# THE DATACENTER IN A BOX SOLUTION PERFORMANCE TEST: COMPARING DELL AND HP BLADE SOLUTIONS

## The Dell™ datacenter in a box solution

using Dell™ EqualLogic™ PS-M4110 Blade Arrays

**55%** fewer storage configuration steps

**48%** more users

**42%** more users per watt

vs. an equivalent HP chassis solution, using Storage Works D2200sb storage blades, while performing a mixed workload including mail, database, and collaboration applications

When you are investing in a converged infrastructure solution to meet the computing needs of a department or remote or branch office of a large enterprise or a small to medium enterprise datacenter, it is important to select wisely. While excellent performance is necessary, other considerations—including how easy the solution is to set up and how much power it will consume—cannot be overlooked in the decision.

We looked at two such server-network-storage solutions, one based on Dell EqualLogic PS-M4110 Blade Arrays and the other based on HP StorageWorks D2200sb storage blades, to see how they compared.

We found that the Dell converged datacenter in a box solution delivered 40 percent greater IOPS performance, supported 48 percent more users, and had greater power efficiency with 42 percent more users per watt of power consumed. Additionally, the Dell EqualLogic PS-M4110 Blade Arrays took one-fifth the time to configure compared to the HP StorageWorks D2200sb storage blades; and this assumes the engineer has familiarity with installing VMware® ESXi™.

A datacenter in a box that excels in performance, supports more users, increases power efficiency, and simplifies setup and configuration delivers benefits to your remote office—as well as any similarly sized deployment—by better utilizing hardware and driving down operating costs.

# BETTER PERFORMANCE AND MORE USERS WITH EASIER SETUP AND LESS COSTLY OPERATION

In our study, we examined the following blade server-network-storage solutions to see how well they would meet the needs of a small to medium business (SMB) or departmental computing solution within a large enterprise:

- **The Dell EqualLogic PS-M4110 solution:** Three Dell PowerEdge™ M620 servers with two Dell EqualLogic PS-M4110 Blade Arrays, 2 Dell Force10 MXL 10/40GbE Blade Switches and 2 Dell PowerConnect™ M8024-k 10GbE switches

- **The HP D2200sb + VSA solution:** Three HP ProLiant BL460c Gen8 blade servers, two HP StorageWorks D2200sb storage blades, and two HP ProLiant BL460c Gen8 partner blades to manage the storage, and four HP Flex-10 10GbE switches

As Figure 1 shows, the Dell solution is considerably more streamlined, with three server blades and two storage blades vs. the HP solution's five servers and two storage blades. Note that the Dell Force10 MXL blade switches are interlinked by a 40G connection. All other connections in Figure 1 are 10G connections.
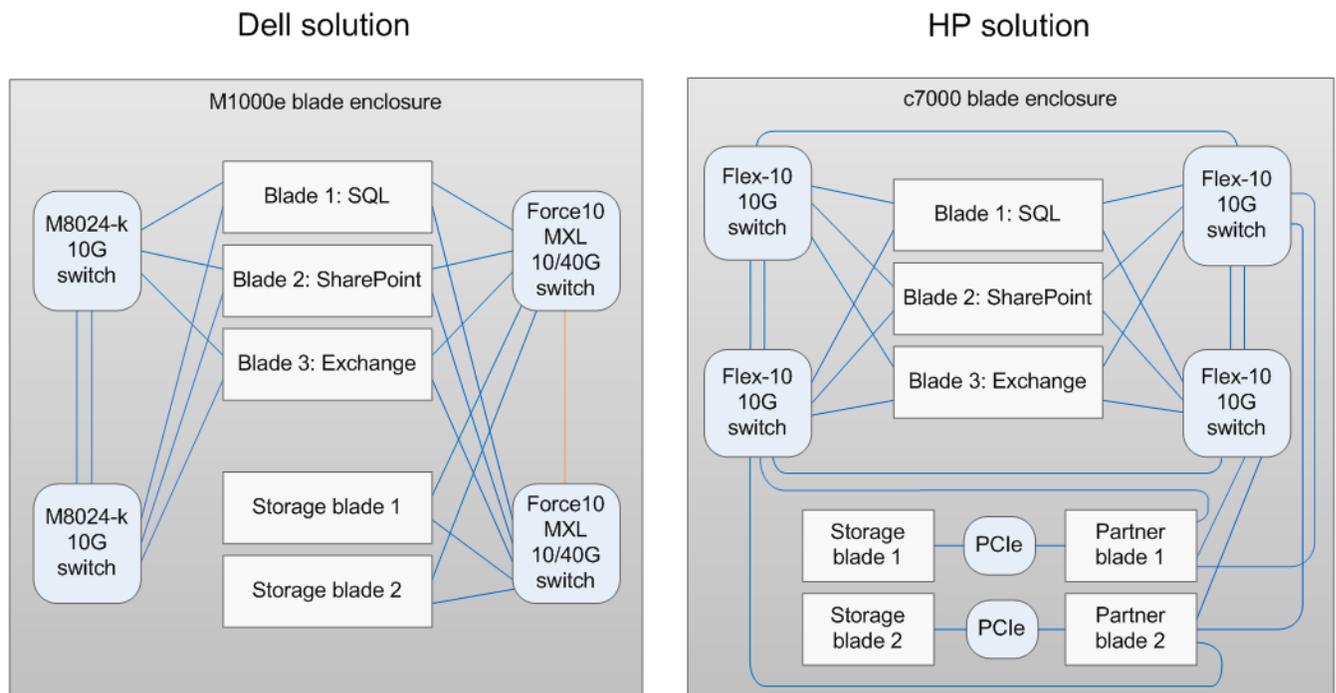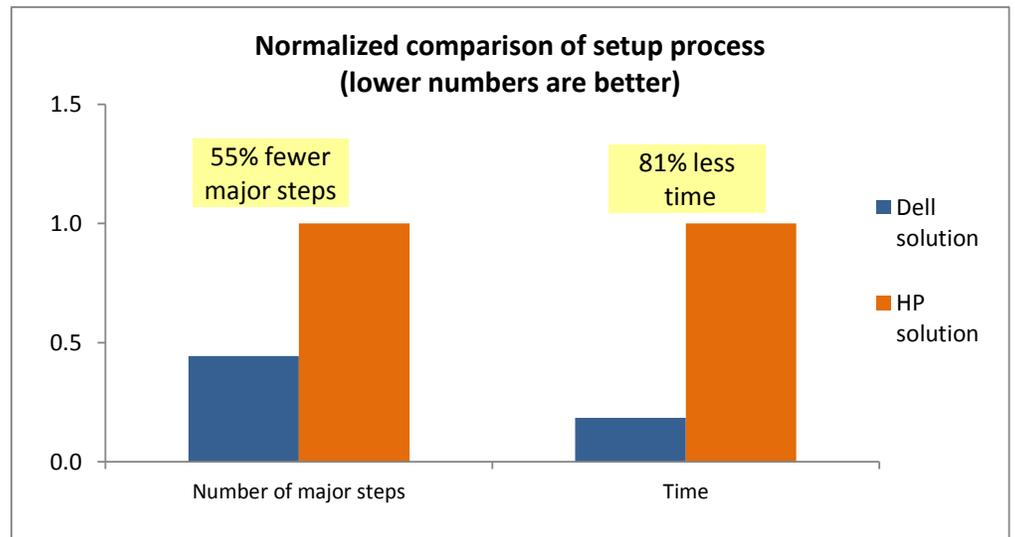


**Figure 1. The Dell solution includes a total of five blades—two storage blades and three server blades, one for each of the three workloads. The HP solution requires two additional partner blades to manage the storage, for a total of seven blades.**

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The datacenter in a box performance test: Comparing Dell and HP blade solutions

Our testing had three components: first, we examined the setup process for both solutions, recording the number of steps involved and the time required to complete them. Next, we tested the performance of both solutions while running a mixed workload including email, database, and collaboration applications. Finally, we compared the amount of power the two solutions used while performing the workloads.
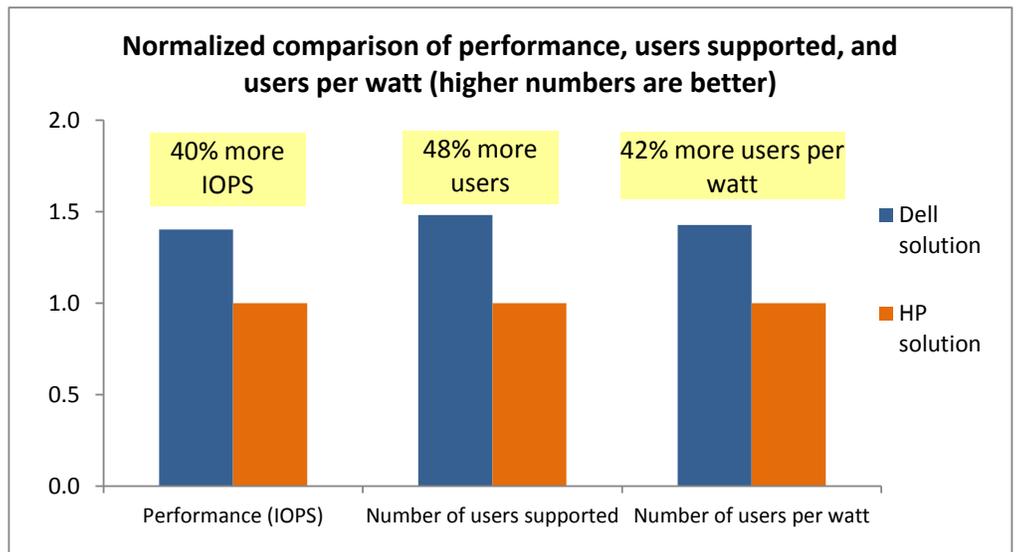
Figures 2 and 3 present comparisons of the factors we tested. They use normalized comparisons, which assigns a value of 1.0 to the HP storage solution and expresses the Dell storage solution's results as a relative percentage greater or lesser. As Figure 2 shows, the Dell solution took 55.6 percent fewer major steps, and 81.6 percent less time to set up.

**Figure 2. Compared to the HP solution, the Dell solution took less time and many fewer steps to set up.**

**Normalized comparison of setup process (lower numbers are better)**

55% fewer major steps

81% less time

- Dell solution
- HP solution

Number of major steps | Time

As Figure 3 shows, the Dell solution delivered 40.2 percent greater performance and supported 48.1 percent more users and 42.7 percent more users per watt.

**Figure 3. Compared to the HP solution, the Dell solution delivered greater performance, supported more users and more users per watt.**

**Normalized comparison of performance, users supported, and users per watt (higher numbers are better)**

40% more IOPS

48% more users

42% more users per watt

- Dell solution
- HP solution

Performance (IOPS) | Number of users supported | Number of users per watt

# EASIER AND FASTER TO CONFIGURE

Figure 4 presents a summary of the steps involved in configuring the two storage blade solutions. The Dell EqualLogic PS-M4110 Blade Array setup was considerably more streamlined, taking only 8 major steps versus the HP StorageWorks D2200sb + VSA's 18 major steps—a difference of 55.6 percent. When we compare the entire number of steps each storage solution requires, the disparity is even more dramatic—the Dell storage solution required a total of 44 steps, whereas the HP storage solution required 259 steps—a difference of 83.0 percent. (See Appendix E for the complete set of steps.)

Configuring the Dell storage solution was also much faster, taking a total of 16 minutes and 46.7 seconds, 81.6 percent less time than the HP storage solution's total of 1 hour, 30 minutes, and 58.2 seconds.

| Dell EqualLogic PS-M4110 solution<br>Total number of major steps: 8<br>Total amount of time: 16 min, 46.7 sec | HP StorageWorks D2200sb + VSA solution<br>Total number of major steps: 18<br>Total amount of time: 1 hour, 30 min, 58.2 sec |
|---|---|
| **Storage blades**<br><br>1.  Insert the two blade arrays into the chassis and power on.<br>2.  Configure the first blade array in the Dell M1000e CMC Web interface.<br>3.  Configure the second blade array in the Dell M1000e CMC Web interface (and add to the existing storage group created in the previous step)<br>4.  Log into the EqualLogic Group Manager GUI from a system attached to the iSCSI storage network (Fabric-B) and configure the group settings.<br>5.  Configure the RAID level of the two members.<br>6.  Create the volumes and restrict iSCSI access by IQN.<br><br>**Host Integration Tools (HIT)**<br><br>7.  Install the Dell EqualLogic Host Integration Tools for Microsoft  on each application blade. This is required for multipathing.<br><br>**iSCSI configuration on application blades and storage**<br><br>8.  Configure iSCSI initiator on each blade in Windows.<br>Notes:<br><br>• The Dell EqualLogic PS-M4110 is managed via a Java application using a Web browser. | **Storage blades**<br><br>1.  Insert the storage blades in the appropriate slots and power on.<br><br>**Partner blades**<br><br>2.  Insert the partner blades in the appropriate slots and power on.<br>3.  Use the BIOS RAID utility to set the RAID level for the first partner blade logical drive and the first storage blade logical drive.<br>4.  Use the BIOS RAID utility to set the RAID level for the second partner blade logical drive and the second storage blade logical drive.<br><br>**ESXi**<br><br>5.  Install ESXi on the first partner blade logical drive.<br>6.  Log into the first partner blade ESXi instance using vSphere client and add the storage blade datastore.<br>7.  Deploy the first VSA VM and install the HP P4000 Centralized Management Console on your management system.<br>8.  Set the first VSA VM IP address/networking.<br>9.  Install ESXi on the second partner blade logical drive.<br>10. Log into the second partner blade ESXi instance using vSphere client and add the storage blade datastore.<br>11. Deploy the second VSA VM. |

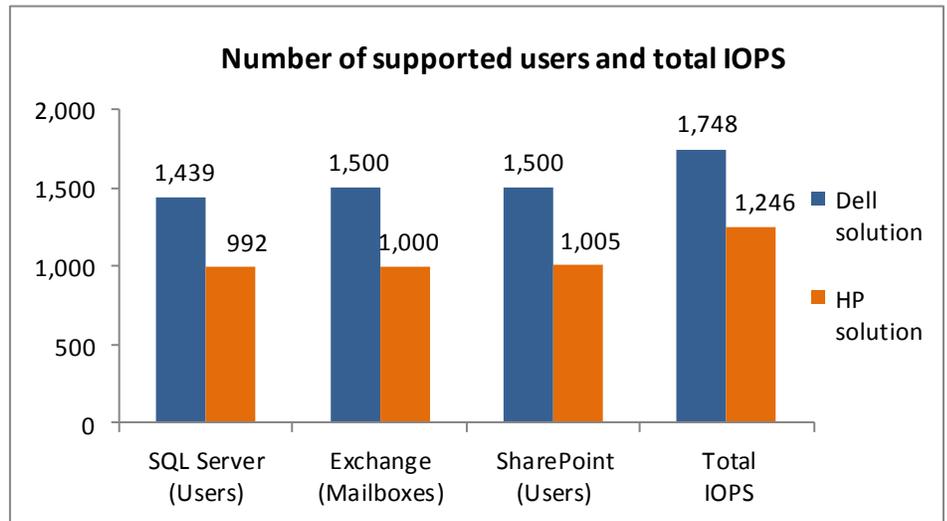| Dell EqualLogic PS-M4110 solution<br>Total number of major steps: 8<br>Total amount of time: 16 min, 46.7 sec | HP StorageWorks D2200sb + VSA solution<br>Total number of major steps: 18<br>Total amount of time: 1 hour, 30 min, 58.2 sec |
| --- | --- |
| | 12. Set the second VSA VM IP address/networking.<br>**Failover Manager (FOM)**<br>    13. Deploy the FOM on an appropriate host server to establish quorum between the two nodes.<br>**HP Centralized Management Console**<br>    14. Log into the LeftHand Centralized Management Console on the management system and add the VSA nodes and FOM to the CMC.<br>    15. Use the console to create a new management group and cluster using the two VSA nodes and FOM, and assign a virtual group IP.<br>    16. Create the volumes, add the application servers, and assign the relevant volumes to the application servers.<br>**Install HP multipathing software**<br>    17. Install HP DSM for MPIO software on each application blade.<br>**iSCSI configuration on application blades and storage**<br>    18. Configure iSCSI initiator on each application blade in Windows. |

**Figure 4. Summary of steps required to configure the two solutions.**

# GREATER PERFORMANCE AND MORE USERS SUPPORTED

We used three different benchmarks to assess database, mail, and collaboration performance: DVD Store version 2.1, Microsoft Load Generator 2010, and WSSDW 1.0.0.0 Beta respectively. To determine the maximum number of users supported by each configuration in our tests, we used read latency for each storage solution as a threshold to determine the supported users (and subsequently, the workload) for each configuration. We simulated the same number of SharePoint and Exchange users, and scaled the SQL Server workload while maintaining an acceptable read latency threshold for each configuration.

As Figure 5 shows, the Dell solution supported more users than the HP solution on all three workloads: 50.0 percent more Exchange mailboxes, 45.1 percent more SQL Server users, and 49.3 percent more SharePoint users. The Dell datacenter in a box also delivered 40.2 percent more total IOPS.

## Number of supported users and total IOPS



**Figure 5. The Dell datacenter in a box supported as many as 50.0 percent more users than the HP solution.**

## Database testing

To create our real-world ecommerce workload, we used the DVD Store Version 2.1 benchmarking tool. DS2 models an online DVD store, where customers log in, search for movies, and make purchases. DS2 reports these actions in orders per minute that the system could handle, to show what kind of performance you could expect for your customers. The DS2 workload also performs other actions, such as adding new customers, to exercise the wide range of database functions you would need to run your ecommerce environment.

We ran DS2 with 32 threads on both solutions, with a 0.12-second think time on the Dell solution and a 0.18-second think time on the HP solution. This allowed us to simulate a user completing one order approximately every 15 seconds on both solutions, within the read latency requirements.

For more details about the DS2 tool, see http://www.delltechcenter.com/page/DVD+Store.

## Mail testing

To test the solutions' mail server performance, we used the Microsoft Load Generator 2010 (LoadGen) benchmark, performing tasks to simulate a heavy user generating mail activity. For our workloads, we used the following settings:

- Mailbox Profile: 250MB mailboxes
- Action Profile: Very heavy
- Client Type: Outlook_500

For more details about LoadGen, see http://www.microsoft.com/downloads/details.aspx?FamilyId=DDEC1642-F6E3-4D66-A82F-8D3062C6FA98&displaylang=en.

## Collaboration testing

To simulate the traffic of SharePoint Server 2010 users, we used the WSSDW 1.0.0.0 Beta test. This test creates sample data, populates the server with it, and simulates SharePoint Server users completing everyday tasks.

We used Visual Studio 2010 to execute the test workload, generating a realistic user workload where each of the simulated heavy users performed a task every minute. To do this, we set up the test to run 200 and 134 Visual Studio virtual users with an 8-second think time in between each of the various tasks, to simulate 1,500 users for the Dell solution and 1,005 users for the HP solution, respectively. The virtual user count here was set to match the Exchange user count. The test workload then reports throughput in tests per second.

For more details about SharePoint Server, see http://office.microsoft.com/en-us/sharepoint-server-help/.

## Detailed performance findings

In our testing, we used the read latency of each storage solution while running the three applications to determine how many users each solution could support. Typically, read latency should not exceed 20ms, so we used this as our threshold to determine acceptable performance. A short response time is an important measure of performance—it means that the users need to wait less time for the server to complete a task. Figure 6 shows the average read and write latency in milliseconds, for the two solutions under test.

| | Read latency (milliseconds) | Percentage decrease from HP solution | Write latency (milliseconds) | Percentage decrease from HP solution |
|---|---|---|---|---|
| Dell solution | 11.7 | 41.5% | 5.1 | 64.8% |
| HP solution | 20.0 | | 14.5 | |

Figure 6. Read and write latency for the two solutions. Lower numbers are better.

Figure 7 shows the average throughput in IOPS each of the solutions delivered. We conducted three test runs, and present the results from the median run. As Figure 7 shows, the Dell datacenter in a box solution increased overall throughput over the HP solution by an average of 40.2 percent.

| | Throughput (IOPS) | Average percentage increase over HP solution |
|---|---|---|
| Dell solution | 1,747.9 | 40.2% |
| HP solution | 1,246.4 | |

Figure 7. Median throughput for the three applications running on the solutions. Higher numbers are better.

Figure 8 shows the number of users each solution supported while delivering an acceptable read latency averaging less than 20ms for end users. The number of SQL Server users supported, in this case, is determined by assuming that a user would generate four SQL Server transactions per minute.

| | Users | Percentage increase over HP solution |
|---|---|---|
| **SQL Server** | | |
| Dell solution | 1,439 | 45.1% |
| HP solution | 992 | |
| **Exchange** | | |
| Dell solution | 1,500 | 50.0% |
| HP solution | 1,000 | |
| **SharePoint** | | |
| Dell solution | 1,500 | 49.3% |
| HP solution | 1,005 | |
| **Total across applications** | | |
| Dell solution | 4,439 | 48.1% |
| HP solution | 2,997 | |

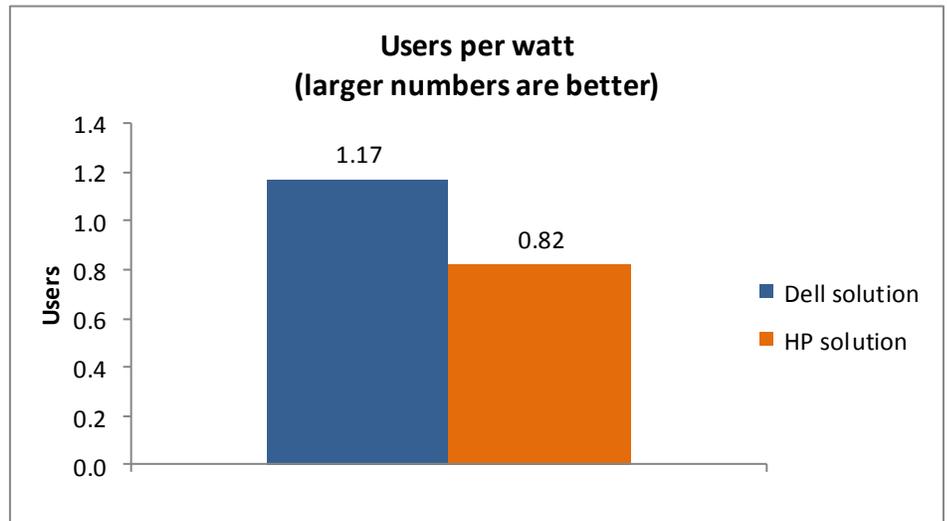**Figure 8. Number of users the solutions supported. Higher numbers are better.**

## SUPPORT MORE USERS PER WATT

As Figure 9 shows, the two solutions consumed roughly the same amount of power while performing the performance workloads described above, even though the Dell solution supported as many as 1.5 times as many users. This translates to a users-per-watt advantage of 42.7 percent for the Dell datacenter in a box solution. (See Figure 10.)

| | | Percentage increase over HP solution |
|---|---|---|
| **Watts used** | | |
| Dell solution | 1,263 | 4.0% |
| HP solution | 1,214 | |
| **Total number of users** | | |
| Dell solution | 4,439 | 48.1% |
| HP solution | 2,997 | |
| **Users per watt** | | |
| Dell solution | 1.17 | 42.7% |
| HP solution | 0.82 | |

**Figure 9. Number of users per watt the solutions supported.**

**Users per watt
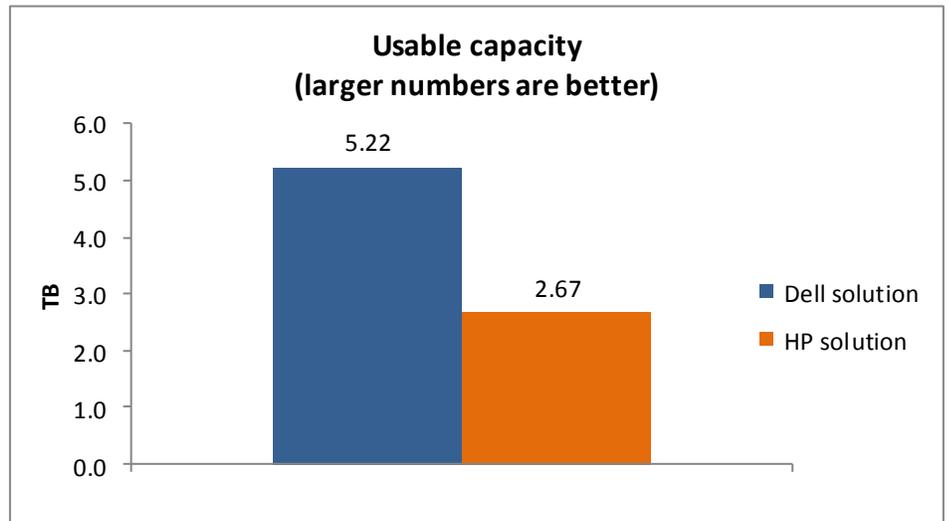(larger numbers are better)**



**Figure 10. The Dell solution supported more users per watt than the HP solution.**

# GREATER USABLE CAPACITY

More usable capacity in your server-storage solution provides more room to grow with your business, either by giving applications more space as needed or supporting additional blade servers using the existing storage infrastructure. This translates directly to the total cost of ownership of your consolidated blade server/storage deployment, or datacenter in a box. As Figure 11 shows, the Dell solution provides 95.5 percent more usable capacity than the HP solution as configured. Each Dell EqualLogic PS-M4110 Blade Array comes equipped with redundant controllers, RAID technology to prevent data loss with failed drives, and redundant power supplies that are available with the Dell M1000e blade chassis. For high availability configuration, the redundant controllers in the Dell EqualLogic PS-M4110 arrays allow for spanning data across the two arrays instead of the mirroring data across nodes required for high availability by the single-controller-based HP storage arrays. This allows the Dell datacenter in a box greater capacity, while still providing high availability at the component level.

**Figure 11. The Dell solution had greater usable capacity than the HP solution.**

# IN CONCLUSION

Throughout our testing, the Dell datacenter in a box solution based on Dell EqualLogic PS-M4110 Blade Arrays had the advantage over the HP solution based on HP StorageWorks D2200sb storage blades. Not only did the Dell solution deliver 40.2 percent better performance, it required 55.6 percent fewer major steps to set up, supported 42.7 percent more users per watt, and took one-fifth of the time to configure. Choosing such a complete datacenter in a box solution can simplify infrastructure setup and configuration, boost performance, and save your organization in data center costs over the life of the hardware.

# APPENDIX A – DETAILED CONFIGURATION INFORMATION

Figures 12 and 13 provide detailed configuration information about the test server blades and chassis from each solution. The Dell used three PowerEdge M620 blade servers to run the applications and test workload while the HP used three ProLiant BL460c blade servers to run the applications and test workload. Additionally, we used two ProLiant BL460c blade servers for the required partner blades for the HP StorageWorks D2200sb arrays.

| Server | Dell PowerEdge M620 (Application blade) |
|---|---|
| **Enclosure** | |
| Blade enclosure | Dell PowerEdge M1000e |
| **General dimension information of blade enclosure** | |
| Height (inches) | 17.25 |
| Width (inches) | 19 |
| Depth (inches) | 29.5 |
| U size in server rack (U) | 10 |
| **Power supplies of blade enclosure** | |
| Total number | 6 |
| Wattage of each power supply (W) | 2,360 |
| **Cooling fans of blade enclosure** | |
| Total number | 9 |
| Dimensions (h x w) of each | 3-1/4" x 3-1/4 " |
| Voltage (V) | 12 |
| Amps (A) | 5 |
| **General processor setup** | |
| Number of processor packages | 2 |
| Number of cores per processor package | 6 |
| Number of hardware threads per core | 2 |
| System power management policy | Balanced |
| **CPU** | |
| Vendor | Intel |
| Name | Xeon E5-2640 |
| Stepping | C2 |
| Socket type | Socket 2011 LGA |
| Core frequency (GHz) | 2.50 |
| L1 cache | 32 KB + 32 KB (per core) |
| L2 cache | 256 KB (per core) |
| L3 cache | 15 MB (shared) |
| **Platform** | |
| Vendor and model number | Dell PowerEdge M620 |
| Motherboard model number | 0GVN4C |
| Motherboard chipset | Intel ID3C00 Rev. 07 |
| BIOS name and version | Phoenix ROM BIOS PLUS Version 1.10 1.1.2 (03/09/2012) |
| BIOS settings | Default |

| Server | Dell PowerEdge M620 (Application blade) |
|---|---|
| **Memory modules** | |
| Total RAM in system (GB) | 64 |
| Number of types of memory modules | 1 |
| Vendor and model number | Samsung M393B1K70BH1-CH9 |
| Type | PC3-10600R |
| Speed (MHz) | 1,333 |
| Speed in the system currently running @ (MHz) | 1,333 |
| Timing/latency (tCL-tRCD-iRP-tRASmin) | 9-9-9-24 |
| Size (GB) | 8 |
| Number of RAM modules | 8 |
| Chip organization | Double-sided |
| **Hard disk** | |
| Vendor and model number | Dell MBE2147RC |
| Number of disks in system | 2 |
| Size (GB) | 146 |
| Buffer size (MB) | 16 |
| RPM | 15,000 |
| Type | SAS |
| **Operating system** | |
| Name | Windows Server 2008 R2 Enterprise |
| Build number | 7601 |
| File system | NTFS |
| Language | English |
| **Network card/subsystem** | |
| Vendor and model number | Intel Ethernet X520 10GbE Dual Port KX4-KR Mezzanine card |
| Type | PCI |
| Driver | Intel 2.9.68.0 (12/5/2011) |

**Figure 12. Detailed configuration information for the Dell PowerEdge M620 blades we used in our tests.**

| Servers | HP ProLiant BL460c Gen8 (Application blade) | HP ProLiant BL460c Gen8 (Partner blade) |
|---|---|---|
| **Enclosure** | | |
| Blade enclosure | HP BladeSystemc7000 | HP BladeSystem c7000 |
| **General dimension information of blade Enclosure** | | |
| Height (inches) | 17.4 | 17.4 |
| Width (inches) | 17.6 | 17.6 |
| Depth (inches) | 32.0 | 32.0 |
| **Power supplies of blade Enclosure** | | |
| Total number | 6 | 6 |
| Wattage of each power supply (W) | 2,450 | 2,450 |

| Servers | HP ProLiant BL460c Gen8 (Application blade) | HP ProLiant BL460c Gen8 (Partner blade) |
|---|---|---|
| **Cooling fans of blade Enclosure** | | |
| Name and model number | HP BL C Class Fan Turbine 486206-001 | HP BL C Class Fan Turbine 486206-001 |
| Total number | 10 | 10 |
| Dimensions (h x w) of each | 3-1/2" x 7-1/2" | 3-1/2" x 7-1/2" |
| Voltage (V) | 12 | 12 |
| Amps (A) | 16.5 | 16.5 |
| **General processor setup** | | |
| Number of processor packages | 2 | 2 |
| Number of cores per processor package | 6 | 6 |
| Number of hardware threads per core | 12 | 12 |
| System power management policy | Balanced | Balanced |
| **CPU** | | |
| Vendor | Intel | Intel |
| Name | Xeon E5-2640 | Xeon E5-2640 |
| Stepping | C2 | C2 |
| Socket type | LGA2011 | LGA2011 |
| Core frequency (GHz) | 2.50 | 2.50 |
| L1 cache | 32 KB + 32 KB (per core) | 32 KB + 32 KB (per core) |
| L2 cache | 256 KB (per core) | 256 KB (per core) |
| L3 cache | 15 MB (shared) | 15 MB (shared) |
| **Platform** | | |
| Vendor and model number | HP ProLiant BL460c Gen8 Blade | HP ProLiant BL460c Gen8 Blade |
| Motherboard model number | ProLiant BL460c GEN8 | ProLiant BL460c GEN8 |
| Motherboard revision number | 07 | 07 |
| BIOS name and version | HP I31 02/21/2012 | HP I31 02/21/2012 |
| BIOS settings | Default | Default |
| **Memory modules** | | |
| Total RAM in system (GB) | 64 | 32 |
| Vendor and model number | Samsung M393B1K70BH1-CH9 | Hynix HMT31GR7BFR4A-H9 |
| Type | PC3-10600R | PC3L-10600R |
| Speed (MHz) | 1,333 | 1,333 |
| Speed in the system currently running @ (MHz) | 1,333 | 1,333 |
| Timing/latency (tCL-tRCD-iRP-tRASmin) | 9-9-9-24 | 9-9-9-36 |
| Size (GB) | 8 | 8 |
| Number of RAM modules | 8 | 4 |
| Chip organization | Double-sided | Double-sided |
| **Hard disk** | | |
| Vendor and Model Number | HP EH0146FARWD | HP EH0146FARWD |
| Number of disks in the system | 2 | 2 |

| Servers | HP ProLiant BL460c Gen8 (Application blade) | HP ProLiant BL460c Gen8 (Partner blade) |
|---|---|---|
| Size (GB) | 146 | 146 |
| Buffer size (MB) | 16 | 16 |
| RPM | 15,000 | 15,000 |
| Type | SAS | SAS |
| **Operating system** | | |
| Name | Windows Server 2008 R2 Enterprise SP1 | ESXi 5.0.0 |
| Build number | 7601 | 474610 |
| File system | NTFS | Ext3 |
| Language | English | English |
| **Network card/subsystem** | | |
| Type | Flex Module | Flex Module |
| Vendor and model number | HP FlexFabric 10 Gb dual port 554M Adapter | HP FlexFabric 10 Gb dual port 554M Adapter |

**Figure 13. Detailed configuration information for the HP ProLiant BL460c Gen8blades we used in our tests.**

# APPENDIX B – TEST STORAGE INFORMATION

Figures 14 and 15 provide detailed information for the test storage. We used two of each of the storage arrays for each test configuration.

| Storage array | Dell EqualLogic PS-M4110 |
|---|---|
| Number of storage controllers per array | 2 |
| RAID level | 50 |
| Number of drives per array | 14 (10 active data drives, 2 parity, 2 spares) |
| Drive vendor and model number | Dell MK3001GRRB |
| Drive size (GB) | 300 |
| Drive buffer size (MB) | 32 |
| Drive RPM | 15,000 |
| Drive type | 6Gb SAS |

Figure 14. Detailed configuration information for the two Dell EqualLogic PS-M4110 storage arrays.

| Storage array | HP StorageWorks D2200sb |
|---|---|
| Number of storage controllers per array | 1 |
| RAID level | Disk RAID 5; Network RAID 10 |
| Number of drives per array | 12 (10 active data drives, 1 parity, 1 spare) |
| Drive vendor and model number | HP EH300FBQDD |
| Drive size (GB) | 300 |
| Drive buffer size (MB) | 64 |
| Drive RPM | 15,000 |
| Drive type | 6Gb SAS |

Figure 15. Detailed configuration information for the two HP StorageWorks D2200sb storage arrays.

# APPENDIX C – STORAGE CONFIGURATION FOR PERFORMANCE TESTING

We followed the configuration steps for each of the storage solutions as outlined in Appendix E. For our testing, we placed the Failover Manager (FOM) for the HP D2200sb + VSA solution directly on one of the two nodes to establish quorum without affecting power utilization. In a real-world environment, you should deploy the FOM onto another server connected to the iSCSI network to ensure that it remains active in the event that one of the VSA nodes loses connectivity or goes offline. For each solution, we configured the storage with the volumes listed below.

- Exchange Data 1 – 150GB
- Exchange Data 2 – 150GB
- Exchange Data 3 – 150GB
- Exchange Data 4– 150GB
- Exchange Log 1– 10GB
- Exchange Log 2– 10GB
- Exchange Log 3– 10GB
- Exchange Log 4– 10GB
- Exchange Backup – 500GB
- SQL Data 1 – 100GB
- SQL Data 2 – 100GB
- SQL Data 3 – 100GB
- SQL Data 4 – 100GB
- SQL Logs – 100GB
- SQL Backup – 200GB
- SharePoint Data – 200GB
- SharePoint Backup – 200GB

# APPENDIX D – SERVER CONFIGURATION FOR PERFORMANCE TESTING

For performance testing, we configured each of the three blade servers in each solution to run one of the applications (SQL Server, Exchange Server, and SharePoint Server) with the data for each application on the respective blade storage solution.  For our benchmark test clients and domain controller, we configured virtual machines on a separate server, ensuring that each virtual machine had ample hardware resources. We also configured the client VM host servers with 10G network adapters to connect to the 10G switches in each solution. See Figure 1 for a detailed diagram showing our network configurations. For each solution, we had a single domain controller VM, a DVD store client VM, a WSSDW client VM, and ten LoadGen client VMs distributing the user workload evenly.

## Installing the operating system on the application blade servers

1. Insert the installation DVD for Windows Server 2008 R2 SP1 Enterprise into the DVD drive.
2. At the Language Selection Screen, click Next.
1. Click Install Now.
2. Select Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
3. Click the I accept the license terms checkbox, and click Next.
4. Click Custom.
5. Click Next.
6. At the User's password must be changed before logging on warning screen, click OK.
7. Enter the desired password for the administrator in both fields, and click the arrow to continue.
8. At the Your password has been changed screen, click OK.
9. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
10. Enable remote desktop access.
11. Change the hostname and reboot when prompted.
12. Set up networking:
    a. Click Start→Control Panel, right-click Network Connections, and choose Open.
    b. Right-click the NIC assigned to the private network, and choose Properties.
    c. Select TCP/IP (v4), and choose Properties.
    d. Set the IP address, subnet, gateway, and DNS server for the virtual NIC, which will handle outgoing server traffic. Click OK, and click Close.
    e. Repeat steps b-d for the iSCSI NIC and apply the appropriate IP address.
13. After creating and configuring the storage volumes on the storage level and in iSCSI initiator:
    a. Click the Server Manager icon in the taskbar.
    b. In the left pane, expand Storage, and click Disk Management.
    c. Right-click the first volume, and choose Initialize Disk.
    d. In the right pane, right-click the volume and choose New Simple Volume…
    e. At the Welcome screen, click Next.
    f. At the Specify Volume Size screen, leave the default selection, and click Next.
    g. At the Assign Drive Letter or Path screen, choose a drive letter, and click Next.
    h. At the Format Partition screen, leave the defaults and click Next.
    i. At the Completing the New Simple Volume Wizard screen, click Finish.
    j. Repeat steps c through i for the remaining volumes.

## Configuring the first application server for SQL 2012

### Installing Microsoft SQL Server 2012

1. Insert the installation DVD.

---

2. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2012 DVD, and double-click.
3. If the installer prompts you with a .NET installation prompt, click Yes to enable the .NET Framework Core role.
4. In the left pane, click Installation.
5. Click New SQL Server stand-alone installation or add features to an existing installation.
6. At the Setup Support Rules screen, wait for the rule check to complete. If there are no failures or relevant warnings, click OK.
7. Select the Specify a free edition and select Evaluation from the drop-down menu. Click Next.
8. Click the checkbox to accept the license terms, and click Next.
9. If no failures are displayed after the setup support files are installed, click Next.
10. At the Setup Role screen, choose SQL Server Feature Installation.
11. 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.
12. At the Installation Rules screen, click Next once the check completes.
13. At the Instance configuration screen, leave the default selection of default instance, and click Next.
14. At the Disk Space Requirements screen, click Next.
15. At the Server Configuration screen, check that NT Service\SQLSERVERAGENT  is selected for SQL Server Agent, and that NT Service\MSSQLSERVER is selected for SQL Server Database Engine. Click Next.
16. Assuming no failures are displayed, click Next.
17. At the Database Engine Configuration screen, select 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 Next.
21. At the Error and usage reporting screen, click Next.
22. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
23. At the Ready to Install screen, click Install.
24. After installation completes, click Close.
25. Close the installation window.

# Configuring the second application server for Exchange

## Installing .NET Framework 3.5.1 Features and Internet Information Services

1. Select Start→Administrative Tools→Server Manager.
2. Click Features.
3. Click Add Features.
4. Select .NET Framework 3.5.1 Features
5. Click Add Required Role Services.
6. Click Next.
7. Click Next.
8. At the Select Role Services screen, select the IIS 6 Metabase Compatibility, IIS 6 Management Console, Basic Authentication, Windows Authentication, Digest Authentication, Static content compression, and Dynamic content Compression checkboxes, and click Next.
9. At the Confirm Installation Selections screen, click Install.
10. At the Installation Results screen, click Close.

## Installing Microsoft Filter Pack 2.0

1. Download the Microsoft Filter Pack 2.0. (http://www.microsoft.com/downloads/en/details.aspx?FamilyID=5cd4dcd7-d3e6-4970-875e-aba93459fbee)

2. Run FilterPackx64.EXE.
3. Click Next.
4. Click I accept the terms in the License Agreement, and click Next.
5. When the installation is complete, click OK.

## Installing Exchange Server 2010

1. Click Start, type `services` and press Enter.
2. Right-click the Net.Tcp Port Sharing service, and click Properties.
3. Change the Net.Tcp Port Sharing startup type to Automatic, and click OK.
4. Open command prompt and type `ServerManagerCmd –i RSAT–ADDS`, and press Enter.
5. Reboot the server.
6. Insert the installation DVD and click Setup.EXE when prompted.
7. The installer should consider steps 1 and 2 complete, and gray them out.
8. Click the link for Step 3: Choose Exchange Language Option.
9. Click Install only languages from the DVD.
10. Click the link for Step 4: Install Microsoft Exchange Server 2010 SP1.
11. Click Next to go past the introduction screen.
12. Accept the license agreement, and click Next.
13. Select No for error reporting, and click Next.
14. Select Typical Exchange Server Installation, and click Next.
15. Leave the organization name at default (First Organization), and click Next.
16. At the question about client computers running Outlook 2003 and earlier, select Yes, and click Next.
17. Click Next to accept defaults for Configure Client Access server external domain.
18. At the Customer Experience Improvement Program screen, select I don't want to join the program at this time, and click Next.
19. If a warning about a lack of SMTP appears after the check finishes, ignore it.
20. Click Install to start the installation process.
21. Once installation is complete, click Finish.
22. Click OK when prompted to reboot.
23. Click Close.
24. Click Yes to confirm exit.
25. Reboot the server.

## Installing SP2 for Microsoft Exchange 2010

1. Download Service Pack 2 for Microsoft Exchange 2010 (Exchange2010-SP2-x64.exe) from http://www.microsoft.com/download/en/details.aspx?id=28190 to c:\SP2.
2. Double-click the downloaded file to extract the installation files.
3. Click OK to accept the destination directory for the extracted files.
4. Double-click setup.exe to launch the installer.
5. Click Install Microsoft Exchange Server upgrade.
6. At the Introduction screen, click Next.
7. Accept the terms in the license agreement, and click Next. The Readiness Checks will now run.
8. Install any roles in Server Manager that the Readiness Checks prompt you to install.
9. When the checks successfully complete, click Upgrade.
10. Click Finish, and reboot.

## Server 2010 roles

1. Select Start→All Programs→Microsoft Exchange Server 2010→Exchange Management Console.
2. In the left pane, click Microsoft Exchange On-Premises.

3. In the left pane, expand Organization Configuration, and select Hub Transport.
4. In the action pane on the far right, select New Send Connector.
5. Name the send connector `SMTP`, select the intended use as Internet, and click Next.
6. In the Address space screen, click Add.
7. In the SMTP Address Space screen, type * as the address, ensure that the installer has checked Include all subdomains, and click OK.
8. Click Next.
9. Accept defaults for the next two pages by clicking Next.
10. At the New Connector page, click New to create the connector.
11. Click Finish to close the New SMTP Send Connector wizard.

### Configuring the Exchange Server 2010 Mailbox role

Before completing this section, create an additional three mailbox databases so that you have four total, and complete these steps on each mailbox database.

1. Select Start→All Programs→Microsoft Exchange Server 2010→Exchange Management Console.
2. In the left pane, expand Organization Configuration, and click Mailbox.
3. Click the Database Management tab.
4. Right-click Mailbox Database, and select Properties.
5. Select the Maintenance tab.
6. Check the Enable circular logging box.
7. Check the box beside This database can be overwritten by a restore.
8. Next to Maintenance interval, click Customize.
9. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
10. Click OK.
11. Click OK to any warnings about circular logging being applied after the database is remounted.
12. On the far right panel, click Move Databases.
13. Change the Database file and Log folder path locations to E:\Database\(filename) and F:\Maillogs respectively, and click Move.
14. If the application prompts you to dismount, click Yes.
15. Click Finish.
16. Right-click Public Folder Database, and select Properties.
17. Check the Enable circular logging checkbox and uncheck the ESE scanning checkbox.
18.
19. Click Customize next to Maintenance interval.
20. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
21. Click OK.
22. On any warnings about circular logging being applied after the database is remounted, click OK.
23. Click Move Database on the far right panel.
24. Change the Database file and Log folder path locations to E:\Database\(filename) and F:\Publiclogs respectively, and click Move.
25. If the application prompts you to dismount, click Yes.
26. Click Finish.

## Configuring the third application server for SharePoint

We installed a separate instance of SQL Server 2012 for our SharePoint databases. This prevented creating an unnecessary bottleneck by having WSSDW and DVD Store running against the same instance of SQL on the same application server.

### Installing Microsoft SQL Server 2012

1. Insert the installation DVD.
2. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2012 DVD, and double-click.
3. If the installer prompts you with a .NET installation prompt, click Yes to enable the .NET Framework Core role.
4. In the left pane, click Installation.
5. Click New SQL Server stand-alone installation or add features to an existing installation.
6. At the Setup Support Rules screen, wait for the rule check to complete. If there are no failures or relevant warnings, click OK.
7. Select the Specify a free edition and select Evaluation from the drop-down menu. Click Next.
8. Click the checkbox to accept the license terms, and click Next.
9. If no failures are displayed after the setup support files are installed, click Next.
10. At the Setup Role screen, choose SQL Server Feature Installation.
11. 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.
12. At the Installation Rules screen, click Next after the check completes.
13. At the Instance configuration screen, leave the default selection of default instance, and click Next.
14. At the Disk Space Requirements screen, click Next.
15. At the Server Configuration screen, check that NT Service\SQLSERVERAGENT is selected for SQL Server Agent, and that NT Service\MSSQLSERVER is selected for SQL Server Database Engine. Click Next.
16. Assuming there are no failures, click Next.
17. At the Database Engine Configuration screen, select 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 and enter the appropriate drive and folder to which you eventually deploy the SharePoint databases.
21. Click Next.
22. At the Error and usage reporting screen, click Next.
23. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
24. At the Ready to Install screen, click Install.
25. After installation completes, click Close.
26. Close the installation window.

## Installing Microsoft SharePoint Server 2010

1. Insert the installation DVD.
2. Launch setup.exe, and click Install software prerequisites.
3. Review the list of software, and click Next.
4. Accept the EULA, and click Next.
5. When the prerequisites finish installing, click Finish.
6. On the main SharePoint installation menu, click Install SharePoint Server.
7. Enter your product license key, and click Continue.
8. Accept the EULA, and click Continue.
9. Choose the Complete server type, and click Install.
10. When the installation finishes, check the box for Run the SharePoint Products Configuration Wizard now, and click Close.
11. On the Welcome to SharePoint Products screen, click Next.
12. On the pop-up warning about services that will need to be restarted during the configuration, click Yes.

13. Choose Create a new server farm, and click Next.
14. Enter the name of your existing database instance on the same application server.
15. Specify a username and password, and click Next.
16. Enter a passphrase into the Passphrase and Confirm Passphrase fields, and click Next.
17. Leave the default settings on the Configure SharePoint Central Administration Web Application screen, and click Next.
18. Verify your settings, and click Next.
19. When the wizard has completed the configuration, click Finish.
20. Choose Run the farm configuration wizard on the Central Administration site.
21. Choose the services you wish to include in your server farm, and click Next.
22. Enter the specifications for the new site, and click OK.
23. Click Finish.

## Configuring the database (DVD Store)

### Data generation overview

We generated the data using the Install.pl script included with DVD Store version 2.1 (DS2), providing the parameters for our 100GB database size and the database platform on which we ran: Microsoft SQL Server. We ran the Install.pl script on a utility system running Linux. The database schema was also generated by the Install.pl script.

After processing the data generation, we transferred the data files and schema creation files to a Windows-based system running SQL Server 2008 R2 SP1. We built the 100GB database in SQL Server 2008 R2, and then performed a full backup, storing the backup file on the C: drive for quick access. We used that backup file to restore to the servers between test runs. We performed this procedure once.

The only modification we made to the schema creation scripts were the specified file sizes for our database. We explicitly set the file sizes higher than necessary to ensure that no file-growth activity would affect the outputs of the test. Besides this file size modification, the database schema was created and loaded according to the DVD Store documentation. Specifically, we followed the steps below:

1. We generated the data and created the database and file structure using database creation scripts in the DS2 download. We made size modifications specific to our 100GB database and the appropriate changes to drive letters.
   a. We transferred the files from our Linux data generation system to a Windows system running SQL Server.
   b. We created database tables, stored procedures, and objects using the provided DVD Store scripts.
   c. We set the database recovery model to bulk-logged to prevent excess logging.
   d. We loaded the data we generated into the database. For data loading, we used the import wizard in SQL Server Management Studio. Where necessary, we retained options from the original scripts, such as Enable Identity Insert.
   e. We created indices, full-text catalogs, primary keys, and foreign keys using the database-creation scripts.
   f. We updated statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
   g. On the SQL Server instance, we created a ds2user SQL Server login using the following Transact SQL (TSQL) script:

```
USE [master]
GO
```

```
CREATE LOGIN [ds2user] WITH PASSWORD=N'',
        DEFAULT_DATABASE=[master],
        DEFAULT_LANGUAGE=[us_english],
        CHECK_EXPIRATION=OFF,
        CHECK_POLICY=OFF
GO
```

    h.  We set the database recovery model back to full.
    i.  We created the necessary full text index using SQL Server Management Studio.
    j.  We created a database user and mapped this user to the SQL Server login.
    k.  We then performed a full backup of the database. This backup allowed us to restore the databases to a pristine state relatively quickly between tests.

## Running the DVD Store tests

We created a series of batch files, SQL scripts, and shell scripts to automate the complete test cycle. DVD Store outputs an orders-per-minute metric, which is a running average calculated through the test. In this report, we report the last OPM result reported by each client/target pair.

Each complete test cycle consisted of the general steps listed below. For each scenario, we ran three test cycles, and reported the median outcome.

1. Clean up prior outputs from the server and all client driver systems.
2. Drop all databases from the test servers.
3. Restore all databases on all test servers.
4. Reboot the server and all client systems.
5. Let the test server idle until the power utilization settled.
6. Start the DVD Store driver on all respective clients.
   We used the following DVD Store parameters for testing the servers in this study:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 –
warmup_time=10 --run_time=30 --n_threads=20 --db_size=100GB --
think_time=0.12 (Dell) or 0.18 (HP)
```

# Installing and configuring the Exchange 2010 mail test clients (LoadGen)

For our testing, we used 10 virtual client machines to distribute the LoadGen workload evenly for each of the solutions. To create the mail clients, we installed several software components. First, we made sure to statically assign an IP address for each client. We followed this process for each installation:

## Installing Windows Server 2008 R2 SP1 Enterprise Edition

1. Insert the installation DVD for Windows Server 2008 R2 SP1 Enterprise into the DVD drive.
2. At the Language Selection Screen, click Next.
3. Click Install Now.
4. Select Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
5. Click the I accept the license terms checkbox, and click Next.
6. Click Custom.
7. Click Next.
8. At the User's password must be changed before logging on warning screen, click OK.
9. Enter the desired password for the administrator in both fields, and click the arrow to continue.

10. At the Your password has been changed screen, click OK.
11. Click Start, type `change power-saving settings` and press Enter.
12. Click Change plan settings.
13. Change the Turn off the display drop-down menu to Never.
14. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization screens.

To set up this server, we had to install several additional software components. The following subsections detail the necessary installation processes.

## Joining the domain

1. Select Start→Control Panel→Network Connections→Local Area Connection.
2. Click Properties.
3. Highlight Internet Protocol (TCP/IP), and click Properties.
4. Select the Use the following DNS server addresses radio button, and enter the IP of the DNS server in the Preferred DNS server field. Click OK.
5. Right-click My Computer, and select Properties.
6. Under the Computer Name tab, click Change.
7. In the Computer Name Changes screen, under the Member of section, select the Domain radial box, and type `test.local`
8. Select OK to start joining the domain.
9. When the screen appears asking for a person qualified on the domain, type `Tester` as the username and `Password1` as the password.
10. At the Welcome pop-up window and the window warning that you must reset the computer for the changes to take effect, click OK.
11. At the System Properties screen, click OK.
12. When a pop-up appears asking if you want to restart now, click Yes to restart your computer.

## Installing Internet Information Services

1. Click Start→Administrative Tools→Server Manager.
1. On the left pane, click Roles.
2. Click Add Roles.
3. Click the Application Server checkbox.
4. When the Add features required for Application Server? screen appears, click Add Required Features.
5. Click Next.
6. Click Next.
7. At the Select Role Services page for Application Server, click the Web Server (IIS) Support checkbox.
8. Click Add Required Support Role Services.
9. Click Next.
10. Click Next.
11. At the Select Role Services page for Web Server (IIS), click IIS 6 Management Compatibility, ASP, and CGI checkboxes; and click Next.
12. Click Install.
13. Click Close.

## Installing Load Generator

Download and install Load Generator using all defaults.

## Preparing Load Generator

1. Log into the mail client using the tester account.

2. Select Start→All Programs→Microsoft Exchange→Exchange Load Generator 2010.
3. When the Load Generator screen appears, select Start a new test.
4. Select Create a new test configuration, and click Continue.
5. Change the total length of simulation to 1 hour and 15 minutes.
6. In the Specify test settings screen, type `Password1` as the Directory Access Password and Mailbox Account Master Password, and click Continue with recipient management.
7. Make 250 users per mailbox (1,000 total) for the HP or 375 users per mailbox (1,500 total) for the Dell in the Mailbox Database, and click Continue.
8. To accept defaults for Advanced recipient settings, click Continue.
9. In the Specify test user groups screen, select the plus sign to add a user group.
10. Change the Client Type to Outlook_500, the Action Profile to Average, and the Mailbox size to 250 MB.
11. Check the PreTestLogon checkbox, and click Continue.
12. In Remote configurations, enter the computer names of all of the test clients, check the checkbox to enable distributing the workload, and click Continue.
13. Click Save the configuration file as, and name it `testcfg.xml`
14. After saving the configuration file, check the Initialize public store as well checkbox, and click Start the initialization phase (recommended before running the test).

## Backing up the mail databases

On the Exchange server virtual machine, once we set up the LoadGen client and created its initial mail database, we backed up the databases so we can have clean copies for each test.

1. Select Start→All Programs→Microsoft Exchange Server 2010→Exchange Management Console in the mail server.
2. In the left pane, expand Organization Configuration and Mailbox.
3. In the right pane, right-click each of the four Mailbox Databases, and select Dismount Database from the menu.
4. At the Do you want to continue? pop-up message, click Yes.
5. Right-click Public Folder Database, and select Dismount Database from the menu.
6. At the Do you want to continue? pop-up message, click Yes. The red arrow appears when you have dismounted the Public Folder Store.
7. Using Windows Explorer, create a new folder: `E:\backup\`
8. With Windows Explorer, copy all database and public folder files from E:\Database to E:\backup. This process may take several minutes.
9. Close Windows Explorer.
10. In the Exchange Management Console, right-click each of the four Mailbox Databases, and select Mount Database from the menu.
11. Right-click the Public Folder Database, and select Mount Database from the menu.
12. Close the Exchange Management Console.

## Preparing the SharePoint test client

Install Windows Server 2008 SP1 with current updates.

### Installing Microsoft Visual Studio 2010 Ultimate Edition

1. Download vs_ultimateweb.exe from [www.microsoft.com/download/en/details.aspx?id=12752](www.microsoft.com/download/en/details.aspx?id=12752)
2. Double-click vs_ultimateweb.exe to run the installer.
3. Uncheck the box beside Yes, send information about my computer, and click Next.
4. If you see a pop-up requiring a Windows Imaging component, click the Windows Imaging Component is Required link.
5. Click Download on the appropriate Imaging component, and choose Run.
6. Accept the EULA, and click Next.

---

7. Close the pop-up window.
8. Click Next.
9. Accept the EULA, review the components to be installed, and click Next.
10. Choose the Full installation and location for the install, and click Install.
11. Click Finish.
12. Reboot the machine.
13. Click Start→All Programs→Microsoft Visual Studio 2010→Microsoft Visual Studio 2010.
14. When prompted, select General Development Settings and click Start Visual Studio.

## Setting up and running WSSDW 1.0.0.0 Beta

1. Complete the following steps on the Domain Controller machine:
   a. Click Start→Administrative Tools→Active Directory Users and Computers.
   b. Right-click the domain name and select New→Group.
   c. Enter `testdomaingroup1` for the group name.
   d. Repeat steps a through c and create another group named `testdomaingroup2`
2. Download the following from http://sptdatapop.codeplex.com/releases/view/1141
   - To the SharePoint 2010 VM
     o WSS Data Population Tool RunTime.zip
     o WSS Data Population Tool.chm
     o WSS Data Population Tool Sample.zip
   - To the SharePoint 2010 test client
     o WSS Performance Load Tests
3. Complete the following steps on the SharePoint 2010 VM:
   a. Extract the contents of WSS Data Population Tool RunTime.zip and WSS Data Population Tool Sample.zip.
   b. Copy the contents of both extracted .zip folders (WSS Data Population Tool Run Time and WSS Data Population Tool Sample) into the root of C:
4. Download SharePtServerDeployment.doc from http://www.microsoft.com/en-us/download/details.aspx?id=10009 and place it into the c:\wssdw folder.
   a. Rename WSS Data Population Sample File.xml to `WSS_Data_Population_Sample_File.xml` so that there are no spaces in the name. This allows the script to execute from the command prompt.
   b. Right-click WSS_Data_Population_Sample_File.xml and click Edit to open the document in Notepad. Scroll down to line 55 and remove ".txt" from the document name in the destfile parameter. Then, change any applicable parameters to match the following:

```
<setproperty NumberOfSiteCollections="100" />
<setproperty SiteNameBase="testsite" />
<setproperty NumberOfGroups="2" />
<setproperty GroupNameBase="testgroup" />
<setproperty TargetDomain="test.local" />
<setproperty DomainGroupRoot="testdomaingroup" />
<setproperty DomainUserName="administrator" />
<setproperty DomainUserPassword="Password1" />
<setproperty DesignerGroup="design" AdminGroup="full control" />
<setproperty NumberOfDocumentLibraries="10" />
<setproperty DocumentLibraryNameBase1="testdoclib_A" />
<setproperty NumberOfDocuments="10" />
<setproperty SourceFileLocation="c:\wssdw\SharePtServerDeployment.doc"
/>
```

```
<setproperty DestFile="test.doc" />
<setproperty NumberOfFileVersions="3" />
<setproperty DocumentLibraryNameBase2="testdoclib_B" />
<setproperty NumberOfLists="10" />
<setproperty ListNameBase="testlist" />
<setproperty NumberOfListItems="20" />
<setproperty webpartpath="webpartpagesfolder" />
```

    c.   Open the command prompt and execute the script:

```
C:\>WSSDW.exe WSS_Data_Population_Sample_File.xml
```

5. Complete the following steps on the SharePoint 2010 test client:
   a. Extract the contents of WSS Performance Load Test to C: drive on the SharePoint test client.
   b. On the SharePoint test client, open the WSSTransactions folder, right-click→Edit, and modify the following files as follows:
      - users.csv
        Under `username,password` enter `test.local\administrator,Password1` and remove the remaining entries.
      - serverUrl.csv
        Under `serverUrl` replace `http://server` with `http://spserver` to match the server name of the SharePoint 2010 VM.
      - HierarchyManagerUsers.csv
        Under `username,password` replace domain`\username,password` with `test.local\administrator,Password1`
   c. Open the WssTestProject.sln file in Visual Studio 2010 Ultimate.
   d. When prompted, click Next.
   e. Click Finish.
   f. When prompted, leave the Retarget the project to .NET Framework 4. After the project opens, you can retarget it to another Framework or Profile radio button selected, and click OK.
   g. Click Close.
   h. In the Solution Explorer pane, scroll to WSSDispForm, and double-click it.
   i. Expand the top menu under WSSDispForm in the left pane, expand Validation rules, and delete the FindText entry that references mysite.aspx.
   j. Click Save.
   k. Repeat steps h through j for WSSHomePage and WSSSmallDocLibAllItems.
   l. Click Project→Add Load Test.
   m. At the Welcome to the Create New Load Test Wizard, click Next.
   n. Enter `Test` for the load test scenario name, change the think time between test iterations to 45 seconds, and click Next.
   o. At the Load pattern settings for a load test scenario screen, select Constant load, enter 125 for the User Count, and click Next.
   p. Click Next at the Select a test mix model for the load test.
   q. At the Add test to a load test scenario and edit the test mix, click Add and select the following tests from the list below. Additionally, modify the distribution as follows:
      - WSSDispForm 10%
      - WSSDocHTTPFetch 30%
      - WSSHomePage 20%WSSSmallDocLibAllItems 30%

- WSSPutDocumentCoded 10%
   r. Click OK.
   s. At the Network types screen, select LAN, and click Next.
   t. At the Browser screen, click Next.
   u. At the Specify computers to monitor with counters sets during load test run screen, click Next.
   v. At the Review and edit run settings for load test screen, enter 15 minutes for the Warm-up duration, enter 30 minutes for Run duration, 15 minutes for the Cool down duration, and click Finish.
6. To ensure that the WSSDW workload evenly selecta different SharePoint sites at random, create .csv lists of a number of categories within each test and addthe following parameters to each:
   - WSSD WSSDispForm: Site name, list name, and list IDs.
   - WSSDocHTTPFetch: Site name, doc revision, document library name, and document name.
   - WSSHomePage: Site name
   - WSSSmallDocLibAllItems: Site name, and document library name
   - WSSPutDocumentCoded: Site name
7. Add the following lines of code to  the WSSPutDocumentCoded test:

```
    [DeploymentItem("officeservertransactions\\siteNames.csv",
"officeservertransactions")]

    [DataSource("Sites", "Microsoft.VisualStudio.TestTools.DataSource.CSV",
    "|DataDirectory|\\officeservertransactions\\siteNames.csv",
    Microsoft.VisualStudio.TestTools.WebTesting.DataBindingAccessMethod.Random,
    Microsoft.VisualStudio.TestTools.WebTesting.DataBindingSelectColumns.SelectO
    nlyBoundColumns, "siteNames#csv")]

    [DataBinding("Sites", "siteNames#csv", "siteName",
"Sites.siteNames#csv.siteName")]
```

At the "WebTestRequest request1" line, add:

```
    + this.Context["Sites.siteNames#csv.siteName"].ToString() +
```

## Running the test

To run the test, we staggered the workload, allowing each benchmark time to warm up prior to measuring the performance and latency on each of the solutions.

1. Begin running the LoadGen benchmark. LoadGen is set to run for 1 hour and 15 minutes, with a 15-minute allotted warm-up period, 30-minute time of recorded latency, and 15-minute cool-down period.
2. Immediately after beginning the LoadGen benchmark, start the WSSDW workload. This workload is set to run for 1 hour and 15 minutes, with a 15-minute warm up period, 30-minute run period, and 15-minute cool-down period.
3. Five minutes after LoadGen and WSSDW begin, start the DVD Store benchmark. DVD Store is set to warm up for 10 minutes, and then run for 30 minutes of recorded performance to coincide with LoadGen.

# APPENDIX E – CONFIGURATION COMPARISON

| Dell EqualLogic PS-M4110 solution | HP D2200sb + VSA solution |
|---|---|
| 1. Log into the Dell M1000e CMC Web interface using a Web browser.<br>2. Insert the two storage arrays into the chassis and allow them to power on automatically.<br><br>**Configuring the storage array blades**<br>1. At the Server Overview screen in the CMC Web interface, select the corresponding slot for the first storage blade.<br>2. At the Storage Array Status screen, click Configure Array.<br>3. At the Configure Array screen, enter a member name, IP information, and create a new group by entering a group name, IP address, and administrator credentials. Also, select the appropriate network fabric (Fabric B in our case), and click Apply.<br>4. At the Message from webpage popup, click OK.<br>5. Select the corresponding slot for the second storage blade in the Server Overview screen in the CMC Web interface.<br>6. At the Storage Array Status screen, click Configure Array.<br>7. At the Configure Array screen, enter a member name, IP information, and select the Use Existing Group box. Enter the appropriate credentials from step 3, select the appropriate network fabric (Fabric B), and click apply.<br>8. At the Message from webpage popup, click OK.<br><br>**Configuring the array RAID**<br>1. Enter the EqualLogic storage group IP address into a Web browser and use the administrator credentials to log in to the EqualLogic Group Manager.<br>2. Select the storage group, and expand the members (arrays) in the left pane.<br>3. Select the first member (array), which will show as | 1. Install the first storage blade in an even-numbered bay.<br>2. Install the first partner blade in the adjacent odd-numbered bay.<br>3. Install the second storage blade in another even-numbered bay.<br>4. Install the second partner blade in the adjacent odd-numbered bay.<br><br>**Creating the RAID groups**<br>1. Connect a keyboard, monitor, mouse, and DVD ROM using the adapter, and press the power button on the first partner blade.<br>2. When prompted, press F5 to access the Array Configuration Utility.<br>3. At the Array Configuration Utility menu, under the Configuration tab, select the HP Smart Array P220i from the drop-down menu.<br>4. Select the RAID controller under Systems and Devices, and click Create Array in the right pane.<br>5. Select both physical drives, and click OK.<br>6. Select the array under Systems and Devices, and click Create Logical Drive.<br>7. Select RAID 1 under Fault Tolerance, leave the other settings at default, and click Save.<br>8. Change to the HP Smart Array P410i in the drop-down menu.<br>9. Select the RAID controller under Systems and Devices, and click Create Array in the right pane.<br>10. Select the first 11 physical drives, and click OK.<br>11. Select the array under Systems and Devices, and click Create Logical Drive.<br>12. Select RAID 5 under Fault Tolerance, leave the other settings at default, and click Save.<br>13. Select the logical drive under Systems and Devices, and click Spare Management.<br>14. Select the remaining physical drive, and click Save.<br>15. Click Exit ACU. |

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| unconfigured, and click Yes to configure the RAID. | 16. Click the Power icon at the upper right, and click Reboot. |
| 4. At the General Settings screen, leave the default name and storage pool assignment, and click Next. | 17. Connect a keyboard, monitor, mouse, and DVD ROM using the adapter, and press the power button on the second partner blade. |
| 5. At the RAID configuration screen, select RAID 50, and click Next. | 18. When prompted, press F5 to access the Array Configuration Utility. |
| 6. At the Summary screen, click Finish. | 19. At the Array Configuration Utility menu, under the Configuration tab, select the HP Smart Array P220i from the drop-down menu. |
| 7. Select the second member (array), which will show as unconfigured, and click Yes to configure the RAID. | 20. Select the RAID controller under Systems and Devices, and click Create Array in the right pane. |
| 8. At the General Settings screen, leave the default name and storage pool assignment, and click Next. | 21. Select both physical drives, and click OK. |
| 9. At the RAID configuration screen, select RAID 50, and click Next. | 22. Select the array under Systems and Devices, and click Create Logical Drive. |
| 10. At the Summary screen, click Finish. | 23. Select RAID 1 under Fault Tolerance, leave the other settings at default, and click Save. |
| **Creating a volume** | 24. Change to the HP Smart Array P410i in the drop-down menu. |
| 1. In the left pane, click Volumes, and, in the adjacent pane, click Create volume. | 25. Select the RAID controller under Systems and Devices, and click Create Array in the right pane. |
| 2. Name the first volume, and click Next. | 26. Select the first 11 physical drives, and click OK. |
| 3. Enter the appropriate volume size, and click Next. | 27. Select the array under Systems and Devices, and click Create Logical Drive. |
| 4. On the Step 3 – iSCSI Access screen, check the Limit access to iSCSI initiator name checkbox, and enter the appropriate iSCSI initiator name. | 28. Select RAID 5 under Fault Tolerance, leave the other settings at default, and click Save. |
| 5. Click Finish. | 29. Select the logical drive under Systems and Devices, and click Spare Management. |
| **Installing Dell EqualLogic Host Integration Tools** | 30. Select the remaining physical drive, and click Save. |
| 1. Insert the disk, and click Setup64.exe. | 31. Click Exit ACU. |
| 2. At the Welcome screen, click Next. | 32. Click the Power icon at the upper right, and click Reboot. |
| 3. At the License Agreement screen, click Next. | *Installing ESXi* |
| 4. At the Installation Type screen, select Typical (Requires reboot on Windows Server platforms), and click Next. | 1. Attach an external DVD drive to the first partner blade, insert your ESXi 5.0 installation media, and reboot the blade. |
| 5. In the Microsoft iSCSI Initiator service is not running pop-up, click Yes to start the service and enable iSCSI traffic through the firewall. | 2. Select ESXi installer from the boot menu, and press Enter. Allow a few minutes to load. |
| 6. In the Microsoft iSCSI service pop-up, click Yes. | 3. At the Welcome screen, press Enter. |
| 7. When the iSCSI Initiator Properties window pops up, accept the defaults, and click OK. | |
| 8. If a Windows Firewall Detected pop-up appears, click Yes to enable echo requests. | |

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| 9. At the Ready to install the components screen, click Install.<br>10. In the Microsoft Multipath I/O feature is not detected pop-up, click Yes to install the feature.<br>11. At the Installation Complete screen, click Finish.<br>12. In the System Restart Required pop-up, select Yes, I want to restart my computer now, and click OK.<br><br>**Connecting to the volumes with Microsoft iSCSI Initiator**<br>1. Click Start→ Administrative Tools→iSCSI Initiator.<br>2. Select the Discovery Tab, and click Discover Portal.<br>3. Enter the IP address for the Dell EqualLogic Storage Group, and click OK.<br>4. Select the Targets tab, and click Refresh.<br>5. Select the first Inactive Target listed, and click Connect.<br>6. Ensure that Add this connection to the list of Favorite Targets is selected, check the Enable multi-path check box, and click OK. | 4. At the End User License Agreement (EULA) screen, press F11.<br>5. At the Select a Disk to install or Upgrade screen, select the two-disk RAID 1 volume you created to install ESXi on, and press Enter.<br>6. On the Please Select a Keyboard Layout screen, press Enter.<br>7. On the Enter a Root Password screen, assign a root password, and confirm it by entering it again. Press Enter to continue.<br>8. On the Confirm Install screen, press F11 to install.<br>9. On the Installation Complete screen, press Enter to reboot.<br>10. After the server reboots, press F2 to log in, and enter the appropriate credentials.<br>11. Highlight Configure Management Network, and press Enter.<br>12. Highlight IP Configuration, and press Enter.<br>13. Highlight Set static IP address and network configuration, press the space bar to select it, and enter the management IP address. Press Enter.<br>14. Highlight DNS Configuration, and press Enter.<br>15. Enter the applicable DNS server information and an appropriate hostname. Press Enter.<br>16. Press Esc and Y when prompted to restart the management network.<br>17. Press Esc to log out.<br>18. Attach an external DVD drive to the second partner blade, insert your ESXi 5.0 installation media, and reboot the blade.<br>19. Select ESXi installer from the boot menu, and press Enter. Allow a few minutes to load.<br>20. At the Welcome screen, press Enter.<br>21. At the End User License Agreement (EULA) screen, press F11.<br>22. At the Select a Disk to install or Upgrade screen, select the two-disk RAID 1 volume you created to install ESXi on, and press Enter.<br>23. On the Please Select a Keyboard Layout screen, press Enter. |

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| | 24. On the Enter a Root Password screen, assign a root password, and confirm it by entering it again. Press Enter to continue. |
| | 25. On the Confirm Install screen, press F11 to install. |
| | 26. On the Installation Complete screen, press Enter to reboot. |
| | 27. After the server reboots, press F2 to log in, and enter the appropriate credentials. |
| | 28. Highlight Configure Management Network, and press Enter. |
| | 29. Highlight IP Configuration, and press Enter. |
| | 30. Highlight Set static IP address and network configuration, press the space bar to select it, and enter the management IP address. Press Enter. |
| | 31. Highlight DNS Configuration, and press Enter. |
| | 32. Enter the applicable DNS server information and an appropriate hostname. Press Enter. |
| | 33. Press Esc and Y when prompted to restart the management network. |
| | 34. Press Esc to log out. |
| | ***Creating the ESXi datastore*** |
| | For these steps, you will need a system running vSphere client. |
| | 1. Log into the first partner blade running ESXi with vSphere client using the appropriate credentials. If prompted, select Install this certificate and do not display any security warnings for Host IP Address, and click Ignore. |
| | 2. Click Configuration tab→Storage→Add Storage. |
| | 3. Select the appropriave volume, and click Next. |
| | 4. Select VMFS-5, and click Next. |
| | 5. Review the disk layout, and click Next. |
| | 6. For Datastore name, type `VSA-1`, and click Next. |
| | 7. For Capacity, select Maximum available space, and click Next. |
| | 8. Click Finish to create the datastore. |
| | 9. Log into the second partner blade running ESXi with vSphere client using the appropriate credentials. If prompted, select Install this |

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| | certificate and do not display any security warnings for Host IP Address, and click Ignore. |
| | 10. Click Configuration tab→Storage→Add Storage. |
| | 11. Select the appropriate volume, and click Next. |
| | 12. Select VMFS-5, and click Next. |
| | 13. Review the disk layout, and click Next. |
| | 14. For Datastore name, type `VSA-1` and click Next. |
| | 15. For Capacity, select Maximum available space, and click Next. |
| | 16. Click Finish to create the datastore. |
| | |
| | ***Create the virtual networks*** |
| | Complete these steps on the first partner blade: |
| | 1. From vSphere Client, select the Configuration tab, and then select Networking. |
| | 2. Click Add Networking. |
| | 3. Select Virtual Machine for Connection Types, and click Next. |
| | 4. Deselect vmnic1 and select vmnic8 and vmnic9 (the two 10Gb Emulex adapters), and click Next. |
| | 5. Enter an appropriate Network Label, and click Next. |
| | 6. Click Finish. |
| | 7. Click Properties… |
| | 8. Under Ports, select the Virtual Machine Port Group, and click Edit… |
| | 9. Under Failover Order, check the Override switch failover order checkbox. |
| | 10. Select one of the active adapters and move it to be a Standby Adapter. |
| | 11. Click OK. |
| | 12. Click Close. |
| | |
| | Complete these steps on the second partner blade: |
| | 1. From vSphere Client, select the Configuration tab, and then select Networking |
| | 2. Click Add Networking |
| | 3. Select Virtual Machine for Connection Types, and click Next. |
| | 4. Deselect vmnic1 and select vmnic8 and vmnic9 |

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| | (the two 10Gb Emulex adapters), and click Next. |
| | 5. Enter an appropriate Network Label, and click Next. |
| | 6. Click Finish. |
| | 7. Click Properties… |
| | 8. Under Ports, select the Virtual Machine Port Group, and click Edit… |
| | 9. Under Failover Order, check the Override switch failover order checkbox. |
| | 10. Select one of the active adapters and move it to be a Standby Adapter. |
| | 11. Click OK. |
| | 12. Click Close. |
| | |
| | *Deploying the VSA VM* |
| | 1. Copy the HP P4000 VSA 9.5 software installer for ESX servers onto your management server. |
| | 2. Click autorun.exe |
| | 3. At the EULA screen, click Agree. |
| | 4. Click Install VSA for VMware ESX Server. |
| | 5. At the Winzip self-extractor screen, click Unzip. |
| | 6. Click OK. |
| | 7. At the command prompt, type 2 for the GUI wizard, and press Enter. |
| | 8. At the welcome screen, click Next. |
| | 9. Accept the EULA by checking the radio button, and click Next. |
| | 10. At the Install the Centralized Management Console screen, accept defaults, and click Next. |
| | 11. At the ESX host discovery screen, enter the IP address of the first ESX host and the appropriate login credentials, and click Next. |
| | 12. At the connect to ESX host screen, click Next. |
| | 13. At the Type of virtual appliance screen, leave Virtual SAN Appliance (VSA) selected, and click Next. |
| | 14. At the Select the datastore screen, select the RAID 1 partition to store the virtual appliance files, and click Next. |
| | 15. At the Network settings screen, enter the IP |

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| | address, subnet, and gateway information, and select the appropriate network interface. Click Next. |
| | 16. At the Configuration details screen, enter an appropriate virtual appliance name, and click Next. |
| | 17. At the Configuring Virtual SAN Appliance screen, check two VMDK location checkboxes, select the appropriate datastore that corresponds with the attached D2200sb, and enter the desired size of each VMDK. In our case, we used all available space. Click Next. |
| | 18. At the Configure and install another virtual appliance screen, select the No, I am done radio button, and click Next. |
| | 19. At the confirmation pop up, click Yes. |
| | 20. At the summary screen, click Deploy. |
| | 21. Click Finish when the deployment process completes. |
| | 22. Click Install VSA for VMware ESX Server. |
| | 23. At the Winzip self-extractor screen, click Unzip. |
| | 24. Click OK. |
| | 25. At the command prompt, type 2 for the GUI wizard, and press Enter. |
| | 26. At the welcome screen, click Next. |
| | 27. Accept the EULA by checking the radio button, and click Next. |
| | 28. At the ESX host discovery screen, enter the IP address of the second ESX host and the appropriate login credentials, and click Next. |
| | 29. At the connect to ESX host screen, click Next. |
| | 30. At the Type of virtual appliance screen, leave Virtual SAN Appliance (VSA) selected, and click Next. |
| | 31. At the Select the datastore screen, select the RAID 1 partition to store the virtual appliance files, and click Next. |
| | 32. At the Network settings screen, enter the IP address, subnet, and gateway information, and select the appropriate network interface. Click Next. |

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| | 33. At the Configuration details screen, enter an appropriate virtual appliance name, and click Next. |
| | 34. At the Configuring Virtual SAN Appliance screen, check two VMDK location checkboxes, select the appropriate datastore that corresponds with the attached D2200sb, and enter the desired size of each VMDK. In our case, we used all available space. Click Next. |
| | 35. At the Configure and install another virtual appliance screen, select the No, I am done radio button, and click Next. |
| | 36. At the confirmation pop-up, click Yes. |
| | 37. At the summary screen, click Deploy. |
| | 38. Click Finish when the deployment process completes. |
| | *Deploying the FOM* |
| | 1. Click Install VSA for VMware ESX Server. |
| | 2. At the Winzip self-extractor screen, click Unzip. |
| | 3. Click OK. |
| | 4. At the command prompt, type 2 for the GUI wizard, and press Enter. |
| | 5. At the welcome screen, click Next. |
| | 6. Accept the EULA by checking the radio button, and click Next. |
| | 7. At the ESX host discovery screen, enter the IP address of the ESX host you will use to deploy the FOM and the appropriate login credentials, and click Next. |
| | 8. At the connect to ESX host screen, click Next. |
| | 9. At the Type of virtual appliance screen, select Failover Manager (FOM), and click Next. |
| | 10. At the Select the datastore screen, select the appropriate datastore to store the virtual appliance files, and click Next. |
| | 11. At the Network settings screen, enter the IP address, subnet, and gateway information, and select the appropriate network interface. Click Next. |
| | 12. At the Configuration details screen, enter an |

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| | appropriate virtual appliance name, and click Next.<br>13. At the Configure and install another virtual appliance screen, select the No, I am done radio button, and click Next.<br>14. At the confirmation pop up, click Yes.<br>15. At the summary screen, click Deploy.<br>16. Click Finish when the deployment process completes.<br><br>*Customizing and configuring the VSA appliance VMs*<br>1. Log into the first partner blade using vSphere client.<br>2. Right-click the VSA VM, and select Power→Shut Down Guest.<br>3. Click Yes to confirm shutdown.<br>4. Once the VM has shut down, right-click the VSA VM, and select Edit Settings…<br>5. Under Memory, set the memory size to 2 GB.<br>6. Under CPUs, set the number of cores per socket to four.<br>7. Click the Resources tab and set the CPU reservation to 2,000 MHz.<br>8. Set the memory reservation to 2,048 MB RAM.<br>9. Click OK.<br>10. Right-click the VSA VM, and select Power→Power On.<br>11. Once the VM has booted, launch the virtual machine console window.<br>12. Type start and press Enter.<br>13. Press Enter to log in.<br>14. Highlight Network TCP/IP Settings, and press Enter.<br>15. Highlight eth0, and press Enter.<br>16. Enter an appropriate hostname, select Use the following IP address, enter the appropriate network information, and select OK.<br>17. Press Enter to confirm when the dialog box pops up.<br>18. Press Enter to close the pop-up showing that the network was successfully configured. |

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| | 19. Select Back, and then select Log Out. |
| | 20. Log into the second partner blade using vSphere client. |
| | 21. Right-click the VSA VM, and select Power→Shut Down Guest. |
| | 22. Click Yes to confirm shutdown. |
| | 23. Once the VM has shut down, right-click the VSA VM, and select Edit Settings… |
| | 24. Under Memory, set the memory size to 2 GB. |
| | 25. Under CPUs, set the number of cores per socket to four. |
| | 26. Click the Resources tab and set the CPU reservation to 2,000 MHz. |
| | 27. Set the memory reservation to 2,048 MB RAM. |
| | 28. Click OK. |
| | 29. Right-click the VSA VM, and select Power→Power On. |
| | 30. Once the VM has booted, launch the virtual machine console window. |
| | 31. Type start, and press Enter. |
| | 32. Press Enter to log in. |
| | 33. Highlight Network TCP/IP Settings, and press Enter. |
| | 34. Highlight eth0, and press Enter. |
| | 35. Enter an appropriate hostname, select Use the following IP address, enter the appropriate network information, and select OK. |
| | 36. Press Enter to confirm when the dialog box pops up. |
| | 37. Press Enter to close the pop-up showing that the network was successfully configured. |
| | 38. Select Back, and then select Log Out. |
| | ***Configuring the FOM networking*** |
| | 1. Launch the virtual machine console window. |
| | 2. Type start, and press Enter. |
| | 3. Press Enter to log in. |
| | 4. Highlight Network TCP/IP Settings, and press Enter. |
| | 5. Highlight eth0, and press Enter. |

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| | 6. Enter an appropriate hostname, select Use the following IP address, enter the appropriate network information, and select OK.<br><br>7. Press Enter to confirm when the dialog box pops up.<br><br>8. Press Enter to close the pop-up showing that the network was successfully configured.<br><br>9. Select Back, and then select Log Out.<br><br>***Installing HP DSM for MPIO***<br><br>1. Double-click the installer.<br>2. At the welcome screen, click Next.<br>3. At the End User License Agreement screen, accept, and click Next.<br>4. At the Choose Destination Location screen, leave the default location, and click Next.<br>5. At the Ready to Install the Program screen, click Install.<br>6. When prompted, leave the Yes, I want to restart my computer now option selected, and click Finish to reboot the server.<br><br>***Creating a new management group and building a new virtual SAN***<br><br>1. Click Start→All Programs→HP→P4000→HP P4000 Centralized Management Console<br>2. At the Find Systems screen that pops up, click Add…<br>3. Enter the IP address of the first VSA node, and click OK.<br>4. Click Add…<br>5. Enter the IP address of the second VSA node, and click OK.<br>6. Click Add…<br>7. Enter the IP address of the FOM, and click OK.<br>8. Click Close.<br>9. In the left pane of the CMC, click Getting Started.<br>10. In the right pane, click Management Groups, Clusters, and Volumes Wizard.<br>11. At the Welcome screen, click Next. |

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| | 12. At the Choose a Management Group screen, leave New Management Group selected, and click Next. |
| | 13. At the Create a Management Group screen, enter an appropriate management group name, and click Next. |
| | 14. At the Add Administrative User screen, enter a user name and password, and click Next. |
| | 15. At the Management Group Time screen, select either the appropriate NTP server or manually set the time, and click Next. |
| | 16. At the DNS information screen, enter the applicable DNS information. For our testing purposes, we did not need to configure email notifications, so we left this blank and clicked Next, then Accept Incomplete. |
| | 17. At the SMTP settings screen, enter the applicable SMTP server information. For our testing purposes, we did not need to configure email notifications, so we left this blank and clicked Next, then Accept Incomplete. |
| | 18. At the Create a Cluster screen, leave the default selection of Standard Cluster, and click Next. |
| | 19. At the Create Cluster screen, enter a cluster name, and click Next. |
| | 20. At the Assign a Virtual IP and Subnet Masks screen, click Add.. |
| | 21. Enter a virtual IP address and subnet mask, and click OK. Click Next. |
| | 22. At the Create Volume screen, enter the appropriate information for the first volume you wish to create, and click Finish. |
| | 23. At the licensing warning pop-up, click OK. |
| | 24. At the Summary screen, click Close. |
| | 25. At the registration reminder pop up window, click OK. |
| | *Adding and assigning the blade server to the new volume* |
| | 1. Click Start→Administrative Tools→iSCSI Initiator. |
| | 2. When prompted to start the Microsoft iSCSI service, click Yes. |

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| | 3. At the iSCSI Initiator Properties screen, click the Configuration tab, and highlight and copy the IQN initiator name. |
| | 4. Click Start→All Programs→HP→P4000→HP P4000 Centralized Management Console. |
| | 5. At the left pane, click the name of your management group. |
| | 6. At the right pane, click Log in to view, enter the appropriate credentials, and click Log In. |
| | 7. At the left pane, expand the management group→cluster name→Volumes and Snapshots, and click on the new volume. |
| | 8. At the right pane, click Server Tasks, and then click New Server… |
| | 9. Enter the appropriate name, IP address, and paste in the IQN initiator name under Initiator Node Name, then click OK. |
| | 10. Once you have added the server it will automatically go to the the Volumes and Snapshots tab of the newly added server. Click Tasks, and then click Assign and Unassign Volumes and Snapshots… |
| | 11. Select the appropriate volume, and check the Assigned checkbox, and click OK. |
| | *Adding the target volume in iSCSI initiator* |
| | 1. Click Start→ Administrative Tools→iSCSI Initiator. |
| | 2. Select the Discovery Tab, and click Discover Portal. |
| | 3. Enter the virtual IP address for the HP VSA group, and click OK. |
| | 4. Select the Targets tab, and click Refresh. |
| | 5. Select the appropriate Inactive Target listed, and click Connect. |
| | 6. Ensure that Add this connection to the list of Favorite Targets is selected, check the Enable multi-path check box, and click OK. |

# ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.
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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 our clients assess how it will fare against its competition, its performance, its market readiness, 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.