File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

Executive summary

Dell Inc. (Dell) commissioned Principled Technologies (PT) to compare the performance of three Dell™ PowerVault™ NX3000 unified network storage solution configurations running tasks that users at a remote office or smaller business location would typically perform. We tested the following configurations using Microsoft's File Server Capacity Tool (FSCT). Note: We used the Microsoft iSCSI initiator with the Dell™ EqualLogic™ Multipath Device Specific Module (DSM) to connect to the PS Series Storage Arrays in all configurations.

- **Configuration-A:** Value Dell PowerVault NX3000 (one CPU, 3GB RAM, two 1 GigE front-side client ports, and two 1 GigE back-end storage network ports) with one Dell EqualLogic PS4000E storage array

- **Configuration-B:** Value Dell PowerVault NX3000 (one CPU, 3GB RAM, two 1 GigE front-side client ports, and two 1 GigE back-end storage network ports) with two Dell EqualLogic PS4000E storage arrays

- **Configuration-C:** Performance Dell PowerVault NX3000 (two CPUs, 12GB RAM, four 1 GigE front-side client ports, and four 1 GigE back-end storage network ports) with two Dell EqualLogic PS4000E storage arrays

KEY FINDINGS

- The Value Dell PowerVault NX3000 with one Dell EqualLogic PS4000E array (7200 RPM SATA drives in RAID 50), Configuration-A, can support 2,100 FSCT users, encountering no overload for any file server operation. (See Figure 1.)

- The Value Dell PowerVault NX3000 with two Dell EqualLogic PS4000E arrays (7200 RPM SATA drives in RAID 50), Configuration-B, can support 42.9 percent more FSCT users (3,000 total users) than Configuration-A, encountering no overload for any file server operation. (See Figure 1.)

- The Performance Dell PowerVault NX3000 with two Dell EqualLogic PS4000E arrays (7200 RPM SATA drives in RAID 50), Configuration-C, can support almost twice as many FSCT users as Configuration-A (3,900 total users), encountering no overload for any file server operation. (See Figure 1.)
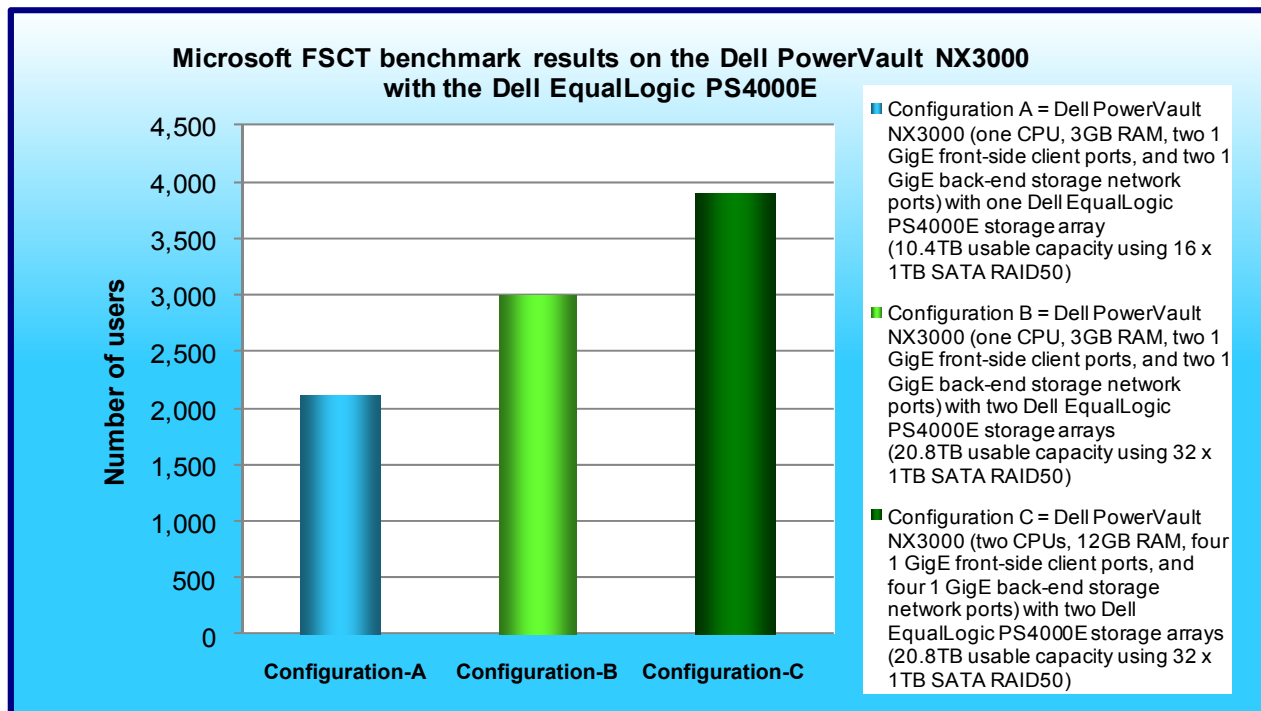
Figure 1: Median Microsoft FSCT user results for the three Dell PowerVault NX3000 configurations. Higher numbers are better.

FSCT tests file server capacity and identifies performance bottlenecks, and reports its results in terms of total users supported. We provide more information about FSCT in the Workload section and detail our testing in the Test methodology section of this report.

Figure 1 displays the FSCT results for the three Dell PowerVault NX3000 configurations. Configuration-A can support 2,100 users, encountering no overload for any file server operation. Configuration-B can support 42.9 percent more users (3,000 total users) than Configuration-A, encountering no overload for any file server operation. Configuration-C can support almost twice as many users as Configuration-A (3,900 total users), encountering no overload for any file server operation. Note: Our goal in this test was not to test back-end storage saturation or show scaling of the back-end storage devices. Rather, our goal was to test the maximum number of real-world users supported by out-of-the-box NX3000 file server solutions as a whole.

Workload
File Server Capacity Tool (FSCT)
FSCT tests file server capacity and helps identify performance bottlenecks. Microsoft is currently developing FSCT and released version 0.7, which we used, in June 2009. Microsoft plans to release version 1.0 later in 2009.

FSCT simulates different file-service workloads in the following ways:
- By focusing on native application and OS behavior, with an emphasis on Microsoft applications (e.g., Microsoft Office applications, Windows Explorer) and Win32 applications (e.g., command line operations)
- By using pre-configured workload test scenarios, which simulate multiple requests from multiple users for server files
- By running multiple sessions per physical client, which allows a single client computer to perform the workload of multiple simulated clients

The primary results FSCT reports about the server under test are its throughput and the total number of users it supported without overloading. FSCT also provides performance information such as latency; OS performance counters, including server CPU utilization; and network capacity. FSCT also reports the errors the test client received, and it provides such tracing information as Event Tracing for Windows.

FSCT comes with a standard workload, the HomeFolders workload. We ran that workload, which simulates 12 user scenarios that run Microsoft applications on a server the user has assigned to store his or her home directory.

FSCT requires a minimum of three computers to perform the roles of server, clients, and controller. The server machine is the system under test; the client machine(s) simulate multiple users who are running the HomeFolders workload on the server; and the controller machine coordinates the client work, captures performance counters, and gathers the workload results.

You can find more information about FSCT at the blog of Jose Barreto, Principal Program Manager with the Microsoft File Server Foundation team: http://blogs.technet.com/josebda/archive/2008/10/06/fsct-a-cifs-smb-smb2-file-server-tool-for-capacity-planning-and-performance-troubleshooting.aspx.

The End User License Agreement for Microsoft's FSCT tool requires the following text accompany all results: "These test results were generated by Principled Technologies, Inc. using the Microsoft File Server Capacity Tool. Test results generated with this pre-release software tool may not be accurate or appropriate for your needs and should not be relied upon as your sole reference. Microsoft makes no warranties of any kind, express or implied, about this tool, or any information or materials provided with this tool, including any results generated by this tool."

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

2

Test results

We report the user results from our FSCT tests. We ran each test three times and report results from the run that produced the median of the three user results. Figure 2 displays the complete results for the three Dell PowerVault NX3000 solution configurations.

Dell PowerVault NX3000				
	Run 1	Run 2	Run 3	Median
Configuration-A	2,100	2,100	2,200	2,100
Configuration-B	3,000	3,000	3,100	3,000
Configuration-C	3,900	3,900	3,800	3,900

Figure 2: Microsoft FSCT user results for the three Dell PowerVault NX3000 configurations. Higher numbers are better.

Test configuration
1GBase-T iSCSI
Storage
- One Dell PowerVault NX3000
- One or two Dell EqualLogic PS4000E arrays each with sixteen 1TB 7200 RPM SATA drives.
- One storage group and one storage pool*
- RAID 50 (with 2 spares per array)
- Four 200GB volumes
  *In Configuration-B and Configuration-C, we added the second array to the same storage pool.

Storage network settings
- Jumbo frames enabled (on NICs and all ports on the switch)
- Flow control enabled
- IP routing enabled
- Spanning tree set to rapid spanning tree protocol (RSTP)
- Link layer discovery protocol (LLDP) disabled

Network connections
- Dell EqualLogic PS4000E Array
  - Three 1Gb (two data; one management) connections per array (six total) connected to the Dell™ PowerConnect™ 6248
  - Dell PowerConnect 6248 used for the storage network
- Test servers (Load generating systems)
  - Two 1Gb connections per server (16 total) connected to the Dell™ PowerConnect™ 5448
  - Dell PowerConnect 5448 used for client-server network
  - Dell PowerConnect 5448 used for client-controller network

FSCT Load generating clients
- Eight Dell™ PowerEdge™ Servers
  - Windows Server 2008 Enterprise x64 SP1
  - Total of 96 physical cores (Intel Xeon)
  - 1 x Dual Port Broadcom BCM5708C integrated network adapter
    - One port for client-server traffic
    - One Port for client-controller traffic

Figure 3 illustrates our test bed.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT
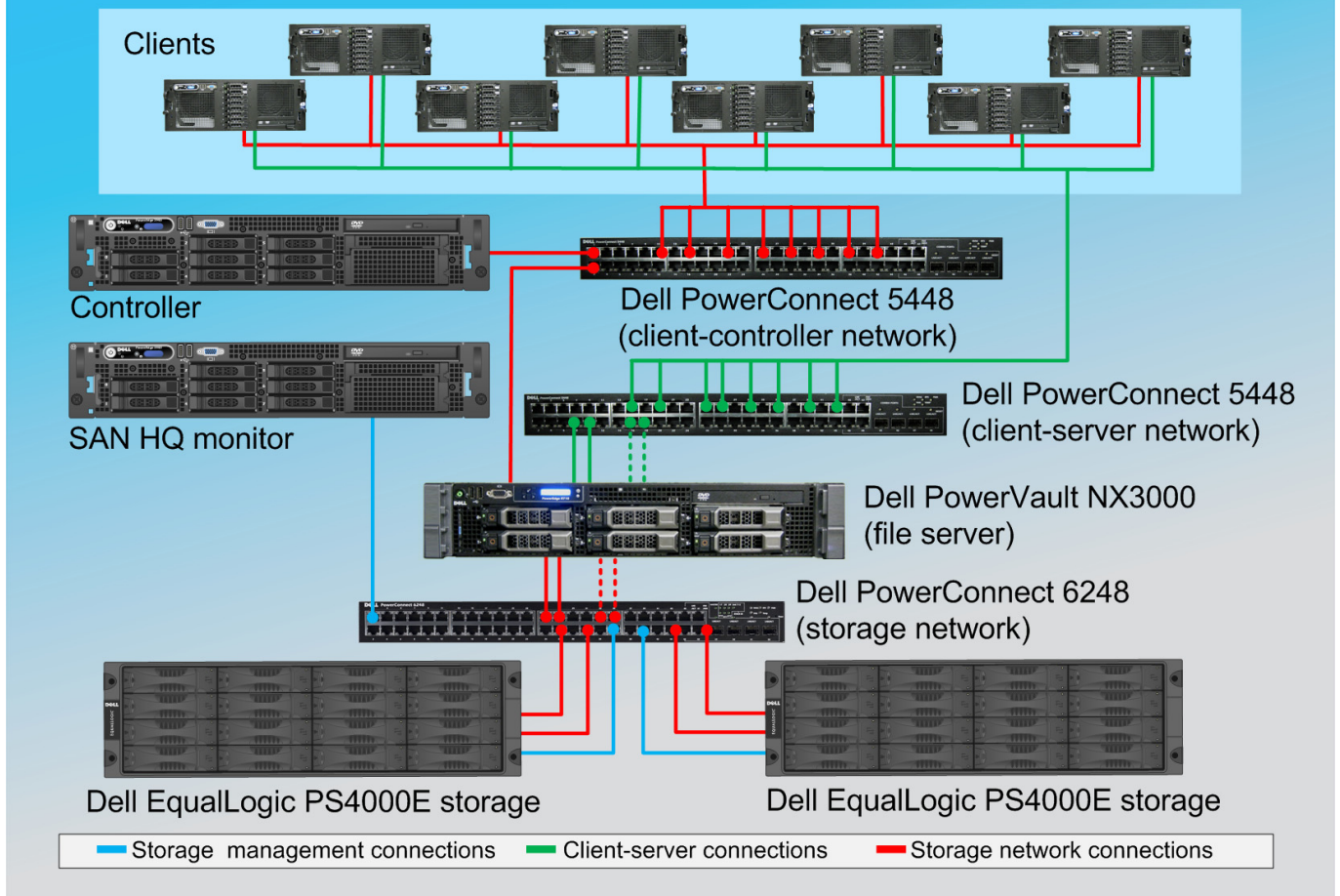
3

Figure 3: Dell PowerVault NX3000 test bed. Dotted red and green lines indicate connections that appear in only the Configuration-C test bed. We used the second Dell EqualLogic PS4000E in Configuration-B and Configuration-C only.

Test methodology

Setting up and configuring the Dell PowerVault NX3000 and Dell EqualLogic PS4000E storage

The two Dell EqualLogic PS4000E arrays contained 16 1TB 7,200RPM SATA drives per array. We cabled both PS4000E arrays to a Dell PowerConnect 6248 storage switch via its three available ports, and we cabled the Dell PowerVault NX3000 to the switch via two or four Broadcom BCM5709C NIC ports, depending on the configuration. We configured both Dell EqualLogic PS4000E arrays in RAID 50 mode. We used the second Dell EqualLogic PS4000E in Configuration-B and Configuration-C only. Note: We used the Microsoft iSCSI initiator with the Dell EqualLogic DSM and the Dell™ EqualLogic™ Host Integration Toolkit v3.2.0 to connect to the PS Series Storage Arrays in all configurations.

Setting up the external storage
1. Using the command line, set up a storage group with the following RAID policies:
    a. PS4000E-1: RAID-50
    b. PS4000E-2: RAID-50
2. Create a storage pool that you name `PS4000-1` with the following members:

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

4

a. PS4000E-1*
3. Create a storage pool that you name `PS4000-2` with the following members:
        a. PS4000E-2
4. Enable all network connections on the PS4000E using the following IP address scheme:
        a. IP Address: `192.168.1.##` (## being any number between 10 and 40)
        b. Subnet Mask: `255.255.248.0`
5. Create the following 200GB volumes with no snapshot reserve:
        a. FSCT-1
        b. FSCT-2
        c. FSCT-3
        d. FSCT-4
6. Enable shared access to the iSCSI target from multiple initiators on the volumes.
7. Create an access control record for the volumes without specifying any limitations.
8. Create a read-only SNMP community name to use for group monitoring.

When running Configuration-B and Configuration-C, modify the member settings of the PS4000E-2 to become a member of the PS4000E-1 storage pool.

Installing and configuring the server
To set up this server, we installed several software components. The following subsections detail the necessary installation processes.

Setting up the operating system
1. Boot up the Dell PowerVault NX3000 server.
2. Log in using the proper username and password.
3. Click Start, Control Panel, and double-click System.
4. Click Change Settings.
5. Click Change.
6. Enter a new computer name, and click OK.
7. Click OK, click Close, and click Restart Now.
8. Right-click the desktop, and select Personalize.
9. Click the Screen Saver link.
10. Click the Screen saver drop-down menu, and select (None).
11. Click Apply.
12. Click Change power settings.
13. Under Balanced plan, click Change plan settings.
14. From the Turn off monitor drop-down menu, select Never.
15. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization windows.
16. Open the Start menu, type `regedit` in the search field, and press Enter.
17. To allow the server to automatically log into the OS after a system reboot, change the following Registry key to have the values shown here:

    ```
    [HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon]
    DefaultPassword=Password1
    AutoAdminLogon=1
    ```

18. Restart the server.

Installing the EqualLogic Host Integration Toolkit
1. Download the EqualLogic Host Integration Toolkit v3.2.0 from EqualLogic's support Web site.
2. Run Setup64.exe.
3. Click Next.
4. Accept the license agreement, and click Next.
5. Click Next.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

5

6.   Click Yes.
7.   Click Yes.
8.   Click Yes.
9.   Click OK.
10. Click OK.
11. Click OK.
12. Click Install.
13. Click OK.
14. Uncheck Launch Remote Setup Wizard, and click Finish.
15. Click OK.

Setting up the network adapters
1.   Click Start→Control Panel.
2.   Double-click Network and Sharing Center.
3.   Click Manage Network Connections.
4.   Right-click the NIC connected to your Server-Controller network, and select Properties.
5.   Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
6.   Select Use the following IP address.
7.   Type `192.168.10.200` for the IP address.
8.   Type `255.255.255.0` for the Subnet mask.
9.   Click OK.
10. Click Close.
11. Right-click the first NIC connected to your SAN, and select Properties.
12. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
13. Select Use the following IP address.
14. Type `192.168.2.5` for the IP address.
15. Type `255.255.255.0` for the Subnet mask.
16. Click OK.
17. Click Close.
18. Right-click the second NIC connected to your SAN, and select Properties.
19. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
20. Select Use the following IP address.
21. Type `192.168.2.6` for the IP address.
22. Type `255.255.255.0` for the Subnet mask.
23. Click OK.
24. Click Close.
25. Right-click the first NIC connected to your Client-Server Network, and select Properties.
26. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
27. Select Use the following IP address.
28. Type `192.168.20.201` for the IP address.
29. Type `255.255.255.0` for the Subnet mask.
30. Click OK.
31. Click Close.
32. Right-click the second NIC connected to your Client-Server Network, and select Properties.
33. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
34. Select Use the following IP address.
35. Type `192.168.20.202` for the IP address.
36. Type `255.255.255.0` for the Subnet mask.

37. Click OK.
38. Click Close.
39. For the Configuration-C only:
    a. Right-click the third NIC connected to your SAN, and select Properties.
    b. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
    c. Select Use the following IP address.
    d. Type `192.168.2.7` for the IP address.
    e. Type `255.255.255.0` for the Subnet mask.
    f. Click OK.
    g. Click Close.
    h. Right-click the fourth NIC connected to your SAN, and select Properties.
    i. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
    j. Select Use the following IP address.
    k. Type `192.168.2.8` for the IP address.
    l. Type `255.255.255.0` for the Subnet mask.
    m. Click OK.
    n. Click Close.
    o. Right-click the third NIC connected to your Client-Server Network, and select Properties.
    p. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
    q. Select Use the following IP address.
    r. Type `192.168.20.203` for the IP address.
    s. Type `255.255.255.0` for the Subnet mask.
    t. Click OK.
    u. Click Close.
    v. Right-click the fourth NIC connected to your Client-Server Network, and select Properties.
    w. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
    x. Select Use the following IP address.
    y. Type `192.168.20.204` for the IP address.
    z. Type `255.255.255.0` for the Subnet mask.
    aa. Click OK.
    bb. Click Close.

Connecting the storage to the server
1. Click Start→Control Panel.
2. Double-click Device Manager.
3. Expand Network Adapters.
4. Double-click the first NIC connected to your SAN.
5. Select the Advanced tab.
6. Click Flow Control.
7. Set the value to Rx and Tx Enabled.
8. Click Jumbo Packet.
9. Set the Value to 9,014 bytes.
10. Click OK.
11. For Configuration-A and Configuration-B, repeat steps 4 through 10 for the second NIC connected to your SAN.
12. For Configuration-C, repeat steps 4 through 10 for the second, third, and fourth NIC connected to your SAN.
13. Click Start→Administrative Tools→iSCSI Initiator.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

7

14. Select the Discovery tab.
15. Click Add Portal…
16. Type `192.168.2.200` and click OK.
17. Select the Targets tab.
18. Select the first inactive target, and click Log On…
19. Check the Automatically restore this connection when the computer starts checkbox.
20. Click OK.
21. Repeat Steps 18 through 20 three more times, for a total of four times.
22. Click Start→Administrative Tools→Server Manager.
23. Expand the Storage menu option.
24. Click Disk Management.
25. Click OK.
26. Right-click the first Unallocated partition, and select New Simple Volume.
27. Click Next.
28. Click Next.
29. Click Next.
30. Check Perform a quick format, and click Next.
31. Click Finish.
32. Repeat steps 26 through 31 three more times, for a total of four times.

Installing FSCT
1. Copy the x64 FSCT ZIP file to the desktop of the server.
2. Unzip the FSCT ZIP file into C:\FSCT. Create the folder if it does not already exist.
3. Delete the ZIP file from the desktop, and empty the recycle bin.

Installing and configuring the clients
We cabled the Dell PowerVault NX3000 to the client network switch via two Broadcom BCM5709C NIC ports or via four dual port Intel PRO/1000PT NIC ports, depending on the configuration.

Installing the operating system
Installing Microsoft Windows Server 2008 Enterprise x64 SP1
1. Insert the installation DVD for Windows Server 2008 x64 SP1 into the DVD drive.
2. Choose the language, time and currency, and keyboard input. Click Next.
3. Click Install Now.
4. Choose Windows Server 2008 Enterprise (Full Installation). Click Next.
5. Accept the license terms, and click Next.
6. Click Custom.
7. Click the disk, and click Drive options (advanced).
8. Click New, Apply, Format, and click Next.
9. Let the installation process continue. The server will reboot several times.
10. After the installation completes, click OK to set the Administrator password.
11. Enter the administrator password twice, and click OK.
12. Click Start, Control Panel, and double-click System.
13. Click Change Settings.
14. Click Change.
15. Enter the new computer name, and click OK.
16. Click OK to restart, click Close, and click Restart Now.
17. Right-click the desktop, and select Personalize.
18. Click the Screen Saver link.
19. Click the Screen saver drop-down menu, and select (None).
20. Click Apply.
21. Click Change power settings.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

8

22. Under Balanced plan, click Change plan settings.
23. From the Turn off monitor drop-down menu, select Never.
24. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization windows.
25. Open the Start menu, type `regedit` in the search field, and press Enter.
26. To allow the server to automatically log into the OS after a system reboot, change the following Registry key to have the values shown here:

```
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon]
DefaultPassword=Password1
AutoAdminLogon=1
```

27. Restart the server.

Installing Windows updates
1. Click Start→Windows Update.
2. Click Change settings.
3. Click Never check for updates.
4. Click OK.
5. Click Check for updates.
6. When the application prompts you to install an update for Windows Update, click Install Now.
7. Click View available updates to ensure you install the necessary updates.
   Note: We installed the following updates:
   - Update for Windows Server 2008 x64 Edition (KB955430)
   - Update for Windows Server 2008 x64 Edition (KB955430)
   - Microsoft .NET Framework 3.5 Service Pack 1 and .NET Framework 3.5 Family Update (KB951847) x64
   - LSI Corporation - Storage - Dell SAS 6/iR Integrated Controller
   - Microsoft .NET Framework 3.5 Service Pack 1 and .NET Framework 3.5 Family Update (KB951847) x64
   - Update for Windows Server 2008 x64 Edition (KB955430)
   - Security Update for Windows Server 2008 x64 Edition (KB958687)
   - Update for Windows Server 2008 x64 Edition (KB957388)
   - Security Update for Windows Server 2008 x64-based Systems (KB938464)
   - Update for Windows Server 2008 x64 Edition (KB949189)
   - Security Update for Windows Server 2008 x64 Edition (KB955069)
   - Security Update for Windows Server 2008 x64 Edition (KB954459)
   - Security Update for Windows Server 2008 x64 Edition (KB957097)
   - Security Update for Windows Server 2008 x64 Edition (KB958690)
   - Cumulative Security Update for Internet Explorer 7 for Windows Server 2008 x64 Edition (KB963027)
   - Security Update for Windows Server 2008 x64 Edition (KB960803)
   - Internet Explorer 8 for Windows Server 2008 x64 Edition
   - Security Update for Windows Server 2008 x64 Edition (KB958623)
   - Update for Windows Server 2008 x64 Edition (KB959130)
   - Windows Malicious Software Removal Tool x64 - May 2009 (KB890830)
   - Update for Windows Server 2008 x64 Edition (KB957200)
   - Security Update for Windows Server 2008 x64 Edition (KB953733)
   - Security Update for Windows Server 2008 x64 Edition (KB950762)
   - Update for Windows Server 2008 x64 Edition (KB955839)
   - Security Update for Windows Server 2008 x64 Edition (KB958624)
   - Security Update for Windows Server 2008 x64 Edition (KB950974)
   - Update for Windows Server 2008 x64 Edition (KB951978)

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

9

- Update for Windows Server 2008 for x64-based Systems (KB955020)
- Microsoft .NET Framework 3.5 Service Pack 1 and .NET Framework 3.5 Family Update (KB951847) x64
- Security Update for Windows Server 2008 x64 Edition (KB956572)
- Security Update for Windows Mail for Windows Server 2008 x64 Edition (KB951066)
- Update Rollup for ActiveX Killbits for Windows Server 2008 x64 Edition (KB960715)
- Security Update for Windows Server 2008 x64 Edition (KB960225)
- Security Update for Windows Server 2008 x64 Edition (KB956802)
- Update for Windows Server 2008 x64 Edition (KB957321)
- Update for Windows Server 2008 x64 Edition (KB952287)
- Security Update for Windows Server 2008 x64 Edition (KB958644)
- Security Update for Windows Server 2008 x64 Edition (KB959426)
- Security Update for Windows Server 2008 x64 Edition (KB952004)
- Security Update for Windows Server 2008 x64 Edition (KB951698)
- Update for Windows Server 2008 x64 Edition (KB950050)
- Cumulative Security Update for ActiveX Killbits for Windows Server 2008 x64 Edition (KB950760)
- Update for Windows Server 2008 x64 Edition (KB955302)
- Windows Update Agent 7.2.6001.788

8. Click Install.
9. Agree to the license terms, and click Finish.
10. When the application requests you do so, restart the server.
11. After the system restarts, check Windows Update again for further updates.
12. Click Start→Windows Update.
13. Click Check for updates.
14. If Windows lists no important updates, then close the updates window.

Setting up the network adapters
1. Click Start→Control Panel.
2. Double-click Network and Sharing Center.
3. Click Manage Network Connections.
4. Right-click the NIC connected to your Client-Controller network, and select Properties.
5. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
6. Select Use the following IP address.
7. Type `192.168.10.10#` for the IP address (# is the Client number).
8. Type `255.255.255.0` for the Subnet mask.
9. Click OK.
10. Click Close.
11. Right-click the NIC connected to your Client-Server network, and select Properties.
12. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
13. Select Use the following IP address.
14. Type `192.168.20.10#` for the IP address (# is the Client number).
15. Type `255.255.255.0` for the Subnet mask.
16. Click OK.
17. Click Close.

Installing FSCT
1. Copy the x64 FSCT ZIP file to the desktop of the server.
2. Unzip the FSCT ZIP file into C:\FSCT. Create the folder if it does not already exist.
3. Delete the ZIP file from the desktop, and empty the recycle bin.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

10

Installing and configuring the controller
Installing Windows Server 2008 Enterprise x64
1. Insert the installation DVD for Windows Server 2008 x64 SP1 into the DVD drive.
2. Choose the language, time and currency, and keyboard input. Click Next.
3. Click Install Now.
4. Choose Windows Server 2008 Enterprise (Full Installation). Click Next.
5. Accept the license terms, and click Next.
6. Click Custom.
7. Click the disk, and click Drive options (advanced).
8. Click New, Apply, Format, and click Next.
9. Let the installation process continue. The server will reboot several times.
10. After the installation completes, click OK to set the Administrator password.
11. Enter the administrator password twice, and click OK.
12. Click Start, Control Panel, and double-click System.
13. Click Change Settings.
14. Click Change.
15. Enter the new computer name, and click OK.
16. Click OK to restart, click Close, and click Restart Now.
17. Right-click the desktop, and select Personalize.
18. Click the Screen Saver link.
19. Click the Screen saver drop-down menu, and select (None).
20. Click Apply.
21. Click Change power settings.
22. Under Balanced plan, click Change plan settings.
23. From the Turn off monitor drop-down menu, select Never.
24. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization windows.
25. Open the Start menu, type `regedit` in the search field, and press Enter.
26. To allow the server to automatically log into the OS after a system reboot, change the following Registry key to have the values shown here:

    ```
    [HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon]
    DefaultPassword=Password1
    AutoAdminLogon=1
    ```

27. Restart the server.

Installing Windows updates
1. Click Start→Windows Update.
2. Click Change settings.
3. Click Never check for updates.
4. Click OK.
5. Click Check for updates.
6. When the application prompts you to install an update for Windows Update, click Install Now.
7. Click View available updates to ensure you install the necessary updates.
   Note: We installed the following updates:
   - Update for Windows Server 2008 x64 Edition (KB955430)
   - Update for Windows Server 2008 x64 Edition (KB955430)
   - Microsoft .NET Framework 3.5 Service Pack 1 and .NET Framework 3.5 Family Update (KB951847) x64
   - LSI Corporation - Storage - Dell SAS 6/iR Integrated Controller
   - Microsoft .NET Framework 3.5 Service Pack 1 and .NET Framework 3.5 Family Update (KB951847) x64
   - Update for Windows Server 2008 x64 Edition (KB955430)

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

11

- Security Update for Windows Server 2008 x64 Edition (KB958687)
- Update for Windows Server 2008 x64 Edition (KB957388)
- Security Update for Windows Server 2008 x64-based Systems (KB938464)
- Update for Windows Server 2008 x64 Edition (KB949189)
- Security Update for Windows Server 2008 x64 Edition (KB955069)
- Security Update for Windows Server 2008 x64 Edition (KB954459)
- Security Update for Windows Server 2008 x64 Edition (KB957097)
- Security Update for Windows Server 2008 x64 Edition (KB958690)
- Cumulative Security Update for Internet Explorer 7 for Windows Server 2008 x64 Edition (KB963027)
- Security Update for Windows Server 2008 x64 Edition (KB960803)
- Internet Explorer 8 for Windows Server 2008 x64 Edition
- Security Update for Windows Server 2008 x64 Edition (KB958623)
- Update for Windows Server 2008 x64 Edition (KB959130)
- Windows Malicious Software Removal Tool x64 - May 2009 (KB890830)
- Update for Windows Server 2008 x64 Edition (KB957200)
- Security Update for Windows Server 2008 x64 Edition (KB953733)
- Security Update for Windows Server 2008 x64 Edition (KB950762)
- Update for Windows Server 2008 x64 Edition (KB955839)
- Security Update for Windows Server 2008 x64 Edition (KB958624)
- Security Update for Windows Server 2008 x64 Edition (KB950974)
- Update for Windows Server 2008 x64 Edition (KB951978)
- Update for Windows Server 2008 for x64-based Systems (KB955020)
- Microsoft .NET Framework 3.5 Service Pack 1 and .NET Framework 3.5 Family Update (KB951847) x64
- Security Update for Windows Server 2008 x64 Edition (KB956572)
- Security Update for Windows Mail for Windows Server 2008 x64 Edition (KB951066)
- Update Rollup for ActiveX Killbits for Windows Server 2008 x64 Edition (KB960715)
- Security Update for Windows Server 2008 x64 Edition (KB960225)
- Security Update for Windows Server 2008 x64 Edition (KB956802)
- Update for Windows Server 2008 x64 Edition (KB957321)
- Update for Windows Server 2008 x64 Edition (KB952287)
- Security Update for Windows Server 2008 x64 Edition (KB958644)
- Security Update for Windows Server 2008 x64 Edition (KB959426)
- Security Update for Windows Server 2008 x64 Edition (KB952004)
- Security Update for Windows Server 2008 x64 Edition (KB951698)
- Update for Windows Server 2008 x64 Edition (KB950050)
- Cumulative Security Update for ActiveX Killbits for Windows Server 2008 x64 Edition (KB950760)
- Update for Windows Server 2008 x64 Edition (KB955302)
- Windows Update Agent 7.2.6001.788

8. Agree to the license terms, and click Finish.
9. When the application requests you do so, restart the server.
10. After the system restarts, check Windows Update again for further updates.
11. Click Start→Windows Update.
12. Click Check for updates.
13. If Windows lists no important updates, then close the updates window.

Setting up the network adapters
1. Click Start→Control Panel.
2. Double-click Network and Sharing Center.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

12

3. Click Manage Network Connections.
4. Right-click the NIC connected to your Client-Controller network, and select Properties.
5. Click Internet Protocol Version 4 (TCP/IPv4), and select Properties.
6. Select Use the following IP address.
7. Type `192.168.10.60` for the IP address (# is the Client number).
8. Type `255.255.255.0` for the Subnet mask.
9. Click OK.
10. Click Close.

Installing FSCT
1. Copy the x64 FSCT ZIP file to the desktop of the controller.
2. Unzip the FSCT ZIP file into C:\FSCT. Create the folder if it does not already exist.
3. Delete the ZIP file from the desktop, and empty the recycle bin.

Preparing the systems
Preparing the server
1. Open an elevated command prompt on the server.
2. Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3. Type the following command line, replacing the variables with the relevant information for your run:
   ```
   prepare server /clients
   client1,client2,client3,client4,client5,client6,client7,client8 /password
   Password1 /users 625 /volumes E:,F:,G:,H: /workload HomeFolders
   ```
   Note: We used the HomeFolders workload for all tests.
4. When the server has finished the preparation, it is ready to begin the test.

Preparing the clients
1. Open an elevated command prompt on each client.
2. Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3. Type the following command line, replacing the variables with the relevant information for your run: `fsct`
   ```
   prepare client /server DNX30001 /password Password1 /users 625 /server_ip
   <server IP address> /workload HomeFolders
   ```
   Note: On Configuration-A and Configuration-B, we used one IP address for clients 1 through 4 and another IP address for clients 5 through 8. On Configuration-C, we used one IP address for clients 1 and 2, another IP address for clients 3 and 4, another IP address for clients 5 and 6, and another IP address for clients 7 and 8.
4. When the clients are finished with their user creation, they are ready to begin the test.

Preparing the controller
1. Open an elevated command prompt.
2. Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3. Type the following command line, replacing the variables with the relevant information for your run: `fsct`
   ```
   prepare controller
   ```
4. When the controller is finished and has closed the network, it is ready to begin.

Running the test
Running the clients
1. Open an elevated command prompt.
2. Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3. Type the following command line, replacing the variables with the relevant information for your run: `fsct`
   ```
   run client /controller controller /server DNX30001 /password Password1
   ```
4. The test will begin when the controller starts.

Running the controller
1. Open an elevated command prompt.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

13

2.   Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3.   Type the following command line replacing the variables with the relevant information for your run: `fsct run controller /server DNX30001 /password Password1 /volumes E:,F:,G:,H: /clients client1,client2,client3,client4,client5,client6,client7,client8 /min_users <minusers> /max_users <maxusers> /step <usersstep> /duration <duration> /workload HomeFolders`
     Note: min_users, max_users, step, and duration depend upon the configuration you use and the test you run. For initial tuning runs, we used 1,000 for min_users, 5,000 for max_users, 1,000 for step, and 600 for duration. After we knew our range within 1,000 users, we ran min_users at the lowest user count that the previous run had run without overload, the max user count to the first user count that had overload, the step to 100, and the duration to 600. Once we narrowed the user count down to the nearest 100, we ran the cleanup and prepare scripts and ran the test with min_user set to two increments below what the highest user count that the previous run was able to do without overload, the max_user count to 500 above the min_user count, the step to 100, and duration to 900. We then repeated the previous run two more times for each configuration and used the cleanup and prepare scripts in between each run.
4.   When the controller starts, the test will begin.

Cleanup
When the test is finished, you will need to run the FSCT cleanup scripts before beginning the next run to delete the users, files, and directories from the machines.

Cleaning up the clients
1.   Open an elevated command prompt.
2.   Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3.   Type the following command line, replacing the variables with the relevant information for your run: `fsct cleanup client /users <number of users>`
4.   When the cleanup is finished, restart the client.

Cleaning up the controller
1.   Open an elevated command prompt.
2.   Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3.   Type the following command line replacing the variables with the relevant information for your run: `fsct cleanup controller /backup <backup directory>`
4.   When the cleanup is finished, restart the client.

Cleaning up the server
1.   Open an elevated command prompt.
2.   Navigate to the FSCT folder by typing `cd c:\FSCT` and pressing Enter.
3.   Type the following command line replacing the variables with the relevant information for your run: `fsct cleanup server /clients client1,client2,client3,client4,client5,client6,client7,client8 /users 625 /volumes E:,F:,G:,H:`
4.   When the cleanup is finished, restart the server.

Appendix A –Test server information

Client 1

- Dell PowerEdge 2950
- 2 x Intel Xeon E5405 (2.00 GHz)
- 8 x 2,048 MB Samsung PC2-5300 FB-DDR2 (16,384 MB), 1,333 FSB,
- Dell BIOS 2.5.0 (09/12/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- ipmi 1.06, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 1 x SATA Western Digital WD800AAJS, 80 GB, 7.2K, 3 Gb/s, Firmware- SM04, Intel 6321ESB Control Device driver- Microsoft 6.0.6001.18000 (6/21/2006)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.600

Client 2

- Dell PowerEdge 2950
- 2 x Intel Xeon E5405 (2.00 GHz)
- 8 x 2,048 MB Samsung PC2-5300 FB-DDR2 (16,384 MB), 1,333 FSB,
- Dell BIOS 2.5.0 (09/12/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- ipmi 1.06, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 1 x SATA Western Digital WD800AAJS, 80 GB, 7.2K, 3 Gb/s, Firmware- SM04, Intel 6321ESB Control Device driver- Microsoft 6.0.6001.18000 (6/21/2006)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.600

Client 3

- Dell PowerEdge 2950
- 2 x Intel Xeon E5405 (2.00 GHz)
- 8 x 2,048 MB Samsung PC2-5300 FB-DDR2 (16,384 MB), 1,333 FSB,
- Dell BIOS 2.5.0 (09/12/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- ipmi 1.06, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 1 x SATA Western Digital WD800AAJS, 80 GB, 7.2K, 3 Gb/s, Firmware- SM04, Intel 6321ESB Control Device driver- Microsoft 6.0.6001.18000 (6/21/2006)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.600

Client 4

- Dell PowerEdge 2950
- 2 x Intel Xeon E5405 (2.00 GHz)
- 8 x 2,048 MB Samsung PC2-5300 FB-DDR2 (16,384 MB), 1,333 FSB,
- Dell BIOS 2.5.0 (09/12/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- ipmi 1.06, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 1 x SATA Western Digital WD800AAJS, 80 GB, 7.2K, 3Gb/s, Firmware- SM04, Intel 6321ESB Control Device driver- Microsoft 6.0.6001.18000 (6/21/2006)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.600

Client 5

- Dell PowerEdge R900
- 4 x Intel Quad-Core Xeon E7340 (2.40 GHz)
- 16 x 4,096 MB FB-DDR2 (65530 MB), 1,066 FSB,
  Dell BIOS 1.1.10 (11/14/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- UMP 1.1.9, Driver- Broadcom 3.7.19.0 (1/19/2008)

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

15

- 2 x SAS Seagate Savvio ST973451SS, 73 GB, 15K, 3 Gb/s, Firmware- SM04, Dell PERC 6/i Integrated RAID Control Device driver- LSI 2.13.0.64 (5/11/2007)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.6001

Client 6
- Dell PowerEdge R900
- 4 x Intel Xeon E7450 6-Core (2.40 GHz)
- 32 x 2,048 MB FB-DDR2 (65,530 MB), 1,066 FSB
- Dell BIOS 1.1.9 (8/1/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- UMP 1.1.9, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 2 x SAS Seagate Savvio ST973451SS, 73 GB, 15K, 3,Gb/s, Firmware- SM04, Dell PERC 6/i Integrated RAID Control Device driver- LSI 2.13.0.64 (5/11/2007)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.6001

Client 7
- Dell PowerEdge R900
- 4 x Intel Quad-Core Xeon E7340 (2.40 GHz)
- 16 x 4,096 MB FB-DDR2 (65530 MB), 1,066 FSB, Dell BIOS 1.1.10 (11/14/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- ipmi 1.06, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 2 x SAS Seagate Savvio ST973451SS, 73 GB, 15K, 3 Gb/s, Firmware- SM04, Dell PERC 6/i Integrated RAID Control Device driver- LSI 2.13.0.64 (5/11/2007)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.6001

Client 8
- Dell PowerEdge 2950
- 2 x Intel Quad-Core Xeon E5440 (2.83 GHz)
- 8 x 4,096 MB FB-DDR2 (32,768 MB), 1,333 FSB, Dell BIOS 2.2.6 (2/5/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- ipmi 1.06, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 2 x SAS 73 GB, 15K, 3 Gb/s, Firmware- SM04, Dell PERC 6/i Integrated RAID Control Device driver- LSI 2.13.0.64 (5/11/2007)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.6001

Controller
- Dell PowerEdge 2950
- 2 x Intel Quad-Core Xeon E5440 (2.83 GHz)
- 8 x 4,096 MB FB-DDR2 (32,768 MB), 1,333 FSB, Dell BIOS 2.2.6 (2/5/2008)
- 1 x BCM5708C - 10/100/1000BASE-T TOE PCI Express Ethernet Controller, 1,000 Mbps, Firmware- ipmi 1.06, Driver- Broadcom 3.7.19.0 (1/19/2008)
- 2 x SAS 73 GB, 15K, 3 Gb/s, Firmware- SM04, Dell PERC 6/i Integrated RAID Control Device driver- LSI 2.13.0.64 (5/11/2007)
- Microsoft Windows Server 2008 Enterprise Service Pack 1 x64, build 6.0.6001

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

16

Appendix B –Test unified network storage solution information

Figure 4 provides detailed system configuration information for the test unified network storage solution.

Unified network storage solution	Dell PowerVault NX3000
General	
Number of processor packages	2 in Configuration-C, 1 in Configuration A and B
Number of cores per processor package	4
Number of hardware threads per core	1
System power management policy	Balanced
CPU	
Vendor	Intel
Name	Xeon L5520
Stepping	D0
Socket type	LGA1366
Core frequency (GHz)	2.26
Front-side bus frequency (MHz)	QPI 5.86 GT/s
L1 cache	32 KB + 32 KB (per core)
L2 cache	2 MB (256 KB per core)
L3 cache	8 MB (shared)
Platform	
Vendor and model number	Dell 0M233H
Motherboard chipset	Intel 5520
BIOS name and version	Dell 1.1.2 (04/09/2009)
BIOS settings	Default
Memory modules	
Configuration-A and Configuration-B	
Vendor and model number	Elpida EBJ10EE8BAFA-DJ-E
Type	DDR3
Speed (MHz)	1,066
Speed in the system currently running @ (MHz)	1,066
Timing/latency (tCL-tRCD-iRP-tRASmin)	7-7-7-19
Total size (MB)	3,072
Number of RAM modules (MB)	3 x 1,024
Chip organization	Single-sided
Configuration-C	
Vendor and model number	Qimonda IMSH2GE13AF1CT13H
Type	DDR3
Speed (MHz)	1,066
Speed in the system currently running @ (MHz)	1,066
Timing/latency (tCL-tRCD-iRP-tRASmin)	7-7-7-19
Total size (MB)	12,288
Number of RAM modules (MB)	6 x 2,048
Chip organization	Double-sided
Hard disk	
Vendor and model number	Fujitsu MBA3300RC
Number of disks in system	6
Size (GB)	300
Buffer size (MB)	16
RPM	15,000
Type	SAS
Controller	Dell PERC 6/i Integrated RAID Controller

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

17

Unified network storage solution	Dell PowerVault NX3000
Controller driver	Dell 2.24.0.64 (01/19/2009)
Operating system	
Name	Windows Storage Server 2008 Standard x64
Build number	6001
Service Pack	1
Microsoft Windows update date	NA
File system	NTFS
Kernel	ACPI x64-based PC
Language	English
Microsoft DirectX version	10
Graphics	
Vendor and model number	Matrox G200
Chipset	Matrox Graphics
BIOS version	00
Type	Integrated
Memory size (MB)	8
Resolution	1,024 x 768 x 32-bit
Driver	Microsoft 6.0.6001.18000 (06/21/2006)
Network card/subsystem	
First network card/subsystem	
Network card	Broadcom BCM5709C NetXtreme II GigE (2 chips/4 integrated ports)
Type	Integrated
Network driver	Broadcom 4.8.5.0 (01/28/2009)
Second network card/subsystem	
Network card	2 x Intel PRO/1000 PT Dual Port Server Adapter
Type	PCI-Express
Network driver	Intel 9.12.36.0 (12/04/2008)
Third network card/subsystem	
Network card	2 x Intel PRO/1000 PT Dual Port Server Adapter
Type	PCI-Express
Network driver	Intel 9.12.36.0 (12/04/2008)
Fourth network card/subsystem	
Network card	Intel PRO/1000 PT Server Adapter
Type	PCI-Express
Network driver	Intel 9.12.36.0 (12/04/2008)
Optical drive	
Vendor and model number	TSSTcorp TS-L33A
Type	DVD-ROM
Interface	EIDE
Dual/single layer	Dual
USB ports	
Number of ports	4
Type of ports (USB 1.1, USB 2.0)	2.0

Figure 4: Detailed system configuration information for the test unified network storage solution.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

18

Appendix C —Test storage information

Figure 5 provides detailed configuration information about the storage array system.

Storage array	Dell EqualLogic iSCSI SAN
Arrays	Two Dell EqualLogic PS4000E arrays
Disks	32 x 7,200RPM SATA disks total for the two arrays (16 per array)
Active storage cache (GB)	4 (2 per array)
Number of active storage controllers	2 (1 per array)
Number of active storage ports	4 (2 per array)
Firmware revision	v4.1.4
Switch type/model/firmware revision	One Dell PowerConnect 6248 v2.2.0.1
Disk vendor and model number	32 x Seagate ST31000340NS
Disk size (TB)	1
Disk buffer size (MB)	32
Disk RPM	7,200
Disk type	SATA

Figure 5: Detailed configuration information for the storage array system. We used one Dell EqualLogic PS4000E in Configuration-A. We used the second Dell EqualLogic PS4000E in Configuration-B and Configuration-C only.

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

19

About Principled Technologies

We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help you assess how it will fare against its competition, its performance, whether it's ready to go to market, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.

Principled Technologies®

Principled Technologies, Inc.: File server performance comparison of three Dell PowerVault NX3000 configurations using Microsoft FSCT

20