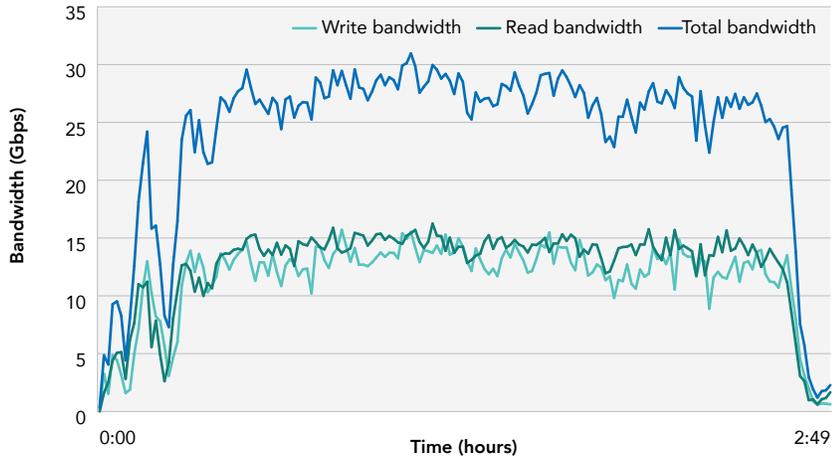
Bandwidth during full clone deployment



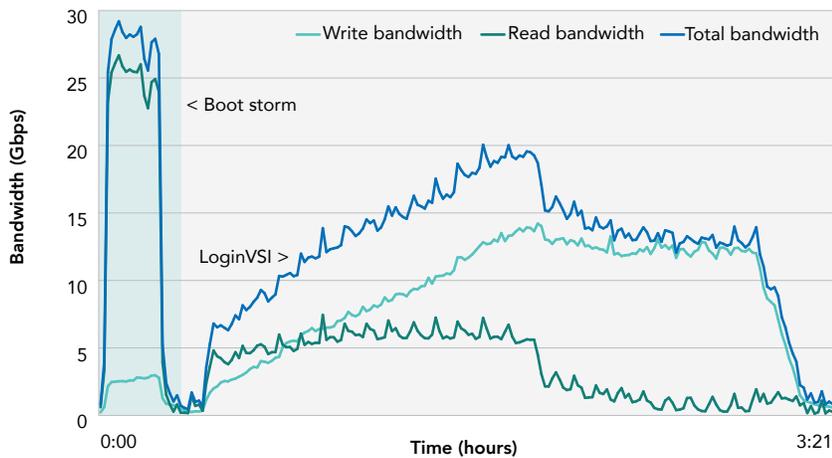
Bandwidth during full clones boot storm and Login VSI test run



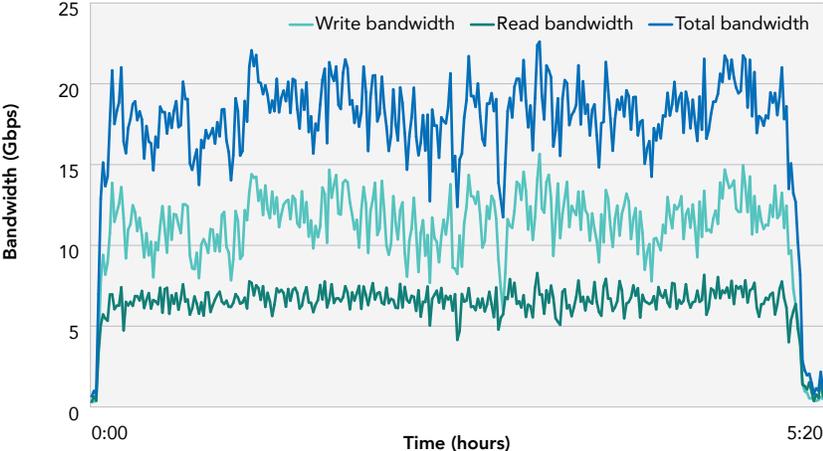
Bandwidth during linked clones deployment



Bandwidth during linked clones boot storm and Login VSI test run

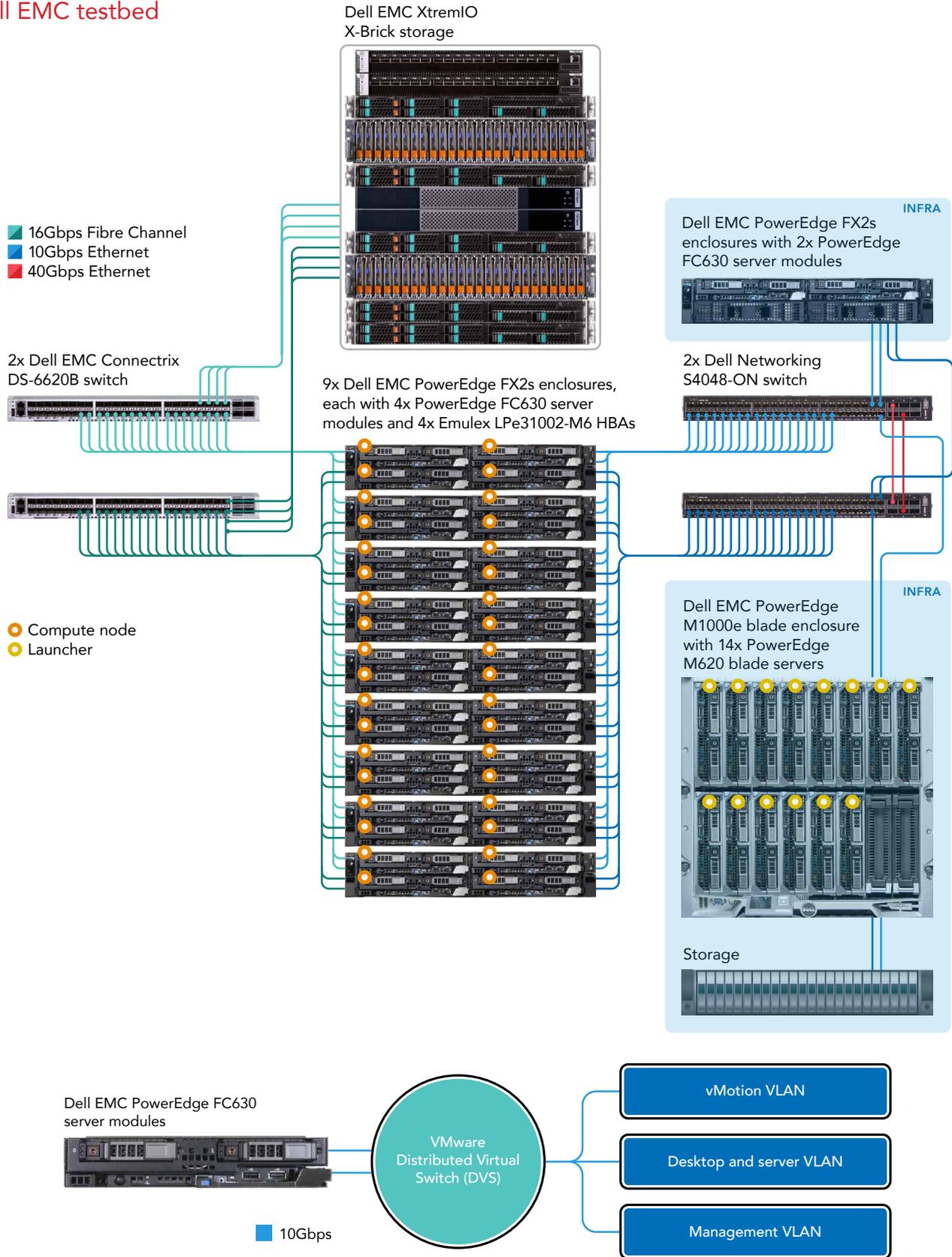


Bandwidth during linked clones recomposition



Appendix C: How we tested

Dell EMC testbed



Installing the Dell EMC PowerEdge M1000e blade enclosure to host launchers VMs

Before we installed and configured any software, we populated 14 slots in a Dell EMC PowerEdge M1000e blade enclosure with Dell EMC PowerEdge M620 blade servers. We used the Lifecycle Controller to perform BIOS and firmware updates on each blade server and deployed 224 Launcher VMs on 14 M620 server blades.

Installing ESXi 6.5 on systems under test

Perform these steps on each M620 blade server and each FC630 server. In a similar fashion, we also set up two FC630s to host all infrastructure VMs.

1. Insert the vSphere installation media, power on the server, and boot from the DVD drive.
2. Select the standard vSphere installer, and allow the files to copy into memory.
3. At the welcome screen, press F11.
4. At the keyboard language selection screen, press Enter.
5. Enter a password twice for the root user, and press Enter.
6. Choose to install to the local SD card.
7. Allow the installer to finish installing vSphere, and reboot the server.

Installing Microsoft® Active Directory® and DNS services on DC1

1. Deploy a Windows Server® 2012 R2 VM from template named DC1, and log in as administrator.
2. Launch Server Manager.
3. Click Manage→Add Roles and Features.
4. At the Before you begin screen, click Next.
5. At the Select installation type screen, leave Role-based or feature-based installation selected, and click Next.
6. At the Server Selection Screen, select the server from the pool, and click Next.
7. At the Select Server Roles screen, select Active Directory Domain Services. Click Add Features when prompted, and click Next.
8. At the Select Features screen, click Next.
9. At the Active Directory Domain Services screen, click Next.
10. At the Confirm installation selections screen, check Restart the destination server automatically if required, and click Install.

Configuring Active Directory and DNS services on DC1

1. After the installation completes, a screen should pop up with configuration options. If not, click the Tasks flag in the upper-right section of Server Manager.
2. Click Promote this server to a Domain Controller.
3. At the Deployment Configuration screen, select Add a new forest. In the Root domain name field, type `test.local` and click Next.
4. At the Domain Controller Options screen, leave the default values, and enter a password twice.
5. Click Next four times to accept default settings for DNS, NetBIOS, and directory paths.
6. At the Review Options screen, click Next.
7. At the Prerequisites Check dialog, allow the check to complete. If there are no relevant errors, check Restart the destination server automatically if required, and click Install.
8. When the server restarts, log on using `test\Administrator` and the specified password.

Configuring the Windows® time service on DC1

To ensure reliable time, we pointed our Active Directory server to a physical NTP server.

1. Open a command prompt.
2. Type the following:

```
w32tm /config /syncfromflags:manual /manualpeerlist:"<ip address of a NTP server>"
w32tm /config /reliable:yes
w32tm /config /update
w32tm /resync
Net stop w32time
Net start w32time
```

Setting up DHCP services on DC1

1. Open Server Manager.
2. Select Manage, and click Add Roles and Features.
3. Click Next twice.
4. Select DHCP Server, and click Next.

5. At the Introduction to DHCP Server screen, click Next.
6. At the Specify IPv4 DNS Settings screen, type test.local for the parent domain.
7. Type the preferred DNS server IPv4 address, and click Next.
8. At the Specify IPv4 WINS Server Settings screen, select WINS is not required for applications on the network, and click Next.
9. At the Add or Edit DHCP Scopes screen, click Add.
10. At the Add Scope screen, enter the Name DHCP Scope name.
11. In the next box, set the following values, and click OK.
 - a. Start IP address=172.16.10.1
 - b. End IP address=172.16.100.254
 - c. Subnet mask=255.255.0.0
12. Check the Activate This Scope box.
13. At the Add or Edit DHCP Scopes screen, click Next.
14. Click the Enable DHCP v6 Stateless Mode radio button, and click Next.
15. Leave the default IPv6 DNS Settings, and click Next.
16. At the Authorize DHCP server dialog box, select Use current credentials.
17. At the Confirm Installation Selections screen, click Next. If the installation is set up correctly, a screen displays saying that DHCP server install succeeded.
18. Click Close.

Installing SQL Server® 2014 on SQL01

1. Deploy a Windows Server 2012 R2 VM named SQL01, and log in as administrator.
2. Prior to installing, add the .NET Framework 3.5 feature to the server.
3. Mount the installation DVD for SQL Server 2014.
4. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2014 DVD, and double-click it.
5. In the left pane, click Installation.
6. Click New SQL Server stand-alone installation or add features to an existing installation.
7. Select the Enter the product key radio button, and enter the product key. Click Next.
8. Click the checkbox to accept the license terms, and click Next.
9. Click Use Microsoft Update to check for updates, and click Next.
10. Click Install to install the setup support files.
11. If there are no failures displayed, click Next.
12. At the Setup Role screen, choose SQL Server Feature Installation, and click Next.
13. At the Feature Selection screen, select Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools – Basic, and Management Tools – Complete. Click Next.
14. At the Installation Rules screen, after the check completes, click Next.
15. At the Instance configuration screen, leave the default selection of default instance, and click Next.
16. At the Server Configuration screen, choose NT Service\SQLSERVERAGENT for SQL Server Agent, and choose NT Service\MSSQLSERVER for SQL Server Database Engine. Change the Startup Type to Automatic. Click Next.
17. At the Database Engine Configuration screen, select the authentication method you prefer. For our testing purposes, we selected Mixed Mode.
18. Enter and confirm a password for the system administrator account.
19. Click Add Current user. This may take several seconds.
20. Click the Data Directories tab to relocate the system, user, and temp db files.
21. Change the location of the root directory to the D:\ volume.
22. Click Next.
23. At the Error and usage reporting screen, click Next.
24. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
25. At the Ready to Install screen, click Install.
26. After installation completes, click Close.
27. Close the installation window.
28. Open SQL Server 2014 Configuration Manager, and expand Protocols for MSSQLSERVER.
29. Right-click Named Pipes, and choose Enabled.
30. Click OK, and restart the SQL service.

Setting up databases for VMware vCenter® and VMware View® Composer™

1. Log onto SQL01 as TEST\administrator.
2. From the server desktop, open SQL Server Configuration Manager.

3. Click SQL Server Network Configuration→Protocols for MSSQLSERVER.
4. Right-click TCP/IP, and select Enabled.
5. Click SQL Services, right-click SQL Server Browser, and select Properties.
6. In the SQL Server Browser Properties, select the Services tab, change the Start mode to Automatic, and click OK. Repeat this step for the SQL Server Agent service.
7. Start the SQL Server browser service and the SQL Server Agent service.
8. From the SQL Server desktop, open SQL Server Management Studio.
9. Click Connect.
10. Select the Databases folder, right-click, and select New Database.
11. Provide the name vCenter for the new database.
12. Select the Databases folder, right-click, and select New Database.
13. Provide the name composer for the new database.
14. Click Options, change the recovery model from full to simple, and click OK.

Installing VMware vCenter 6.5

1. Mount the image, navigate to the vcsa folder, and launch VMware-ClientIntegrationPlugin-x.x.x.exe.
2. In the wizard that appears, click Next.
3. Accept the terms of the license agreement, and click Next.
4. Leave the default installation directory, and click Next.
5. Click Install.
6. Click Finish.
7. In the mounted image's top directory, open vcsa-setup.html.
8. When prompted, click Allow.
9. Click Install.
10. Accept the terms of the license agreement, and click Next.
11. Enter the FQDN or IP address of the host onto which the vCenter Server Appliance will be deployed.
12. Provide a username and password for the system in question, and click Next.
13. To accept the certificate of the host you chose to connect to, click Yes.
14. Select the appropriate datacenter, and click Next.
15. Select the appropriate resource, and click Next.
16. Provide a name and password for the virtual machine, and click Next.
17. Select Install vCenter Server with an Embedded Platform Services Controller, and click Next.
18. Select Create a new SSO domain.
19. Provide a password, and confirm it.
20. Provide an SSO Domain name and SSO Site name, and click Next.
21. Set an appropriate Appliance Size, and click Next.
22. Select an appropriate datastore, and click Next.
23. Select Use an embedded database (PostgreSQL), and click Next.
24. At the Network Settings page, configure the network settings as appropriate for your environment, and click Next.
25. Review your settings, and click Finish.
26. When installation completes, click Close.
27. Log into vCenter VM as TEST\administrator.
28. From the VMware vCenter 6.5 install media, click Autorun.
29. To start the install wizard, click Run.
30. Select vCenter Server for Windows, and click Install.
31. At the Install wizard welcome screen, click Next.
32. Accept the End User License Agreement, and click Next.
33. Select embedded deployment and the deployment type, and click Next.
34. Verify the system name, and click Next.
35. Enter and confirm the password you wish to use with the Administrator account for vCenter Single Sign On, and click Next.
36. Select Use Windows Local System Account and the service account, and click Next.
37. Select Use an external database, and enter database credentials. Click Next.
38. At the Configure Ports screen, click Next.
39. Accept the default installation path, and click Next.
40. Click Install.
41. Using the vSphere web client, log into the vCenter server as DOMAIN\administrator.

42. Right-click the root of vCenter, and click New Data center.
43. Name the new datacenter `datacenter`
44. Add the servers under test and infrastructure servers to the datacenter.

Adding DRS/HA clusters

We created three DRS/HA clusters, one each for infrastructure, launchers, and Dell vDT.

1. Log into the vCenter via the VMWare Web client.
2. Right-click the Datacenter, and select New Cluster...
3. Provide an appropriate name, and check the Turn ON boxes for both DRS and vSphere HA.
4. Click OK.
5. When the cluster creation completes, right-click the new cluster, and select Settings.
6. In the vSphere DRS tab, click Edit.
7. Under Additional Options, check the boxes for VM Distribution and Memory Metric for Load Balancing. Leave CPU Over-Commitment unchecked.
8. Click OK.
9. Repeat steps 1 through 8 for each cluster to be created.

Creating a distributed switch and the distributed port groups for the cluster

Before these steps we created VMkernel adapters for management and vMotion on each host under test, and assigned private IP addresses to each. Create a distributed switch and two port groups as follows.

1. Log into the vCenter via the VMware web client.
2. Navigate to the Networking tab in the left pane.
3. Right-click the datacenter, and select Distributed Switch→New Distributed Switch.
4. Provide a name, and click Next.
5. Choose Distributed switch: 6.5.0, and click Next.
6. Specify 2 as the number of uplinks, deselect Create a default port group, and click Next.
7. Click Finish.
8. Right-click the new distributed switch, and select Distributed Port Group→New Distributed Port Group.
9. Provide a name, and click Next.
10. Set the port binding to Static binding, and the port allocation to Elastic. For the vMotion distributed port group only, set the VLAN type to VLAN, with VLAN ID 300.
11. Click Next.
12. Click Finish.
13. Repeat steps 8 through 12 so that you have two distributed port groups, priv-net and vMotion.
14. Right-click the new distributed switch, and select Add and Manage Hosts.
15. Select Add hosts, and click Next.
16. Click New hosts...
17. Select all hosts under test, and click OK.
18. Click Next.
19. Check the boxes for Manage physical adapters and Manage VMkernel adapters, and click Next.
20. For each host, select the first adapter, click Assign Uplink, and click OK.
21. Repeat step 20 for the second adapter on each host.
22. After all hosts' adapters are assigned to uplinks, click Next.
23. For each host, select a VMkernel adapter, and click Assign port group. Select the appropriate distributed port group, and click OK.
24. Repeat step 23 for each VMkernel adapter on each host, and click Next.
25. Click Next.
26. Click Finish.

Setting up a database and ODBC DSN for VMware Horizon Composer

1. Deploy a Windows Server 2012 R2 VM named Composer.
2. Log onto the composer VM as TEST\administrator.
3. From the desktop of the Composer server, select Start, Run, and type `odbcad32.exe`. Press Enter.
4. Click the system DSN tab.
5. Click Add.
6. Click SQL Server Native Client 10.0, and click Finish.
7. In the Create a New Data Source to SQL Server text box, type the connection name `composer`

8. For Server, select SQL, and click Next.
9. Change authentication to With SQL Server authentication using a login ID and password entered by the user, type sa as the Login ID, use the password you defined in SQL Server setup for the SA account, and click Next.
10. Select Change the default database to..., choose Composer from the pull-down menu, and click Next.
11. Click Finish.
12. Click Test Data Source...
13. To create the Composer ODBC connection, click OK.

Setting up VMware Horizon Composer 7

1. Open the View 7 media folder, and run the file named VMware-viewcomposer-7.0.2-4350300.exe.
2. At the Welcome screen and the Patents screen, click Next.
3. Accept the VMware end user license agreement, and click Next.
4. Leave the Destination folder as default, and click Next.
5. In the Database information box, type composer as the source name and sa as the user name. Enter the password, and click Next.
6. Leave the default SOAP port, and click Next.
7. Click Install, and click Finish.
8. Restart the server.

Installing VMware Horizon Connection Server 7

1. Log into the server named Connection1.
2. Browse to VMware Horizon installation media, and click VMware-viewconnectionserver-x86_64-7.0.2-4356666.exe.
3. Click Run.
4. At the Welcome screen, click Next.
5. Agree to the End User License Agreement, and click Next.
6. Keep the default installation directory, and click Next.
7. Select View Standard Server, and click Next.
8. At the Data Recovery screen, enter a backup password, and click Next.
9. Allow View Server to configure the Windows firewall automatically, and click Next.
10. Authorize the local administrator to administer View, and click Next.
11. Choose whether to participate in the customer experience improvement program, and click Next.
12. Complete the installation wizard to finish installing View Connection Server.
13. Click Finish.
14. Reboot server.

Configuring the VMware Horizon Connection Server

1. Open a Web browser to <view connection1 FQDN>/admin.
2. Log in as administrator.
3. Under Licensing, click Edit License...
4. Enter a valid license serial number, and click OK.
5. Open View Configuration → Servers.
6. In the vCenter Servers tab, click Add...
7. Enter vCenter server credentials, and edit the following settings:
 - a. Max concurrent vCenter provisioning operations:20
 - b. Max concurrent power operations:50
 - c. Max concurrent View Composer maintenance operations:20
 - d. Max concurrent View Composer provisioning operations:20
 - e. Max concurrent Instant Clone Engine provisioning operations:20
8. Click Next.
9. At the View Composer screen, select View Composer co-installed with vCenter Server, and click Next.
10. At the View Composer domains screen, click Add...
11. Enter full domain name and user credentials.
12. Do not use Reclaim VM disk space or Enable View Storage Accelerator.
13. At the ready to complete screen, click Finish.

Installing VMware Horizon Replica Server 7

Perform the following steps on connection2, connection3, and connection4.

1. Log into the appropriate server.
2. Browse to VMware View installation media, and click VMware-viewconnectionserver-x86_64-7.0.2-4356666.exe.
3. Click Run.
4. At the Welcome screen, click Next.
5. Agree to the End User License Agreement, and click Next.
6. Keep the default installation directory, and click Next.
7. Select View Replica Server, and click Next.
8. In the Source Server page, provide `connection1.test.local`, and click Next.
9. Leave the default firewall configuration, and click Next.
10. Click Install.
11. When the installation completes, click Finish.

Setting up a Windows 10 Enterprise (x86) ESXi base image VM

1. Log into the vCenter via the VMware Web client.
2. Click the Virtual Machines tab.
3. Right-click, and choose New Virtual Machine.
4. Select Create a new virtual machine.
5. Choose Custom, and click Next.
6. Assign the name View-gold, and click Next.
7. Select any host in the vDT cluster, and click Next.
8. Select the appropriate storage.
9. Choose Virtual Machine Version 11, and click Next.
10. Choose Windows, choose Microsoft Windows 10 (32-bit), and click Next.
11. For CPUs, select one virtual processor socket and two cores per virtual socket, and click Next.
12. Choose 1.5 GB RAM, and click Next.
13. Click 1 for the number of NICs, select VMXNET 3, and click Next.
14. Leave the default virtual storage controller, and click Next.
15. Choose to create a new virtual disk, and click Next.
16. Make the OS virtual disk size 24 GB, choose Thin Provision, specify the OS datastore on the external storage, and click Next.
17. Keep the default virtual device node (0:0), and click Next.
18. Click Finish.
19. Click the Resources tab, click Memory, and check the Reserve all guest memory checkbox.
20. Click the Hardware tab, CD/DVD Drive, and Connect the VM virtual CD-ROM to the Microsoft Windows 10 x86 installation disk.
21. Click OK.

Installing Windows 10 Enterprise (x86) on the ESXi base image VM

1. When the installation prompts you, press any key to begin setup.
2. Enter your language preferences, and click Next.
3. Click Install.
4. Accept the license terms, and click Next.
5. Select Custom, and select the drive that will contain the OS.
6. Click Install.
7. Type `user` for the username, and click Next.
8. Enter no password, and click Next.
9. At the system protection screen, select Use recommended settings, and click Next.
10. Enter your time zone, and click Next.
11. Select the Work Network setting, and click Next.
12. Install VMware Tools, and select Complete Installation. For more information, see kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
13. Reboot.
14. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
15. Join the domain, and restart the VM.
16. Install Microsoft Office Professional Plus 2016.

Installing the VMware Horizon agent

1. Browse to the VMware Horizon View 6 media, and run the VMware-viewagent file.
2. Click Run.

3. At the Welcome screen, click Next.
4. Accept the VMware end user license agreement, and click Next.
5. Select defaults, and click Next.
6. Click Install.

Configuring Regedit for QuickPrep

1. Click Start→Run, and type `regedit`
2. Browse to `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\vmware-viewcomposer-ga`.
3. Right-click Skip License Activation, and click Modify...
4. Change the value from 0 to 1.
5. Shut down the machine, and take a snapshot of the final disk image.

Optimize the Windows 10 master image

1. Download the Windows optimization tool from VMware.
2. Extract the zip file, and run `VMwareOSOptimizationTool_b1084.exe`,
3. Click Template, and select Windows 10 (Horizon Air Hybrid).
4. Click Analyze.
5. Select All Suggestions, and click Optimize.
6. When settings have been applied, reboot the VM.

Deploying virtual desktops using VMware Horizon

We deployed all VMs with a script to ensure repeatability (see [Appendix D](#)).

1. Open the View Administrator.
2. Log in as administrator.
3. Under Inventory, click Pools, and click Add...
4. Select Automatic Pool, and click Next.
5. Select floating, and click Next.
6. Select View Composer linked clones, and click Next.
7. Type pool for the pool ID and display name, and click Next.
8. Leave the pool settings as defaults, and click Next.
9. Under Naming Pattern, enter an appropriate name pattern for the pool.
10. Under Pool Sizing, type 1000 for Max number of desktops and the number of spare (power on) desktops.
11. Select Provision all desktops up-front, and click Next.
12. Select the defaults under View Composer Disks, and click Next.
13. Under Storage Optimization, select Do not use VMware Virtual SAN.
14. Under vCenter Settings, select the following depending on where you are deploying virtual machines:
 - a. Parent VM
 - b. Snapshot
 - c. VM folder location
 - d. Host or cluster
 - e. Resource pool
 - f. Data stores (1 Replica + 8 clone Datastores)
15. Under Guest customization, select the following:
 - a. Domain: test.local
 - b. AD container: OU=Computers,OU=LoginVSI
16. Select Use Quick Prep, and click Next.
17. Click Finish.
18. Select Entitle users after this wizard finishes.
19. Select the LoginVSI group, and click OK.

Installing the Login VSI 4 benchmark

Setting up a VM to host the Login VSI share CIFS1

1. Connect to an infrastructure server via the VMware web client.
2. In the VMware vSphere client, under Basic Tasks, select Create a new virtual machine.
3. Choose Custom, and click Next.

4. Assign the name VSI_share to the virtual machine, and click Next.
5. Select infra1 as the host, and click Next.
6. Select the appropriate storage, and click Next.
7. Choose Virtual Machine Version 11, and click Next.
8. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
9. For CPUs, select one virtual processor socket and two cores per virtual socket, and click Next.
10. Choose 4 GB RAM, and click Next.
11. Click 1 for the number of NICs, select VMXNET3, connect to the PRIV-NET network, and click Next.
12. Leave the default virtual storage controller, and click Next.
13. Choose to create a new virtual disk, and click Next.
14. Make the OS virtual disk size 100 GB, choose thin-provisioned lazy zeroed, specify external storage, and click Next.
15. Keep the default virtual device node (0:0), and click Next.
16. Click Finish.
17. Right-click the VM, and choose Edit Settings.
18. Click the Resources tab, and click Memory.
19. Select Reserve all guest memory, and click OK.
20. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2012 R2 installation disk.
21. Start the VM.

Installing the Microsoft Windows Server 2012 R2 operating system on the VM

1. Open a virtual machine console on VSIShare.
2. Leave the language, time/currency format, and input method as default, and click Next.
3. Click Install Now.
4. Choose Windows Server 2012 R2 Datacenter Edition (Server with a GUI), and click Next.
5. Accept the license terms, and click Next.
6. Click Custom: Install Windows only (advanced).
7. Select Drive 0 Unallocated Space, and click Next, at which point Windows begins automatically, and restarts automatically after completing.
8. Enter the administrator password twice, and click OK.
9. Install VMware Tools. For more information, see kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
10. Reboot the server.
11. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
12. Enable remote desktop access.
13. Change the hostname to VSIShare, and reboot when the installation prompts you.
14. Set up networking for the data network:
 - a. Click Start→Control Panel, right-click Network Connections, and choose Open.
 - b. Right-click the VM traffic NIC, and choose Properties.
 - c. Uncheck TCP/IP (v6).
 - d. Select TCP/IP (v4), and choose Properties.
 - e. Set the IP address, subnet, gateway, and DNS server.

Installing the Login VSI benchmark on VSI_shares

For Login VSI to work correctly, you must create a CIFS share(s), an Active Directory OU, and Active Directory users. For more information on Login VSI, see <https://www.loginvsi.com/documentation>. We created one Windows server VM per 1,000 users, six total, to host roaming profiles and folder redirection (CIFS2-7). We also created one Windows server to host Login VSI content per 1,000 users (VS1-6). Finally, we created one dedicated Windows file share for VSI management (VSI1).

1. Log into CIFS1.
2. Create a folder named D:\share.
3. Right-click the D:\share folder, and click Properties.
4. Click the Sharing tab, and click Share...
5. Add everyone, system, and administrators to the Read/Write group, and click Share.
6. Unpack the Login VSI install media.
7. Open Datacenter setup\setup.exe.
8. At the welcome screen, click Next.
9. Select the share named \\vsishare\share, and click Next.
10. Check the Start Login VSI Management Console checkbox to start the Management Console when the setup is completed, and click Finish.

11. At the management console, enter the path to your Login VSI license file, and click Save.

Configuring Login VSI: AD setup

1. On VSI1, open the VSI management console, and click "1. AD setup."
2. Enter the following:
 - a. Base OU: DC=domain,DC=local
 - b. Username: LoginVSI
 - c. Password1: *****
 - d. Domain: (auto detect checked)
 - e. Number of users: 6000
 - f. Formatting length: 4
 - g. Launcher user: Launcher-v4
 - h. Launcher password: *****
 - i. Click Save to .ps1.
3. Copy the VSIADSetup.ps1 file to \\DC1\c\$.
4. Log into DC1, and execute the VSIADSetup.ps1 in Windows PowerShell™
5. Open Active Directory Users and Computers, and Create 6 OUs under test.local/loginVSI/users/Target by right clicking the Target OU and selecting New→Organizational Unit.
 - a. Name each UO vDT 1-6
 - b. Move users 1-1000 to vDT1, 1001-2000 to vDT2, and so on until each OU has 1,000 users.

Setting up the Login VSI share and Active Directory users

1. Log into each of the 6 CIFS servers, open Windows Explorer, and create the following folders: `e:\profiles`, and `g:\folderredirect`.
2. Add permissions of read/write to the domain.local/everyone group.
3. Right-click the `e:\profiles`, and `g:\folderredirect` folders, and select Properties.
4. Click the Sharing tab, and select Share...
5. Add everyone, system, and administrators to the read/write group, and click Share.
6. Right-click the `g:\folderredirect` folder and select Properties→Sharing→Advanced Sharing→Caching, and select No files or programs from the Share Folder are available offline.
7. Click OK, Apply, OK, and Close.
8. Log onto VSI1 as test\administrator.
9. From the Login VSI media, run the Login VSI AD Setup.
10. Keep the default settings, and click Start.

Setting up roaming profiles for users

We assigned 1,000 users roaming profiles and redirected folders to a CIFS share. Users in vDT1 have their profiles stored on CIFS2, vDT2 on CIFS3, vDT3 on CIFS4, vDT4 on CIFS5, vDT5 on CIFS6, and vDT6 on CIFS7.

1. Open Active Directory Users and Computers.
2. Browse to test.local→Login_VSI→Users→Target→vDT1.
3. Select all Login VSI users, and right-click Properties.
4. Click Profile, and enter profile path `%cifs2\profiles\%username%`
5. Repeat profile creation until all OUs have roaming profiles assigned.

Configuring folder redirection

We redirected folders based on GPO, each of the vDT OUs have a GPO assigned that assures no more than 1,000 users to a Windows file share.

1. Log into DC1 as administrator.
2. Open the Group Policy Editor.
3. Open Forest→Domains→vdi.com, right-click Group Policy Objects, and select New.
4. Type `folder redirection vDT1`, leave source starter GPO as None, and click OK.
5. Right-click the folder redirection GPO, and click Edit.
6. Browse User Configuration→Policies→Windows Settings→Folder Redirection, and right-click AppData (roaming).
7. In the AppData (roaming) Properties, target-tab select the following:
 - Setting = select Basic = Redirect everyone's folders to the same location
 - Target folder location = Create a folder for each user under the root path
 - Root Path = \\CIFS2\folderredirection
8. In the AppData (roaming) Properties→Setting tab, remove the checkbox for Grant the user exclusive right to AppData (roaming), and

- click OK.
- Repeat steps 6 through 8 for all subfolders in the folder redirection tree.
 - Close the Folder Redirection group policy.
 - In the Group Policy Editor, right-click the folder redirection policy, and select GPO Status→Computer Configuration Settings Disabled.
 - Repeat steps 3 through 11 to create 6 GPOs, one for each vDT OU.
 - In the Group Policy Editor, drag the folder redirection GPO for vDT1 to Forest→Domains→test.local→Login_VSI→Users→Target→vDT1.
 - Repeat step 13 until all vDTs have a folder redirection GPO assigned.

Distributing the Login VSI content to VSI 1-6

Login VSI recommends no more than 1,000 users per share. We copied the _VSI_Websites directory and the _VSI_Content folders to six Windows shares (VSI1-6).

- Log into each of the six VSI servers, open Windows Explorer, and create a d:\share on each.
- Add permissions of read/write to the test.local/everyone group.
- Right-click the d:\share, and select Properties.
- Click the Sharing tab, and select Share...
- Add everyone, system, and administrators to the read/write group, and click Share.
- Right-click the g:\folderredirect folder and select Properties→Sharing→Advanced Sharing→Caching, and select No files or programs from the Share Folder are available offline.
- Click OK, Apply, OK, and Close.
- Copy \\vsi1\c\$_VSIwebsites_ to D:\.
- Copy \\vsi1\c\$_VSI_Content to D:\.
- Repeat steps 1 through 9 to create all six file shares.
- Log into VSI1, and open the VSI management console.
- Click Infrastructure→Data servers.
 - Right-click, and select Add server.
 - UNC path= \\VSI1\share_VSI_Content
- Repeat step 12 to create six shares for VSI1-6.
- Click Infrastructure→Web Servers.
 - Right-click, and select Add server.
 - UNC path = \\VSI1\share_VSI_Websites.
- Close the admin console, and log out.

Creating Windows 7 Enterprise x64 image VSI Launchers

Using the vSphere client, we created a Windows 7 Enterprise x64 VM with 2 vCPUs and 12 GB of memory.

Installing VMware Horizon Client on the launcher

- Accept the VMware license terms.
- Select default options.
- Accept or change the destination folder.
- Click Install.

Converting the launcher VM to a template

- In vSphere Client, right-click the launcher VM, and select Template→Convert to Template.

Deploying the launchers VM from the launcher template

- In vSphere Client, browse to HomeVMs and Templates.
- Right-click the launcher template to deploy a virtual machine from the template.
- Type launcher_1 as the new VM name, and click Next.
- Click Datacenter, and click Next.
- Click the launcher server, and click Next.
- Select the appropriate storage, and click Next.
- Select Customization using existing customization specifications, select the appropriate file, and click Next.
- To deploy the new VM, click Finish.
- Repeat steps 1 through 8, or use powercli to deploy more launchers; we used 224 in our testing.

Configuring VSI Launchers for testing

After all 224 launchers are configured and in an idle state, configure the Login VSI test harness to add them to available launcher capacity.

1. Log onto VSI_Share as DOMAIN\administrator.
2. Open the Login VSI management console.
3. Click "2. Add Launchers"
4. At the Add launchers wizard, click Next.
5. Click batch entry and enter the following:
 - a. Name=launcher
 - b. Start number=1
 - c. Increment=1
 - d. Count=224
 - e. Maximum capacity=30
 - f. Formatting length=3
6. Click Next.
7. Click Finish.

About our test tool, Login VSI 4.1

Login Virtual Session Indexer (Login VSI) is a tool that helps assess the virtual desktop performance, capacity, and scalability of a server. The newest version, Login VSI 4.1, has a number of improvements over previous versions. These include the following:

- More realistic user workload patterns
- All workloads are now a 48-minute loop instead of 14 minutes
- Alternating initial segment for each session to ensure equal load distribution
- HTML5 video player instead of flash (flash player is still optional)
- More realistic data set and data/file access in Login VSI workload
- More and larger websites
- MP4 video library with all formats: 480p, 720p and 1080p

Login VSI 4.1 reports the following metrics:

- Minimum Response: The minimum application response time
- Average Response: The average application response time
- Maximum Response: The maximum application response time
- VSI Baseline: Average application response time of the first 15 sessions
- VSI Index Average: Average response time dropping the highest and lowest 2 percent

For more information about Login VSI 4.1, see www.loginvsi.com/product-overview.

Running the Login VSI benchmark

Before we ran our test, we set up AD roaming profiles and folder redirection, and then we ran a profile create job in Login VSI to fully initialize each user's profile. Finally, we used 224 launchers to run an office worker workload. We set the Login VSI testing parameters as indicated in the VSIlauncher.ini (see [Appendix D](#)). For more information on how to run a Login VSI test, see <https://www.loginvsi.com/products/login-vsi>.

The table below details our physical server configuration. We installed VMware ESXi 6.5 onto two Dell EMC PowerEdge FC630 blade servers, and created a Windows Server 2012 R2 VM configured to be an Active Directory domain controller with DNS, DHCP, and NTP roles. We then installed ESXi 6.5 on 14 M620 blade servers and 38 FC630 blade servers. We installed VMware vCenter and created six VMware DRS/HA clusters: six clusters of six servers each for virtual desktops and infrastructure, and two more for Launchers and Dell_vDT. We assigned all the hosts to the appropriate clusters. We installed and configured out guest virtual machines, VMware View infrastructure VMs, and a Microsoft Windows 10 enterprise gold image. For each segment of testing we deployed either six pools of 1,000 Windows 10 Enterprise linked clones or six pools of 1,000 Windows 10 Enterprise full clones. We created a master Windows 10 Enterprise launcher image and cloned 224 Windows 10 Launcher VMs.

| Server name | OS | Roles | Cluster membership |
|------------------|-----------------|---|--------------------|
| LAUNCH1-LAUNCH14 | VMware ESXi 6.5 | Login VSI Launcher host | Launchers |
| DELL1-DELL36 | VMware ESXi 6.5 | Virtual desktop host | Dell_vDT |
| INFRA1-INFRA2 | 12Gb SAS, SSD | ADDS, DNS, DHCP, NTP, vCenter, LoginVSI share | Infrastructure |

Following VM creation, we moved the VMs into the appropriate clusters as follows.

| VM name | Quantity | OS | vCPUs | Memory (GB) | Cluster name | Role(s) |
|------------|----------|---|-------|-------------|----------------|---|
| AD | 2 | Windows Server 2012 R2 | 2 | 8 | Infrastructure | Microsoft Active Directory server, DNS, DHCP |
| SQL | 1 | Windows Server 2012 R2 | 4 | 16 | Infrastructure | SQL database server for vCenter and View Composer |
| vCenter | 1 | VMware vCenter Server Virtual Appliance | 24 | 48 | Infrastructure | vCenter |
| Composer | 1 | Windows Server 2012 R2 | 4 | 16 | Infrastructure | VMware View Composer server |
| Connection | 4 | Windows Server 2012 R2 | 4 | 16 | Infrastructure | VMware View connection servers |
| CIFS 1 | 1 | Windows Server 2012 R2 | 4 | 16 | Infrastructure | Login VSI mgmt. console and log server |
| CIFS 2 | 1 | Windows Server 2012 R2 | 4 | 4 | Infrastructure | Active Directory roaming profiles and folder redirection shares (users 1-1000) |
| CIFS 3 | 1 | Windows Server 2012 R2 | 4 | 4 | Infrastructure | Active Directory roaming profiles and folder redirection shares (users 1001-2000) |
| CIFS 4 | 1 | Windows Server 2012 R2 | 4 | 4 | Infrastructure | Active Directory roaming profiles and folder redirection shares (users 2001-3000) |
| CIFS 5 | 1 | Windows Server 2012 R2 | 4 | 4 | Infrastructure | Active Directory roaming profiles and folder redirection shares (users 3001-4000) |
| CIFS 6 | 1 | Windows Server 2012 R2 | 4 | 4 | Infrastructure | Active Directory roaming profiles and folder redirection shares (users 4001-5000) |
| CIFS 7 | 1 | Windows Server 2012 R2 | 4 | 4 | Infrastructure | Active Directory roaming profiles and folder redirection shares (users 5001-6000) |
| VSI | 6 | Windows Server 2012 R2 | 2 | 8 | Infrastructure | Login VSI file shares and content |
| Launcher | 224 | Windows 7 Enterprise (x64) | 1 | 11 | Launchers | Login VSI launchers |
| DELL_VDT | 6,000 | Windows 10 Enterprise (x86) | 2 | 3 | Dell_vDT | VMware View virtual desktops |

Appendix D: Scripts and configuration files

Dell Networking 4048-ON Ethernet switch A configuration file

We configured our two Ethernet switches to be fully redundant.

```
Current Configuration ...
! Version 9.10(0.1)
!
boot system stack-unit 1 primary system: A:
boot system stack-unit 1 secondary system: B:
!
hostname dell-switchA
!
protocol lldp
  advertise management-tlv system-description system-name
!
redundancy auto-synchronize full
!
enable password 7 (deleted)
!
username admin password 7 (deleted)
!
default-vlan disable
!
protocol spanning-tree rstp
  no disable
  bridge-priority 16384
!
vlt domain 100
  peer-link port-channel 100
  back-up destination 10.217.33.101
  primary-priority 1
  unit-id 0
  delay-restore 10
  peer-routing
!
stack-unit 1 provision S4048-ON
!
interface TenGigabitEthernet 1/1
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 111 mode active
  no shutdown
!
```

```
interface TenGigabitEthernet 1/2
  no ip address
  mtu 9216
  portmode hybrid
  switchport
  speed 1000
  no shutdown
!
interface TenGigabitEthernet 1/3
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 10 mode active
  no shutdown
!
interface TenGigabitEthernet 1/4
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 10 mode active
  no shutdown
!
interface TenGigabitEthernet 1/5
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 11 mode active
  no shutdown
!
interface TenGigabitEthernet 1/6
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 11 mode active
  no shutdown
!
interface TenGigabitEthernet 1/7
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 12 mode active
```

```
no shutdown
!
interface TenGigabitEthernet 1/8
no ip address
mtu 9216
!
port-channel-protocol LACP
port-channel 12 mode active
no shutdown
!
interface TenGigabitEthernet 1/9
no ip address
mtu 9216
!
port-channel-protocol LACP
port-channel 13 mode active
no shutdown
!
interface TenGigabitEthernet 1/10
no ip address
mtu 9216
!
port-channel-protocol LACP
port-channel 13 mode active
no shutdown
!
interface TenGigabitEthernet 1/11
no ip address
mtu 9216
!
port-channel-protocol LACP
port-channel 14 mode active
no shutdown
!
interface TenGigabitEthernet 1/12
no ip address
mtu 9216
!
port-channel-protocol LACP
port-channel 14 mode active
no shutdown
!
interface TenGigabitEthernet 1/13
no ip address
mtu 9216
!
```

```
port-channel-protocol LACP
  port-channel 15 mode active
no shutdown
!
interface TenGigabitEthernet 1/14
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 15 mode active
  no shutdown
!
interface TenGigabitEthernet 1/15
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 16 mode active
  no shutdown
!
interface TenGigabitEthernet 1/16
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 16 mode active
  no shutdown
!
interface TenGigabitEthernet 1/17
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 17 mode active
  no shutdown
!
interface TenGigabitEthernet 1/18
  no ip address
  mtu 9216
!
  port-channel-protocol LACP
    port-channel 17 mode active
  no shutdown
!
interface TenGigabitEthernet 1/19
  no ip address
```

```
mtu 9216
!
port-channel-protocol LACP
  port-channel 18 mode active
no shutdown
!
interface TenGigabitEthernet 1/20
no ip address
mtu 9216
!
port-channel-protocol LACP
  port-channel 18 mode active
no shutdown
!
interface TenGigabitEthernet 1/21
no ip address
mtu 9216
!
port-channel-protocol LACP
  port-channel 19 mode active
no shutdown
!
interface TenGigabitEthernet 1/22
no ip address
mtu 9216
!
port-channel-protocol LACP
  port-channel 19 mode active
no shutdown
!
interface TenGigabitEthernet 1/23
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/24
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/25
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/26
```

```
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/27
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/28
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/29
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/30
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/31
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/32
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/33
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/34
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/35
no ip address
```

```
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/36
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/37
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/38
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/39
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/40
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/41
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/42
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/43
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/44
no ip address
mtu 9216
```

```
shutdown
!
interface TenGigabitEthernet 1/45
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/46
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/47
no ip address
mtu 9216
shutdown
!
interface TenGigabitEthernet 1/48
no ip address
mtu 9216
shutdown
!
interface fortyGigE 1/49
no ip address
no shutdown
!
interface fortyGigE 1/50
no ip address
no shutdown
!
interface fortyGigE 1/51
no ip address
shutdown
!
interface fortyGigE 1/52
no ip address
shutdown
!
interface fortyGigE 1/53
no ip address
shutdown
!
interface fortyGigE 1/54
no ip address
shutdown
!
```

```
interface ManagementEthernet 1/1
  ip address 10.217.33.100/16
  no shutdown
!
interface ManagementEthernet 2/1
  no shutdown
!
interface ManagementEthernet 3/1
  no shutdown
!
interface ManagementEthernet 4/1
  no shutdown
!
interface ManagementEthernet 5/1
  no shutdown
!
interface ManagementEthernet 6/1
  no shutdown
!
interface Port-channel 10
  description fx2-infra
  no ip address
  mtu 9216
  portmode hybrid
  switchport
  no shutdown
!
interface Port-channel 11
  description fx2-c1
  no ip address
  mtu 9216
  portmode hybrid
  switchport
  no shutdown
! interface Port-channel 12
  description fx2-c2
  no ip address
  mtu 9216
  portmode hybrid
  switchport
  no shutdown
!
interface Port-channel 13
  description fx2-c3
  no ip address
  mtu 9216
```

```
portmode hybrid
switchport
no shutdown
!
interface Port-channel 14
description fx2-c4
no ip address
mtu 9216
portmode hybrid
switchport
no shutdown
!
interface Port-channel 15
description fx2-c5
no ip address
mtu 9216
portmode hybrid
switchport
no shutdown
!
interface Port-channel 16
description fx2-c6
no ip address
mtu 9216
portmode hybrid
switchport
no shutdown
!
interface Port-channel 17
description fx2-c7
no ip address
mtu 9216
portmode hybrid
switchport
no shutdown
!
interface Port-channel 18
description fx2-c8
no ip address
mtu 9216
portmode hybrid
switchport
no shutdown
!
interface Port-channel 19
description fx2-c1
```

```
no ip address
mtu 9216
portmode hybrid
switchport
no shutdown
!
interface Port-channel 100
description "VLTi - interconnect link"
no ip address
mtu 9216
channel-member fortyGigE 1/49,1/50
no shutdown
!
interface Port-channel 111
description "uplink to core-network"
no ip address
mtu 9216
switchport
vlt-peer-lag port-channel 111
no shutdown
!
interface Vlan 1
no shutdown
!
interface Vlan 161
description desktop_server-net
no ip address
mtu 9216
tagged Port-channel 10-19,100,111
no shutdown
!
interface Vlan 214
description "mgmt-net"
no ip address
mtu 9216
tagged Port-channel 10-19,100,111
untagged TenGigabitEthernet 1/2
shutdown
!
interface Vlan 300
description vMotion-net
no ip address
mtu 9216
tagged Port-channel 10-19,100,111
shutdown
!
```

```

management route 0.0.0.0/0 10.217.0.1
!
ip ssh server enable
!
line console 0
line vty 0
line vty 1
line vty 2
line vty 3
line vty 4
line vty 5
line vty 6
line vty 7
line vty 8
line vty 9
!
reload-type
  boot-type normal-reload
  config-scr-download enable
!
end

```

Deployment script for linked clones

We ran our linked clone deployment via powercli for VMware Horizon.

```

Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticLinkedClonePool -pool_id dell-pool1 -displayName "dell-pool1" -namePrefix "dell-
pool1-{n:fixed=4}" -parentVMPath /Datacenter/vm/win10-gold -parentSnapshotPath "/ready/snap"
-vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_vDT1/Resources
-datastoreSpecs "[Conservative,OS,data]/Datacenter/host/Dell_vDT1/pool1_clone8; [Conservative,OS,data]/
Datacenter/host/Dell_vDT1/pool1_clone7; [Conservative,OS,data]/Datacenter/host/Dell_vDT1/pool1_
clone6; [Conservative,OS,data]/Datacenter/host/Dell_vDT1/pool1_clone5; [Conservative,OS,data]/
Datacenter/host/Dell_vDT1/pool1_clone4; [Conservative,OS,data]/Datacenter/host/Dell_vDT1/pool1_
clone3; [Conservative,OS,data]/Datacenter/host/Dell_vDT1/pool1_clone2; [Conservative,OS,data]/
Datacenter/host/Dell_vDT1/pool1_clone1; [Conservative,replica]/Datacenter/host/Dell_vDT1/pool1_
replica" -minimumCount 1000 -maximumCount 1000 -headroomCount 1000 -usetempdisk 1 -tempdisksize 4096
-persistence NonPersistent -suspendProvisioningonerror 0 -UseSeSparseDiskFormat 1 -OrganizationalUnit
"OU=Target,OU=Computers,OU=LoginVSI"
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticLinkedClonePool -pool_id dell-pool2 -displayName "dell-pool2" -namePrefix "dell-
pool2-{n:fixed=4}" -parentVMPath /Datacenter/vm/win10-gold -parentSnapshotPath "/ready/snap"
-vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_vDT2/Resources
-datastoreSpecs "[Conservative,OS,data]/Datacenter/host/Dell_vDT2/pool2_clone8; [Conservative,OS,data]/
Datacenter/host/Dell_vDT2/pool2_clone7; [Conservative,OS,data]/Datacenter/host/Dell_vDT2/pool2_
clone6; [Conservative,OS,data]/Datacenter/host/Dell_vDT2/pool2_clone5; [Conservative,OS,data]/

```

```

Datacenter/host/Dell_vDT2/pool2_clone4; [Conservative, OS, data] /Datacenter/host/Dell_vDT2/pool2_clone3; [Conservative, OS, data] /Datacenter/host/Dell_vDT2/pool2_clone2; [Conservative, OS, data] /Datacenter/host/Dell_vDT2/pool2_clone1; [Conservative, replica] /Datacenter/host/Dell_vDT2/pool2_replica" -minimumCount 1000 -maximumCount 1000 -headroomCount 1000 -usetempdisk 1 -tempdisksize 4096 -persistence NonPersistent -suspendProvisioningonerror 0 -UseSeSparseDiskFormat 1 -OrganizationalUnit "OU=Target,OU=Computers,OU=LoginVSI"
sleep 30
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator | Add-AutomaticLinkedClonePool -pool_id dell-pool3 -displayName "dell-pool3" -namePrefix "dell-pool3-{n:fixed=4}" -parentVMPath /Datacenter/vm/win10-gold -parentSnapshotPath "/ready/snap" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_vDT3/Resources -datastoreSpecs "[Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone8; [Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone7; [Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone6; [Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone5; [Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone4; [Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone3; [Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone2; [Conservative, OS, data] /Datacenter/host/Dell_vDT3/pool3_clone1; [Conservative, replica] /Datacenter/host/Dell_vDT3/pool3_replica" -minimumCount 1000 -maximumCount 1000 -headroomCount 1000 -usetempdisk 1 -tempdisksize 4096 -persistence NonPersistent -suspendProvisioningonerror 0 -UseSeSparseDiskFormat 1 -OrganizationalUnit "OU=Target,OU=Computers,OU=LoginVSI"
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator | Add-AutomaticLinkedClonePool -pool_id dell-pool4 -displayName "dell-pool4" -namePrefix "dell-pool4-{n:fixed=4}" -parentVMPath /Datacenter/vm/win10-gold -parentSnapshotPath "/ready/snap" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_vDT4/Resources -datastoreSpecs "[Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone8; [Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone7; [Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone6; [Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone5; [Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone4; [Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone3; [Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone2; [Conservative, OS, data] /Datacenter/host/Dell_vDT4/pool4_clone1; [Conservative, replica] /Datacenter/host/Dell_vDT4/pool4_replica" -minimumCount 1000 -maximumCount 1000 -headroomCount 1000 -usetempdisk 1 -tempdisksize 4096 -persistence NonPersistent -suspendProvisioningonerror 0 -UseSeSparseDiskFormat 1 -OrganizationalUnit "OU=Target,OU=Computers,OU=LoginVSI"
sleep 30
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator | Add-AutomaticLinkedClonePool -pool_id dell-pool5 -displayName "dell-pool5" -namePrefix "dell-pool5-{n:fixed=4}" -parentVMPath /Datacenter/vm/win10-gold -parentSnapshotPath "/ready/snap" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_vDT5/Resources -datastoreSpecs "[Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone8; [Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone7; [Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone6; [Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone5; [Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone4; [Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone3; [Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone2; [Conservative, OS, data] /Datacenter/host/Dell_vDT5/pool5_clone1; [Conservative, replica] /Datacenter/host/Dell_vDT5/pool5_replica" -minimumCount 1000 -maximumCount 1000 -headroomCount 1000 -usetempdisk 1 -tempdisksize 4096 -persistence NonPersistent -suspendProvisioningonerror 0 -UseSeSparseDiskFormat 1 -OrganizationalUnit

```

```

"OU=Target,OU=Computers,OU=LoginVSI"
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticLinkedClonePool -pool_id dell-pool6 -displayName "dell-pool6" -namePrefix "dell-
pool6-{n:fixed=4}" -parentVMPATH /Datacenter/vm/win10-gold -parentSnapshotPath "/ready/snap"
-vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_vDT6/Resources
-datastoreSpecs "[Conservative,OS,data]/Datacenter/host/Dell_vDT6/pool6_clone8;[Conservative,OS,data]/
Datacenter/host/Dell_vDT6/pool6_clone7;[Conservative,OS,data]/Datacenter/host/Dell_vDT6/pool6_
clone6;[Conservative,OS,data]/Datacenter/host/Dell_vDT6/pool6_clone5;[Conservative,OS,data]/
Datacenter/host/Dell_vDT6/pool6_clone4;[Conservative,OS,data]/Datacenter/host/Dell_vDT6/pool6_
clone3;[Conservative,OS,data]/Datacenter/host/Dell_vDT6/pool6_clone2;[Conservative,OS,data]/
Datacenter/host/Dell_vDT6/pool6_clone1;[Conservative,replica]/Datacenter/host/Dell_vDT6/pool6_
replica" -minimumCount 1000 -maximumCount 1000 -headroomCount 1000 -usetempdisk 1 -tempdisksize 4096
-persistence NonPersistent -suspendProvisioningonerror 0 -UseSeSparseDiskFormat 1 -OrganizationalUnit
"OU=Target,OU=Computers,OU=LoginVSI"

```

```

Add-PoolEntitlement -pool_id dell-pool1 -sid S-1-5-21-1969725412-749824268-2044802687-2117
sleep 30
Add-PoolEntitlement -pool_id dell-pool2 -sid S-1-5-21-1969725412-749824268-2044802687-2117
sleep 30
Add-PoolEntitlement -pool_id dell-pool3 -sid S-1-5-21-1969725412-749824268-2044802687-2117
sleep 30
Add-PoolEntitlement -pool_id dell-pool4 -sid S-1-5-21-1969725412-749824268-2044802687-2117
sleep 30
Add-PoolEntitlement -pool_id dell-pool5 -sid S-1-5-21-1969725412-749824268-2044802687-2117
sleep 30
Add-PoolEntitlement -pool_id dell-pool6 -sid S-1-5-21-1969725412-749824268-2044802687-2117

```

Deployment script for full clones

We ran our full clone deployment via powercli for VMware Horizon.

```

Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticPool -pool_id dell-pool1 -displayName "dell-pool1" -persistence NonPersistent -namePrefix
"dell-pool1-{n:fixed=4}" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_
vDT1/Resources -TemplatePath /Datacenter/vm/win10_gold_temp -DataStorePath "/Datacenter/host/Dell_vDT1/
pool1_clone8;/Datacenter/host/Dell_vDT1/pool1_clone7;/Datacenter/host/Dell_vDT1/pool1_clone6;/Datacenter/
host/Dell_vDT1/pool1_clone5;/Datacenter/host/Dell_vDT1/pool1_clone4;/Datacenter/host/Dell_vDT1/pool1_
clone3;/Datacenter/host/Dell_vDT1/pool1_clone1;/Datacenter/host/Dell_vDT1/pool1_clone1;/Datacenter/
host/Dell_vDT1/pool1_replica" -minimumCount 1000 -maximumCount 1000 -suspendProvisioningonerror 0
-CustomizationSpecName win10x86
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticPool -pool_id dell-pool2 -displayName "dell-pool2" -persistence NonPersistent -namePrefix
"dell-pool2-{n:fixed=4}" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_
vDT2/Resources -TemplatePath /Datacenter/vm/win10_gold_temp2 -DataStorePath "/Datacenter/host/Dell_vDT2/
pool2_clone8;/Datacenter/host/Dell_vDT2/pool2_clone7;/Datacenter/host/Dell_vDT2/pool2_clone6;/Datacenter/
host/Dell_vDT2/pool2_clone5;/Datacenter/host/Dell_vDT2/pool2_clone4;/Datacenter/host/Dell_vDT2/pool2_
clone3;/Datacenter/host/Dell_vDT2/pool2_clone2;/Datacenter/host/Dell_vDT2/pool2_clone1;/Datacenter/

```

```

host/Dell_vDT2/pool2_replica" -minimumCount 1000 -maximumCount 1000 -suspendProvisioningonerror 0
-CustomizationSpecName win10x86
sleep 30
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticPool -pool_id dell-pool3 -displayName "dell-pool3" -persistence NonPersistent -namePrefix
"dell-pool3-{n:fixed=4}" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_
vDT3/Resources -TemplatePath /Datacenter/vm/win10_gold_temp3 -DataStorePath "/Datacenter/host/Dell_vDT3/
pool3_clone8;/Datacenter/host/Dell_vDT3/pool3_clone7;/Datacenter/host/Dell_vDT3/pool3_clone6;/Datacenter/
host/Dell_vDT3/pool3_clone5;/Datacenter/host/Dell_vDT3/pool3_clone4;/Datacenter/host/Dell_vDT3/pool3_
clone3;/Datacenter/host/Dell_vDT3/pool3_clone2;/Datacenter/host/Dell_vDT3/pool3_clone1;/Datacenter/
host/Dell_vDT3/pool3_replica" -minimumCount 1000 -maximumCount 1000 -suspendProvisioningonerror 0
-CustomizationSpecName win10x86
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticPool -pool_id dell-pool4 -displayName "dell-pool4" -persistence NonPersistent -namePrefix
"dell-pool4-{n:fixed=4}" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_
vDT4/Resources -TemplatePath /Datacenter/vm/win10_gold_temp4 -DataStorePath "/Datacenter/host/Dell_vDT4/
pool4_clone8;/Datacenter/host/Dell_vDT4/pool4_clone7;/Datacenter/host/Dell_vDT4/pool4_clone6;/Datacenter/
host/Dell_vDT4/pool4_clone5;/Datacenter/host/Dell_vDT4/pool4_clone4;/Datacenter/host/Dell_vDT4/pool4_
clone3;/Datacenter/host/Dell_vDT4/pool4_clone2;/Datacenter/host/Dell_vDT4/pool4_clone1;/Datacenter/
host/Dell_vDT4/pool4_replica" -minimumCount 1000 -maximumCount 1000 -suspendProvisioningonerror 0
-CustomizationSpecName win10x86
sleep 30
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticPool -pool_id dell-pool5 -displayName "dell-pool5" -persistence NonPersistent -namePrefix
"dell-pool5-{n:fixed=4}" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_
vDT5/Resources -TemplatePath /Datacenter/vm/win10_gold_temp5 -DataStorePath "/Datacenter/host/Dell_vDT5/
pool5_clone8;/Datacenter/host/Dell_vDT5/pool5_clone7;/Datacenter/host/Dell_vDT5/pool5_clone6;/Datacenter/
host/Dell_vDT5/pool5_clone5;/Datacenter/host/Dell_vDT5/pool5_clone4;/Datacenter/host/Dell_vDT5/pool5_
clone3;/Datacenter/host/Dell_vDT5/pool5_clone2;/Datacenter/host/Dell_vDT5/pool5_clone1;/Datacenter/
host/Dell_vDT5/pool5_replica" -minimumCount 1000 -maximumCount 1000 -suspendProvisioningonerror 0
-CustomizationSpecName win10x86
Get-ViewVC -serverName vcsa.test.local | Get-ComposerDomain -domain test.local -username administrator
| Add-AutomaticPool -pool_id dell-pool6 -displayName "dell-pool6" -persistence NonPersistent -namePrefix
"dell-pool6-{n:fixed=4}" -vmFolderPath "/Datacenter/vm/clones" -resourcePoolPath /Datacenter/host/Dell_
vDT6/Resources -TemplatePath /Datacenter/vm/win10_gold_temp6 -DataStorePath "/Datacenter/host/Dell_vDT6/
pool6_clone8;/Datacenter/host/Dell_vDT6/pool6_clone7;/Datacenter/host/Dell_vDT6/pool6_clone6;/Datacenter/
host/Dell_vDT6/pool6_clone5;/Datacenter/host/Dell_vDT6/pool6_clone4;/Datacenter/host/Dell_vDT6/pool6_
clone3;/Datacenter/host/Dell_vDT6/pool6_clone2;/Datacenter/host/Dell_vDT6/pool6_clone1;/Datacenter/
host/Dell_vDT6/pool6_replica" -minimumCount 1000 -maximumCount 1000 -suspendProvisioningonerror 0
-CustomizationSpecName win10x86

Add-PoolEntitlement -pool_id dell-pool1 -sid S-1-5-21-1969725412-749824268-2044802687-2117
Add-PoolEntitlement -pool_id dell-pool2 -sid S-1-5-21-1969725412-749824268-2044802687-2117
Add-PoolEntitlement -pool_id dell-pool3 -sid S-1-5-21-1969725412-749824268-2044802687-2117
Add-PoolEntitlement -pool_id dell-pool4 -sid S-1-5-21-1969725412-749824268-2044802687-2117
Add-PoolEntitlement -pool_id dell-pool5 -sid S-1-5-21-1969725412-749824268-2044802687-2117
Add-PoolEntitlement -pool_id dell-pool6 -sid S-1-5-21-1969725412-749824268-2044802687-2117

```

4KB Shell script

We ran the Dell EMC host optimization script and selected Yes for all suggested optimization.

```
#!/bin/sh
#
# check_esx_xtremio
#
# This script checks the configuration of a VMWare host to config that
# it has been configured in line with best practice recommendations for
# an EMC xtremio array.
#
# Version 0.1 - SH - 0413201601 - Initial version
#

yesno()
{
    while true; do
        read -p "(Y/N) " resp
        case $resp in
            [Yy]* ) return 0;;
            [Nn]* ) return 1;;
            * ) echo "Invalid response";;
        esac
    done
}

echo Checking VMWare configuration against best-practices for EMC xtremio arrays
echo

SQ=`esxcfg-advcfg -q -g /Disk/SchedQuantum`

if [ -z "$SQ" ]; then
    echo Error running esxcfg-advcfg command
    exit 1
fi

if [ $SQ -ne 64 ]; then
    echo "SchedQuantum is set to $SQ rather than the recommend value of 64."
    echo -n "Do you want to set SchedQuantum to 64? "
    yesno
    if [ $? -eq 0 ]; then
        echo "Setting SchedQuantum to 64"
        esxcfg-advcfg -s 64 /Disk/SchedQuantum
    else
        echo "Not modifying the value of SchedQuantum"
    fi
fi
```

```

        echo
    else
        echo "SchedQuantum setting is correct"
    fi
    echo

    MaxIO=`esxcfg-advcfg -q -g /Disk/DiskMaxIOSize`

    if [ -z "$MaxIO" ]; then
        echo Error running esxcfg-advcfg command
        exit 1
    fi

    if [ $MaxIO -ne 4096 ]; then
        echo "DiskMaxIOSize is set to $MaxIO rather than the recommend value of 4096."
        echo -n "Do you want to set DiskMaxIOSize to 4096? "
        yesno
        if [ $? -eq 0 ]; then
            echo "Setting DiskMaxIOSize to 4096"
            esxcfg-advcfg -s 4096 /Disk/DiskMaxIOSize
        else
            echo "Not modifying the value of DiskMaxIOSize"
        fi
        echo
    else
        echo "DiskMaxIOSize setting is correct"
    fi
    echo

    OIOC=`esxcli storage core device list | awk ` /[^ ]/ {x=""} /^naa.514f0c5/ {x=$1} /No of outstanding IOs
with competing worlds:/{x}&&!/No of outstanding IOs with competing worlds: 256/ { print x}' | sort -u`

    OIOC=`echo $OIOC | wc -w`

    if [ $OIOC -gt 0 ]; then
        echo "$OIOC disk(s) found with incorrect max number of outstanding IOs"
        echo -n "Do you want to set Outstanding IOs on these disks to 256? "
        yesno
        if [ $? -eq 0 ]; then
            echo "Setting Outstanding IOs to 256 :)"
            for naa in $OIOC; do
                echo "  $naa"
                esxcli storage core device set -d $naa -O 256
            done
        else
            echo
        fi
    fi

```

```

        echo "Not modifying the number of Outstanding IOs"
    fi
else
    echo "Number of Outstanding IOs is correct for all devices"
fi
echo

MPO=`esxcli storage nmp device list | awk ' /^[^ ]/ {x=""} /^naa.514f0c5/ {x=$1} /Path Selection
Policy:/&&x&&!/Path Selection Policy: VMW_PSP_RR/ { print x}' | sort -u`

MPOC=`echo $MPO | wc -w`

if [ $MPOC -gt 0 ]; then
    echo "$MPOC disk(s) found with incorrect Multipathing configuration"
    echo -n "Do you want to set Multipathing to Round-Robin on these disks? "
    yesno
    if [ $? -eq 0 ]; then
        echo "Setting Multipathing to Round-Robin :"
        for naa in $MPO; do
            echo "  $naa"
            esxcli storage nmp device set -d $naa --psp VMW_PSP_RR
            esxcli storage nmp psp roundrobin deviceconfig set -d $naa --iops 1 --type iops
        done
    else
        echo "Not modifying Multipathing settings"
    fi
else
    echo "Existing device Multipath configuration is correct for all disks"
fi
echo

MPDO=`esxcli storage nmp satp rule list | egrep 'VMW_SATP_DEFAULT_AA *DGC'`

MPRO=`echo $MPDO | grep VMW_PSP_RR`

if [ -z "$MPDO" ]; then
    echo "Default Multipathing is not configured for xtremio devices"
    echo -n "Do you want to set the Multipathing to Round-Robin for new xtremio devices?"
    yesno
    if [ $? -eq 0 ]; then
        echo "Setting Default Multipathing to Round-Robin"
        esxcli storage nmp satp rule add -c tpgs_off -e "XtremIO Active/Active" -P VMW_PSP_RR -O
iops=1 -s VMW_SATP_DEFAULT_AA -t vendor -V XtremIO
    fi
fi

```

```

        else
            echo "Not modifying Default Multipathing settings"
        fi
    elif [ -z "$MPRO" ]; then
        echo "Default Multipath configuration does NOT appear to be set to Round-Robin. This will need to
be fixed manually"
    else
        echo "Default Multipath configuration is correct"
    fi
echo

```

LoginVSI launcher config file

VSILauncher.ini

```

[Scenario]
CPUEnabled=disabled
NumberOfCPU=0
CoresEnabled=disabled
NumberOfCores=0
HyperThreadingEnabled=disabled
HostsEnabled=disabled
NumberOfHosts=0
[Launcher]
BaseLinePhase=0
Servername=connection
Username=LoginVSI{count}
Password=enc:BD177557C81239CED1:enc
ShowPassword=C04333158A4E
Domain=test
useCSV=1
MultipleResources=0
CCI="C:\Program Files (x86)\VMware\VMware Horizon View Client\vmware-view.exe" -serverURL %csv_
viewserver% -username %csv_user% -password Password1 -domainName test -desktopName %csv_poolname%
-standAlone -logInAsCurrentUser False --desktoplayout 1920x1080#
CSV=\\cifs1\share\user.csv
AgentRunLoop=1
PhasesCount=1
NumberOfSessions=6000
NumberOfWindows=5400
SequentialInterval=0
AutoLogoff=1
LogoffTimeOut=5400
CreateProfile=0
TSDiscon=0
PreTestScript=
PostTestScript=

```

```
BaselineSampleInterval=3
[Launcher_FD]
Servername=connection
Username=LoginVSI{count}
Password=enc:BD177557C81239CED1:enc
ShowPassword=C04333158A4E
Domain=test
useCSV=1
MultipleResources=0
CCL="C:\Program Files (x86)\VMware\VMware Horizon View Client\vmware-view.exe" -serverURL %csv_
viewserver% -username %csv_user% -password Password1 -domainName test -desktopName %csv_poolname%
-standAlone -logInAsCurrentUser False --desktoplayout 1920x1080#
CSV=\\cifs1\share\user.csv
AgentRunLoop=1
[VSI]
SkipAddLaunchersScreen=0
SkipCommandLineScreen=0
Increment=0
SkipStartTestScreen=1
SkipAllWelcomeScreens=0
[Phase1]
Name=Phase 1
Sessions=6000
PhaseTime=5400
Pause=False
[LauncherWorkload]
launcherUsername=l
launcherPassword=enc:9D177557C81239CE:enc
launcherWorkflow=0
limitConcurrent=5
launcherResolution=1024x768
launcherDisconnectAfterLaunch=0
```

This project was commissioned by Dell Technologies.



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