



Exchange consolidation: Replacing eight legacy servers with one Cisco UCS B200 M1 Blade Server

Executive summary

Cisco Systems, Inc. (Cisco) commissioned Principled Technologies (PT) to see how many legacy servers running Microsoft® Exchange we could replace with one Cisco UCS B200 M1 Blade Server using VMware vSphere™ 4 (vSphere).

We tested the following two servers:

- Cisco UCS B200 M1 Blade Server with Intel® Xeon® Processor X5570 (Cisco UCS B200 M1 Blade Server)
- HP ProLiant DL380 G4 server with Intel Xeon Processor 3.60 GHz (legacy server)

As Figure 1 shows, the Cisco UCS B200 M1 Blade Server provides a consolidation factor of eight. One Cisco UCS B200 M1 Blade Server with VMware vSphere can replace eight legacy servers. We define the number of legacy servers the Cisco UCS B200 M1 Blade Server replaced based on the Microsoft Exchange Server performance running Microsoft Exchange Load Generator (LoadGen) 2007. LoadGen is a Microsoft-provided tool for benchmarking an Exchange Mail Server and gives results as response time. We explain the scores in more detail in the Test results section below.

We found the peak number of Exchange 2007 users the legacy server could handle as our reference score. We then ran the same number of Exchange 2007 users inside a virtual machine (VM) on the Cisco UCS B200 M1 Blade Server. We determined the consolidation factor by seeing how many VMs the Cisco UCS B200 M1 Blade Server could run while still providing proper performance for each. We define the peak number of VMs as the maximum number of concurrent VMs under load where each VM has a less than 1,000ms response time with 3,000 users.

The legacy server handled 3,000 Exchange 2007 users and received a LoadGen 2007 response time less than 1,000ms. The Cisco UCS B200 M1 Blade Server handled 3,000 users in each of eight VMs and received a LoadGen 2007 response time less than 1,000ms in each VM.

KEY FINDING

One Cisco UCS B200 M1 Blade Server with VMware vSphere can replace eight legacy servers running Exchange 2007. (See Figure 1.)

Workload

To build the workload, we used Microsoft Exchange Load Generator 2007, an industry-standard tool for benchmarking an Exchange Mail Server. We based that workload on the settings from LoadGen's default Heavy workload. Our workload consisted of 3,000 users. We found the peak number of Exchange 2007 users on a typical 3- to 5-year-old, dual-socket server with two Intel Xeon 3.6GHz processors, 4 GB of RAM and two onboard NICs. We hooked the server up to one tray of the EMC® CLARiiON® CX4-240 storage, configured in a 15 disks RAID 0, to hold the

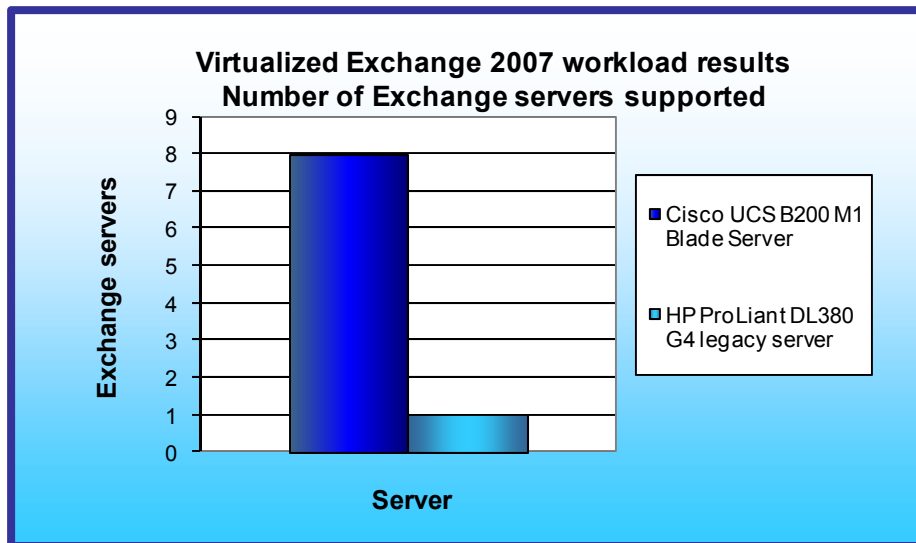


Figure 1: Microsoft Exchange 2007 consolidation results for the servers. Higher numbers are better. (The legacy server ran a single, non-virtual version of the Exchange test.)

Exchange database. We chose 3,000 users with latency just under 500ms as it put a reasonable amount of stress on the legacy server. We then ran the same number of Exchange 2007 users inside a VM on the Cisco UCS B200 M1 Blade Server.

During the tests, LoadGen performs tasks to simulate a standard user generating mail activity. When the workload finishes, LoadGen reports the response time, which is the number of seconds necessary to complete the task. We ran this workload on all virtual machines simultaneously for 30 minutes.

The legacy server ran as a standalone server running Microsoft Windows Server® 2003 with Service Pack 2 and Microsoft Exchange Server 2007. The Cisco UCS B200 M1 Blade Server ran VMware vSphere 4.0, while running Microsoft Windows Server 2008 with Microsoft Exchange Server 2007 inside virtual machines.

System comparison

Figure 2 shows a side-by-side comparison of the key hardware differences between the Cisco UCS B200 M1 Blade Server and the HP ProLiant DL380 G4 legacy server.

Hardware specifications	Cisco UCS B200 M1 Blade Server	HP ProLiant DL380 G4 legacy server
CPU	Intel Xeon X5570	Intel Xeon 3.6GHz
CPU speed (GHz)	2.93	3.60
Number of processor packages	2	2
Number of cores per processor package	4	1
Number of hardware threads per core	2	2
Memory type 1	DDR3 PC3-8500	DDR2 PC2-3200
Total memory (GB)	96	4
Maximum supported memory (GB)	96	12

Figure 2: System configuration information for the Cisco UCS B200 M1 Blade Server and the HP ProLiant DL380 G4 legacy server.

Figure 3 shows the settings we used on the Cisco UCS B200 M1 Blade Server VMs for testing. The HP ProLiant DL380 G4 legacy server ran as a standalone server with no VMs. Refer to the Test methodology section below for detailed steps of how we set up the VMs and the HP ProLiant DL380 G4 legacy server.

VM specifications	VM settings
vCPU	2
Memory (GB)	8
Virtual NIC type	VMXNET 3
Number of virtual disks	3 (OS, Exchange Database, Backup database)

Figure 3: VM configuration information we used for testing.

Test results

Figure 4 shows the latency, in milliseconds, from the median run for the Cisco UCS B200 M1 Blade Server. We ran the Cisco UCS B200 M1 Blade Server with eight virtual machines, so we record the response time for each virtual machine. The legacy server ran as a standalone server, so we do not show the result in the table. The legacy server ran 3,000 users with a response time of 494.5.

The legacy server represents a typical 3- to 5-year old mail server that was heavily utilized, but not necessarily running at saturation point. We targeted a number of users that would give us under a 1 second (1,000 milliseconds) response time while being heavily utilized.

To determine the maximum number of simultaneous virtual machines the Cisco UCS B200 M1 Blade Server could handle, we added virtual machines until one or more had latency greater than 1,000ms. We then subtracted one VM to identify the total number of VMs the server could handle. We performed three runs at the total number to verify the response time met these standards.

We used a 30-minute runtime for testing rather than a longer duration. We have found this shorter runtime produces valid and reproducible results. The results below are the medians of three runs.

VM (3,000 Exchange users)	Cisco UCS B200 M1 Blade Server
Virtual machine 1	743.6
Virtual machine 2	678.1
Virtual machine 3	701.7
Virtual machine 4	686.5
Virtual machine 5	640.3
Virtual machine 6	727.0
Virtual machine 7	717.6
Virtual machine 8	772.9

Figure 4: Latency, in milliseconds, from the median run for each virtual machine for the Cisco UCS B200 M1 Blade Server. Lower numbers are better.

Figure 5 shows the read, write, and total input/output operations per second (IOPS) for the median run of the two servers. Higher numbers are better, as they show that the system is handling more requests.

IOPS	Cisco UCS B200 M1 Blade Server	HP ProLiant DL380 G4 legacy server
Read	4,123.4	568.6
Write	3,684.4	423.0
Total	7,807.8	991.6

Figure 5: IOPS from the median run of the two servers. Higher numbers are better.

Test methodology

Setting up and configuring the EMC storage

We used an EMC CLARiiON CX4-240 Fibre Channel connected SAN for this testing. By design, the CX4-240 has two Storage Processors, SP-A and SP-B. We used the integrated dual port host bus adapter (HBA) in the Cisco UCS B200 M1 Blade Server. We cabled one HBA port to each SP (A and B) on the SAN to balance the load between SPs. We used five enclosures of disks on the SAN; with one exception, each enclosure had 15 disks. We designated RAID 0 for all RAID group configurations.

We created one RAID group on the enclosure that had only five disks. We then created one logical unit number (LUN) on this RAID group for the virtual hard drives (VHDs) that would hold the operating systems for the virtual machines.

We created seven RAID groups for Exchange data. Each of these seven RAID groups was composed of 10 disks. We then created 8 150GB LUNs per RAID group, for a total of 56 LUNs dedicated to virtual machines to hold Exchange data. We used the EMC MetaLUN feature and assigned seven LUNs to MetaLUN-A and seven LUNs to MetaLUN-B. We performed this step four more times so we had a total of eight MetaLUNs. To balance processing load and disk transfers, we assigned half of the MetaLUNs to SP-A and half to SP-B.

For the legacy server, we used one tray of the EMC CLARiiON CX4-240 storage. We connected one port of the dual port QLogic QLA2462 Fibre Channel HBA card in the legacy server to each SP (A and B) on the SAN. We configured all 15 disks into a single RAID 0 LUN. We used this LUN to hold our Exchange data.

Figure 6 shows the configuration that we used to connect the EMC CLARiiON CX4-240 to the Cisco B200 M1 Blade Server for testing.

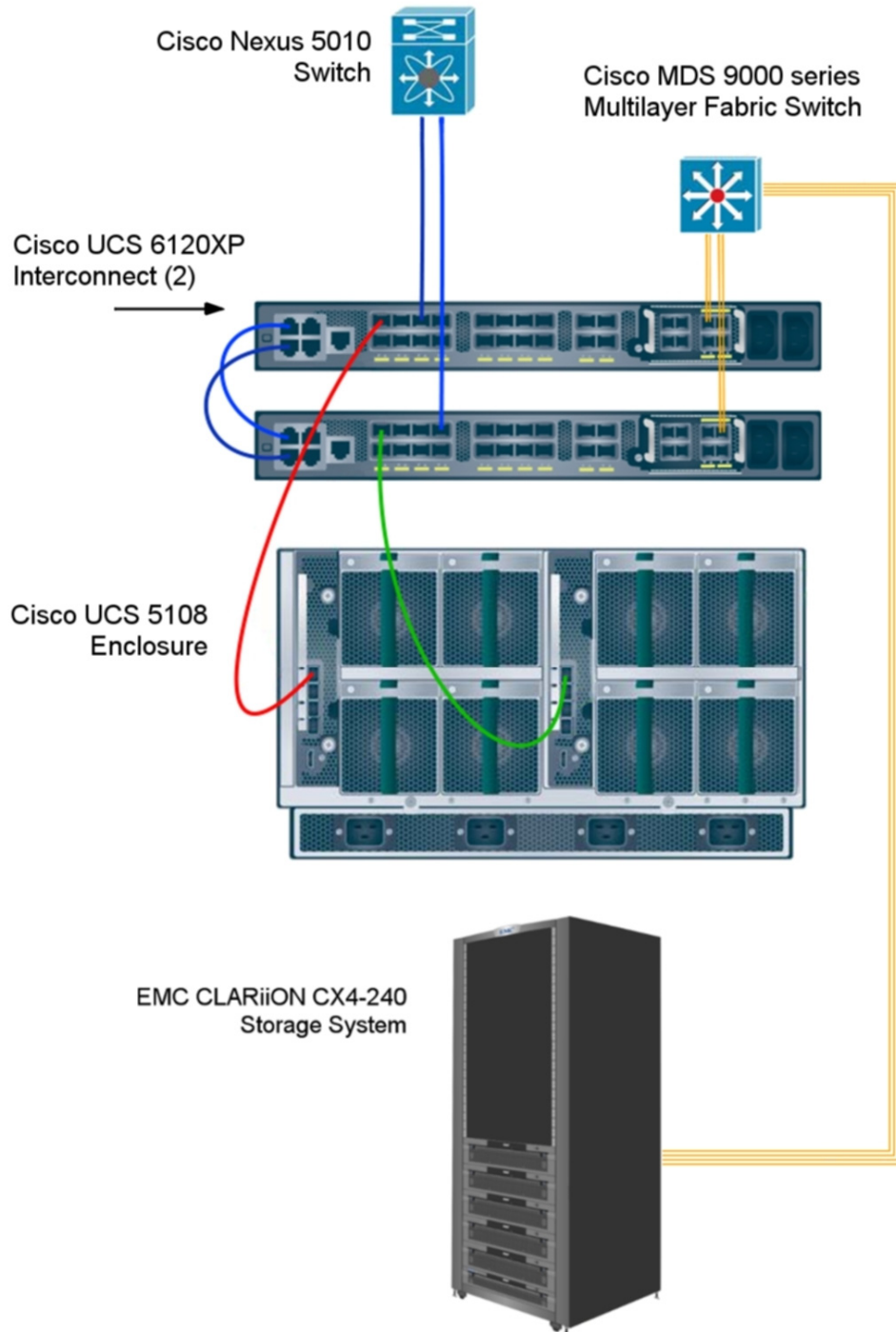


Figure 6: Our test bed configuration for the Cisco Blade Server.

Setting up the Cisco UCS B200 M1 Blade Server

We installed a fresh copy of VMware vSphere 4 on the Cisco UCS B200 M1 Blade Server.

Installing VMware vSphere 4 on the host

1. Insert the ESX DVD, and restart the computer.
2. To start ESX in graphical mode, press Enter.
3. On the Welcome screen, click Next.
4. Click the checkbox to accept the terms of the license agreement, and click Next.
5. Accept the default keyboard layout, and click Next.
6. On the Custom Drivers screen, choose No to install custom drivers, and click Next.
7. You will receive a warning if you chose No. Click Yes to proceed. Drivers will load at this point.
8. Click Next.
9. Enter your serial number now, or choose to enter one later. Click Next.
10. On the Network Configuration screen, choose the NIC that you will use for system tasks and for the client/server test traffic. Click Next.
11. On the next Network Configuration screen, set your IP addressing information, subnet mask, DNS, and hostname. Click Next.
12. On the Setup Type screen, choose standard setup.
13. Select the virtual disk you wish to install ESX on, and click Next.
14. On the Data Loss warning screen, click OK.
15. On the Time Zone Settings screen, choose your appropriate time zone, and click Next.
16. On the Date and Time screen, modify the date and time as you wish, and click Next.
17. Assign a root password for ESX. Optionally, add additional users if you wish, and click Next.
18. On the Summary screen, click Next to install.
19. When the installation is complete, click Next.
20. Click Finish to reboot the system.

Enabling secure shell (ssh) access for the root user

1. Log in as root to the ESX console.
2. Type the following command to change to the appropriate directory:

```
# cd /etc/ssh
```
3. Edit the sshd_config file using vi. Use the following command:

```
# vi sshd_config
```
4. Press the down arrow key to move the cursor to the PermitRootLogin line, and move the cursor to the word no. Press the i key to insert text.
5. Type the word yes and delete the word no.
6. Press the Escape key to return to command mode.
7. Type the following command to save and exit the file:

```
:wq
```
8. Type the following command to restart the ssh service:

```
# service sshd restart
```

Installing vSphere on a management workstation

1. Configure your management workstation to be on the same subnet as your ESX server. In Internet Explorer, navigate to the IP address of your ESX Server.
2. Accept certificate warnings, and continue.
3. Click vSphere to download the vSphere client.
4. Choose Run to install.
5. Choose your language, and click OK.
6. On the Welcome screen, click Next.
7. Accept the license terms, and click Next.
8. Enter user and organization details, and click Next.
9. Optionally, click the checkbox to install the update utility. Click Next.
10. On the Destination Folder screen, click Next.
11. Click Install.

12. Click OK.

Adding the storage volumes to ESX storage

1. In vSphere, click the Configuration tab.
2. Click Storage in the Hardware pane.
3. Click Add Storage...
4. Choose Disk/LUN. Click Next.
5. Select the appropriate LUN. Click Next.
6. Click Next.
7. Enter a name for the datastore. Click Next.
8. Choose 8MB block size from the drop down menu. Click Next.
9. Click Finish to complete the addition of the LUN.

Installing and configuring the mail server

To set up this server, you must install several software components. The following subsections detail the necessary installation processes.

Creating the virtual machine with vSphere

1. Click Start, All Programs, VMware, VMware vSphere client.
2. Enter the IP address or hostname, user name, and password. Click Login.
3. Click the Virtual Machines tab.
4. Right-click, and choose New Virtual Machine.
5. Choose Custom, and click Next.
6. Assign a name to the virtual machine. Click Next.
7. Select a datastore for the virtual machine files. We chose the OS Datastore. Click Next.
8. Choose Virtual Machine Version 7. Click Next.
9. Choose Microsoft Windows, then Microsoft Windows Server 2008 (64-bit). Click Next.
10. Choose two virtual processors. Click Next.
11. Choose 8192MB RAM. Click Next.
12. Click 1 for the number of NICs, and select vmxnet3. Click Next.
13. Leave the default virtual storage controller. Click Next.
14. Choose to create a new virtual disk. Click Next.
15. Make the OS virtual disk size 24 GB, specify the OS datastore on the external storage, and click Next.
16. Keep the default virtual device node, and click Next.
17. Click Finish.

Installing the guest operating system

1. Insert the installation DVD for Windows Server 2008 x64 into the DVD drive.
2. In vSphere, right-click the virtual machine, and choose CD/DVD drive.
3. Click the Host Device radio button, and choose the appropriate drive.
4. Click OK.
5. Right-click the machine, and choose Power, Power On.
6. Right-click the machine, and choose Open console.
7. Choose the language, time and currency, and keyboard input. Click Next.
8. Click Install Now.
9. Choose Windows Server Enterprise (Full Installation). Click Next.
10. Accept the license terms, and click Next.
11. Click Custom.
12. Click the Disk, and click Drive options (advanced).
13. Click New, Apply, Format, and click Next.
14. Let the installation process continue. The VM will reboot several times.
15. After the installation completes, click OK to set the Administrator password.
16. Enter the administrator password twice, and click OK.
17. When the operating systems finishes booting, choose VM, Guest, Install/Upgrade VMware Tools.
18. On the Install VMware Tools screen, click OK.

19. On the AutoPlay menu, click Run setup.exe.
20. On the Welcome screen, click Next.
21. On the Setup Type screen, choose Typical, and click Next.
22. Click Install.
23. On the various Windows Security screens, click Install each time.
24. Click Finish to complete the installation.
25. Click Yes to reboot the VM.
26. Log into the VM after reboot.
27. Click Start, Control Panel, and double-click System.
28. Click Change Settings.
29. Click Change.
30. Enter the new computer name, and click OK.
31. Click OK to restart, click Close, and click Restart Now.
32. Right-click the desktop, and select Personalize.
33. Click the Screen Saver link.
34. Click the Screen saver drop-down menu, and select (None).
35. Click Apply.
36. Click Change power settings.
37. Click Change plan settings under Balanced.
38. Change the Turn off monitor drop-down menu to Never.
39. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization windows.
40. Open the Start menu, type `regedit` in the search field, and press Enter.
41. To allow the VM 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
DefaultUsername=administrator
```

42. Restart the VM.

Installing Windows updates

1. Power on the VM, and open the console.
2. Log into the VM.
3. Click Start, Windows Update.
4. Click View Advanced Options.
5. Click Never Check for Updates.
6. Click OK.
7. Click Check for Updates.
8. Click Install Now when the application prompts you to install an update for Windows Update.
9. Click View available updates to ensure you install the necessary updates.
10. Click Install.
11. Agree to the license terms, and click Finish.
12. Reboot the VM when the application requests you do so.
13. After reboot, check Windows Update again for further updates. Click Start, Windows Update.
14. Click Check for updates.
15. If Windows lists no important updates, close the updates window.

Installing the domain controller

1. Set a static IP address using the following steps:
 - a. Right-click the network icon in the quick-launch bar, and choose Network and Sharing Center.
 - b. Click Manage network connections.
 - c. Right-click the local area connection, and choose Properties.
 - d. Select Internet Protocol Version (TCP/IPv4), and click Properties.

- e. Select the Use the following IP address radio button, and type 192.168.1.250 in the IP address field.
 - f. Press Tab to auto-fill 255.255.255.0 in the Subnet mask field.
 - g. In the Preferred DNS server field, type 127.0.0.1 and click OK to close the IPv4 properties window.
 - h. Click Close.
2. Give the computer a name using the following steps:
 - a. Click Start, right-click Computer, and select Properties.
 - b. Click Change Settings.
 - c. Click Change.
 - d. Type mailserver1 in the Computer name field, and click OK.
 - e. In the Computer Name/Domain Changes pop-up window, click OK.
 - f. Click OK.
 - g. In the Microsoft pop-up window, click Restart Now.
3. Promote the mailserver to domain controller by following these steps:
 - a. Select Start→Command Prompt.
 - b. Type `dcpromo`
 - c. At the Welcome pop-up window, click Next.
 - d. At the Operating System Compatibility screen, click Next.
 - e. At the Domain Controller Type screen, choose Domain controller for a new domain, and click Next.
 - f. At the Create New Domain screen, select the Domain in a new forest radio button, and click Next.
 - g. At the New Domain Name screen, type a domain name (i.e., mailserver.com), and click Next.
 - h. At the NetBIOS Domain Name screen, leave defaults, and click Next.
 - i. At the Database and Log Folders screen, accept defaults, and click Next.
 - j. At the Shared System Volume screen, keep defaults, and click Next.
 - k. At the DNS Registration Diagnostics window (if diagnostic fails), choose Install and configure the DNS server on this computer, set this computer to use this DNS server as its preferred DNS server, and click Next.
 - l. At the Permissions window, accept defaults, and click Next.
 - m. At the Directory Services Restore Mode Administrator Password screen, enter a password, and click Next.
 - n. At the Summary screen, review the selections, and click Next.
 - o. When the installation software prompts you to do so, insert the OS CD, and click OK.
 - p. At the Completing the Active Directory Installation Wizard screen, click Finish.
 - q. When the system prompts you to reboot the server, click Restart Now.
 - r. After the server reboots, log into the system.

Installing Internet Information Services 6.0

1. Select Start→Administrative Tools→Manage Your Server.
2. Click Add or remove a role.
3. At the Preliminary Steps screen, click Next.
4. At the Configure Your Server Wizard popup window, click Continue.
5. At the Server Role screen, click Application Server (IIS), and click Next.
6. At the Summary of Selection screen, review your selections, and click Next.
7. At the This Server is Now an Application server screen, click Finish.

Installing .NET™ 3.5 SP1 and Windows PowerShell™ 1.0

1. Download .NET 3.5 SP1 from Microsoft's Web site.
2. Double-click the dotnetfx35.exe file.
3. At the Welcome to Setup screen, accept the license agreement, and click Install.
4. When the install is finished, click Exit.
5. Click Start→Server Manager, and choose Add a Feature.
6. Choose Windows PowerShell1.0. Click Next to enable the feature.

Installing Exchange Server 2007

1. Insert the Microsoft Exchange Server 2007 CD.
2. In the pop-up AutoPlay window, click Run Setup.EXE.
3. The installer should consider Steps 1, 2, and 3 complete, and gray them out.
4. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP1.
5. Click Next to go past the introduction screen.
6. Accept the license agreement, and click Next.
7. Select No for error reporting, and click Next.
8. Select Typical Exchange Server Installation, and click Next.
9. Leave the organization name at default (First Organization), and click Next.
10. At the question about client computers running Outlook 2003 and earlier, select No, and click Next.
11. If an error about the Active Directory domain is in mixed mode appears, raise the domain function level using the following steps:
 - a. Click Start→All Programs→Administrative Tools→Active Directory Domains and Trusts.
 - b. Right-click mailserver.com, and choose Raise Domain Functional Level.
 - c. Choose Windows 2000 native in the drop-down menu, and click Raise.
 - d. Click OK on the warning popup window.
 - e. When the application raises the level successfully, click OK.
 - f. Close the Active Directory Domains and Trusts window.
 - g. At the Exchange 2007 setup window, click Retry on the Readiness Checks screen.
12. If a warning about a lack of SMTP appears after the check finishes, ignore it.
13. Click Install to start the installation process.
14. Once installation is complete, click Finish.
15. Click OK when the application prompts you to reboot.
16. Reboot the server.

Adding an additional virtual drive to the VM via vSphere

1. Power off the VM, right-click and choose Edit Settings.
2. Click Add.
3. Choose Hard Disk, and click Next.
4. Choose Raw Device Mappings, and click Next.
5. Choose the LUN you would like to use, and click Next.
6. Choose Store with Virtual Machine, and click Next.
7. Under Compatibility, choose Physical, and click Next.
8. From Virtual Device Node drop down menu, choose SCSI (1:0), and click Next.
9. Select new SCSI controller, and click Change Type.
10. In the pop-up window, choose VMware Paravirtual, and click OK.
11. Click OK.

Configuring additional drives in Disk Management

1. Power on the VM, and open the console.
2. Click Start, Administrative Tools, Computer Management.
3. Click Disk Management.
4. Right-click the uninitialized disks (if any), and choose Initialize Disk.
5. Choose MBR.
6. Right-click the volume, and choose New Simple Volume. Click Next.
7. Accept the default volume size. Click Next.
8. Choose E: from the drop-down menu for the drive letter. Click Next.
9. Type Exchange for the volume name. Click Next.
10. Choose NTFS, default allocation unit size, and check the Perform a quick format checkbox. Click Next.
11. Click Finish.

Configuring Exchange Server 2007

1. Select Start→All Programs→Microsoft Exchange Server 2007→Exchange Management Console.
2. In the left pane, expand Organization Configuration, and select Hub Transport.

3. In the action pane on the far right, select New Send Connector.
4. Name the send connector SMTP, select the intended use as Internet, and click Next.
5. In the Address space window, click Add.
6. In the SMTP Address Space window, type * as the address, ensure that the installer has checked Include all subdomains, and click OK.
7. Click Next.
8. Accept defaults for the next two pages by clicking Next.
9. At the New Connector page, click New to create the connector.
10. Click Finish to close the New SMTP Send Connector wizard.
11. In the left pane of the Exchange Management Console window, expand Server Configuration, and select Mailbox.
12. In the Database Management tab, right-click First Storage Group, and select New Public Folder Database.
13. Name the new public folder database Public Folder Database and click New.
14. In the Completion page, click Finish to close the New Public Folder Database window.
15. Select Start→All Programs→Administrative Tools→Active Directory Users and Computers.
16. In the Active Directory Users and Computers window, select mailserver.com in the left pane, and open Users in the right pane.
17. Right-click a blank area in the Users folder, and select New→User.
18. In the New Object - User window, complete the name fields as you wish (we used first name: test, last name: tester, logon name: tester), and select Next.
19. Enter a secure password (we used Password1), and check Password never expires.
20. In the pop-up information window, click Accept.
21. Select Finish to close the New Object – User window.
22. Double-click the new user to bring up the Properties window.
23. Under the Member Of tab, click Add.
24. In the Enter the object names to select dialog box, type Domain Admins; Exchange Organization Administrators select Check Names to verify, and click OK.
25. Click OK to close the User Properties window and close the Active Directory Users and Computers window.
26. Select Start→All Programs→Microsoft Exchange Server 2007→Exchange Management Console.
27. In the left pane of the Exchange Management Console window, select Recipient Configuration; in the right pane, select New Mailbox.
28. In the New Mailbox window, select User Mailbox, and click Next.
29. In the User Type page, select Existing users, and click Add.
30. Select the new account you created earlier, and click OK to add it to selection box.
31. Click Next.
32. In the Mailbox Settings page, leave the Alias textbox with default settings, and select Browse in the Mailbox database selection spot.
33. In the Select Mailbox database window, select Mailbox Database, and click OK.
34. Click through the next screens to create the new mailbox, and close when you have done so.
35. In the left windowpane, expand Server Configuration and Mailbox so the First Storage Group is visible.
36. Right-click First Storage Group, and select Properties.
37. Check the Enable circular logging box.
38. Click OK.
39. Right-click First Storage Group, and select Move Storage Group Path.
40. Click Browse, change the log files and system files path locations to E:\Logs and E:\Database respectively, and click Move.
41. When the pop-up message appears asking if you want to perform this task, click Yes.
42. Click Finish.
43. Right-click First Storage Group, and select New Mailbox Database.
44. Under Mailbox database name, type Mailbox Database 2
45. Click the Browse button, and select E:\Mailstore. If there is not a directory with the name of Mailstore, create it.
46. Click the New button to create the database.

47. Click Finish.
48. Right-click Mailbox Database under First Storage Group, and select Properties.
49. Check the box beside This database can be overwritten by a restore.
50. Click Customize next to Maintenance interval.
51. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
52. At the Mailbox Store Properties window, click Apply.
53. Click OK to close the Mailbox Store Properties window.
54. Right-click Mailbox Database under First Storage Group, and select Move Database Path.
55. Click Browse, move the database file path to E:\Mailstore, and click Move.
56. When a warning message appears, click Yes.
57. Click Finish.
58. Right-click Mailbox Database 2 under First Storage Group, and select Properties.
59. Check the box beside This database can be overwritten by a restore.
60. Click Customize next to Maintenance interval.
61. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
62. At the Mailbox Database 2 Properties window, click Apply.
63. Click OK to close the Mailbox Database 2 Properties window.
64. Right-click Public Folder Database, and choose Move Database Path.
65. Click Browse, and move the database file path to E:\Mailstore. Click Move.
66. When a warning message appears, click Yes.
67. Click Finish.
68. Right-click Public Folder Database under First Storage Group, and select Properties.
69. Check the box beside This database can be overwritten by a restore.
70. Click Customize next to Maintenance interval.
71. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
72. At the Public Folder Database Properties window, click Apply.
73. Click OK to close the Public Folder Database Properties window.
74. Click Start→Administrative Tools→Services.
75. Find the Microsoft Exchange Search Indexer service, right-click the service, and choose Properties.
76. Click Stop, and choose Disabled in the Startup type drop-down menu.
77. Click OK.
78. Close the Services window.

Creating the additional VMs on the host blade

After installing and configuring the initial VM, we cloned that VM using a combination of the vmkfstools and vmware-cmd utilities on the VMware ESX Server platform. Below is a sample shell script to clone VMs containing three virtual disks, such as our configuration.

```
# cp -reply=yes /sourcepath/VM1.vmx /destpath/VM2.vmx
# sed -i "s/VM1/VM2/g" /destpath/VM2.vmx
# sed -i `/\sched.swap.derivedName/d` /destpath/VM2.vmx
# sed -i `/\checkpoint.vmState/d` /destpath/VM2.vmx
# vmkfstools -i /sourcepath/VM1.vmdk /destpath/VM2.vmdk
# vmware-cmd -s register /destpath/VM2.vmx
```

Configuring the additional VMs after cloning

1. Power on the VM, and open the console.
2. Click Start→Control Panel→Right-click Network Connections, and double-click the Local Area Connection.
3. Select Internet Protocol Version 4 (TCP/IPv4), and click Properties.
4. In the Internet Protocol Version 4 (TCP/IPv4) Properties screen, select the Use the following IP address radio button.
5. Enter a valid static IP address for this new VM, subnet mask, and default gateway.
6. Click OK, and click Close to exit.
7. Repeat steps 1 through 6 for each VM.

Installing and configuring the mail clients

To create the mail client, you must install several software components. We followed this process for each installation:

1. Install Microsoft Windows Server 2003 R2 Enterprise x64 Edition Service Pack 2 on the client system.
2. Assign a computer name of `Clientx` for the mail client, where `x` is the client number.
3. For the licensing mode, use the default setting of five concurrent connections.
4. Enter a password for the administrator log on.
5. Select Eastern Time Zone.
6. Use typical settings for the Network installation.
7. Type `Testbed` for the workgroup.

To set up this system, we had to install several additional software components. The following subsections detail the necessary installation processes. Before following these instructions, make sure to assign a static IP address for the client, and to then plug that port into the system under test. This allows the client to join the Active Directory domain.

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 window, under the Member of section, select the Domain radial box, and type `mailserver.com`
8. Select OK to start joining the domain.
9. When the window 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 window, 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 7.0

1. Select Start→Control Panel→Add or Remove Programs.
2. Click Add/Remove Windows Components.
3. Select Application Servers, and click Details.
4. Make sure a check appears in the Internet Information Services (IIS), Application Server Console, and Enable network COM+ access check boxes.
5. Click OK to close the Application Server window.
6. At the Windows Components Wizard, click Next to begin the installation.
7. When the system prompts you to do so, insert the OS CD, and click OK.
8. At the Completing the Windows Components Wizard window, click Finish.
9. Close the Add or Remove Programs window.

Installing .NET 3.5 SP1 and Windows PowerShell 1.0

1. Download .NET 3.5 SP1 from Microsoft's Web site.
2. Double-click the `dotnetfx35.exe` file.
3. At the Welcome to Setup screen, accept the license agreement, and click Install.
4. When the install is finished, click Exit.
5. Download Windows PowerShell 1.0 from Microsoft's Web site.
6. Double-click the `.exe` file.

7. At the Welcome window, click Next.
8. Accept the license agreement, and click Next.
9. When the install is complete, click Finish.

Installing Exchange Server 2007 and Load Generator

1. Insert the Microsoft Exchange Server 2007 CD.
2. In the pop-up AutoPlay window, click Run Setup.EXE.
3. The installer should consider Steps 1, 2, and 3 complete, and gray them out.
4. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP1.
5. Click Next to go past the introduction screen.
6. Accept the license agreement, and click Next.
7. Select No for error reporting, and click Next.
8. Select Custom Exchange Server Installation, and click Next.
9. Select Custom Exchange Server Installation, and click Next.
10. Check Management Tools, and click Next.
11. If an error about the Active Directory domain is in mixed mode appears, raise the domain function level using the following steps:
 - a. Click Start→All Programs→Administrative Tools→Active Directory Domains and Trusts.
 - b. Right-click mailserver.com, and choose Raise Domain Functional Level.
 - c. Choose Windows 2000 native in the drop-down menu, and click Raise.
 - d. Click OK on the warning popup window.
 - e. When the application successfully raises the level, click OK.
 - f. Close the Active Directory Domains and Trusts window.
 - g. At the Exchange 2007 setup window, click Retry on the Readiness Checks screen.
12. If a warning about a lack of SMTP appears after the check finishes, ignore it.
13. Click Install to start the installation process.
14. Once installation is complete, click Finish.
15. Click OK when the application prompts you to reboot.
16. Reboot the server.
17. Download and install Load Generator with all defaults.

Preparing Load Generator

1. Log into the MailClient using the tester account.
2. Select Start→All Programs→Microsoft Exchange→Exchange Load Generator.
3. When the Load Generator window appears, select Start a new test.
4. Select Create a new test configuration, and click Continue.
5. Type `tester` as the account name.
6. In the Specify test settings window, type `Password1` as the Directory Access Password and Mailbox Account Master Password, and click Continue with recipient management.
7. Type `3000` into the Number of users box, and click the Spread evenly across databases link. Click Continue.
8. To accept defaults for Advanced recipient settings, click Continue.
9. In the Specify test user groups window, select the plus sign to add a user group.
10. Change the Client Type to Outlook 2007 Online and the Action Profile to Heavy.
11. Leave defaults in Remote configurations, and click Continue.
12. Click Save the configuration file as, and name it `Loadgen.cfg`
13. Click Start the initialization phase (recommended before running the test) to start initialization. The initialization process might take a few hours.

Setting up and configuring the HP DL380 G4 legacy server

Installing the guest operating system

1. Insert the Microsoft Windows Server 2003 R2 Enterprise Edition CD into the CD-ROM drive.
2. Reboot the system.
3. When a screen appears prompting you to press any key to boot from the CD, press any key.
4. Press Enter at the Welcome to Setup screen to setup Windows Server 2003.

5. Press F8 at the Windows Licensing Agreement screen.
6. If a previous version of Windows Server is already present, you will get a prompt asking if you would like to repair the damaged installation. Press Esc to continue installing a fresh copy of Windows without repairing.
7. At the Windows Server 2003 Setup screen, delete any existing C: partitions by selecting the partition to delete and pressing the D key.
8. Press Enter to confirm the deletion.
9. Press L to reconfirm the deletion.
10. At the Windows Server 2003 Setup screen, select the Unpartitioned Space, and press Enter.
11. Using the arrow keys, select Format the partition using the NTFS file system (Quick), and press Enter.
12. Once Windows Server finishes the formatting and the file copy, it prompts you to restart your computer. Press Enter to restart.
13. A Windows Server 2003 loading screen and then a Windows installation screen will appear. Wait for both of those windows to close.
14. Click Next at the Regional and Language Options screen.
15. When the installation software prompts you to Personalize Your Software, type `user` as the name, leave the organization field blank, and click Next.
16. At the Your Product Key screen, enter the product key, and click Next.
17. Leave the default settings at the Licensing Modes screen, and click Next.
18. For computer name, type `mailserver` and for administrator's password, type `Password1` and type `Password1` again to confirm the password. Click Next.
19. A Windows Setup Alert window will warn that the password you selected is not strong. Select Yes to continue.
20. At the Date and Time Settings screen, select the current date and time and the appropriate time zone. Leave the Automatically adjust clock for daylight savings changes checked, and click Next.
21. Windows will automatically complete the installation process and restart the server.
22. Press Ctrl+Alt+Delete when the system prompts you to begin running Windows Server.
23. Log onto Windows Server using the password you selected earlier.
24. At the Windows Setup Screen, the system will prompt you to insert Windows Server CD 2. Insert the CD, and click OK.
25. At the Windows Server 2003 R2 Setup Wizard Welcome Screen, click Next.
26. At the Windows Server 2003 R2 Setup Wizard Setup Summary, click Next.
27. The Installer will copy more files to the server. When the Windows Server 2003 R2 Setup Wizard Completing Windows Server Setup screen appears, click Finish.
28. At the Windows Server Post-Setup Security Updates screen, click Finish.
29. At the Windows Server Post-Setup Security Updates WARNING pop-up, click Yes to close the page.
30. At the Manage Your Server screen, check the box next to Don't display this page at logon, and click the X in the top right corner to close the screen.

Installing Windows updates

1. Click Start, Windows Update.
2. Click Check for Updates.
3. Click View available updates to ensure you install the necessary updates.
Note: We installed all critical updates up to the date of 9/1/2009.
4. Click Install.
5. Agree to the license terms, and click Finish.
6. Reboot the server when the application requests you do so.
7. After reboot, check Windows Update again for further updates. Click Start, Windows Update.
8. Click Check for updates.
9. If Windows lists no important updates, close the updates window.

Installing the domain controller

1. Set a static IP address using the following steps:
 - a. Right-click the network icon in the quick-launch bar, and choose Network and Sharing Center.
 - b. Click Manage network connections.

- c. Right-click the local area connection, and choose Properties.
 - d. Select Internet Protocol Version (TCP/IPv4), and click Properties.
 - e. Select the Use the following IP address radio button, and type 192.168.1.250 in the IP address field.
 - f. Press Tab to auto-fill 255.255.255.0 in the Subnet mask field.
 - g. In the Preferred DNS server field, type 127.0.0.1 and click OK to close the IPv4 properties window.
 - h. Click Close.
2. Give the computer a name using the following steps:
 - a. Click Start, right-click Computer, and select Properties.
 - b. Click Change Settings.
 - c. Click Change.
 - d. Type `mailserver` in the Computer name field, and click OK.
 - e. In the Computer Name/Domain Changes pop-up window, click OK.
 - f. Click OK.
 - g. In the Microsoft pop-up window, click Restart Now.
3. Promote the mailserver to domain controller by following these steps:
 - a. Select Start→Command Prompt.
 - b. Type `dcpromo`
 - c. At the Welcome pop-up window, click Next.
 - d. At the Operating System Compatibility screen, click Next.
 - e. At the Domain Controller Type screen, choose Domain controller for a new domain, and click Next.
 - f. At the Create New Domain screen, select the Domain in a new forest radio button, and click Next.
 - g. At the New Domain Name screen, type a domain name (i.e., `mailserver.com`), and click Next.
 - h. At the NetBIOS Domain Name screen, leave defaults, and click Next.
 - i. At the Database and Log Folders screen, accept defaults, and click Next.
 - j. At the Shared System Volume screen, keep defaults, and click Next.
 - k. At the DNS Registration Diagnostics window (if diagnostic fails), choose Install and configure the DNS server on this computer, set this computer to use this DNS server as its preferred DNS server, and click Next.
 - l. At the Permissions window, accept defaults, and click Next.
 - m. At the Directory Services Restore Mode Administrator Password screen, enter a password, and click Next.
 - n. At the Summary screen, review the selections, and click Next.
 - o. When the installation software prompts you to do so, insert the OS CD, and click OK.
 - p. At the Completing the Active Directory Installation Wizard screen, click Finish.
 - q. When the system prompts you to reboot the server, click Restart Now.
 - r. After the server reboots, log into the system.

Installing Internet Information Services 6.0

1. Select Start→Administrative Tools→Manage Your Server.
2. Click Add or remove a role.
3. At the Preliminary Steps screen, click Next.
4. At the Configure Your Server Wizard popup window, click Continue.
5. At the Server Role screen, click Application Server (IIS), and click Next.
6. At the Summary of Selection screen, review your selections, and click Next.
7. At the This Server is Now an Application server screen, click Finish.

Installing .NET 3.5 SP1 and Windows PowerShell 1.0

1. Download .NET 3.5 SP1 from Microsoft's Web site.
2. Double-click the `dotnetfx35.exe` file.
3. At the Welcome to Setup screen, accept the license agreement, and click Install.
4. When the install is finished, click Exit.
5. Download Windows PowerShell 1.0 from Microsoft's Web site.

6. Double-click the .EXE file.
7. At the Welcome window, click Next.
8. Accept the license agreement, and click Next.
9. When the install is complete, click Finish.

Installing Exchange Server 2007

1. Insert the Microsoft Exchange Server 2007 CD.
2. In the pop-up AutoPlay window, click Run Setup.EXE.
3. The installer should consider Steps 1, 2, and 3 complete, and gray them out.
4. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP1.
5. Click Next to go past the introduction screen.
6. Accept the license agreement, and click Next.
7. Select No for error reporting, and click Next.
8. Select Typical Exchange Server Installation, and click Next.
9. Leave the organization name at default (First Organization), and click Next.
10. At the question about client computers running Outlook 2003 and earlier, select No, and click Next.
11. If an error about the Active Directory domain is in mixed mode appears, raise the domain function level using the following steps:
 - a. Click Start→All Programs→Administrative Tools→Active Directory Domains and Trusts.
 - b. Right-click mailserver.com, and choose Raise Domain Functional Level.
 - c. Choose Windows 2000 native in the drop-down menu, and click Raise.
 - d. Click OK on the warning popup window.
 - e. When the application raises the level successfully, click OK.
 - f. Close the Active Directory Domains and Trusts window.
 - g. At the Exchange 2007 setup window, click Retry on the Readiness Checks screen.
12. If a warning about a lack of SMTP appears after the check finishes, ignore it.
13. Click Install to start the installation process.
14. Once installation is complete, click Finish.
15. Click OK when the application prompts you to reboot.
16. Reboot the server.

Configuring Exchange Server 2007

1. Select Start→All Programs→Microsoft Exchange Server 2007→Exchange Management Console.
2. In the left pane, expand Organization Configuration, and select Hub Transport.
3. In the action pane on the far right, select New Send Connector.
4. Name the send connector SMTP, select the intended use as Internet, and click Next.
5. In the Address space window, click Add.
6. In the SMTP Address Space window, type * as the address, ensure that the installer has checked Include all subdomains, and click OK.
7. Click Next.
8. Accept defaults for the next two pages by clicking Next.
9. At the New Connector page, click New to create the connector.
10. Click Finish to close the New SMTP Send Connector wizard.
11. In the left pane of the Exchange Management Console window, expand Server Configuration, and select Mailbox.
12. In the Database Management tab, right-click First Storage Group, and select New Public Folder Database.
13. Name the new public folder database Public Folder Database and click New.
14. In the Completion page, click Finish to close the New Public Folder Database window.
15. Select Start→All Programs→Administrative Tools→Active Directory Users and Computers.
16. In the Active Directory Users and Computers window, select mailserver.com in the left pane, and open Users in the right pane.
17. Right-click a blank area in the Users folder, and select New→User.
18. In the New Object - User window, complete the name fields as you wish (we used first name: test, last name: tester, logon name: tester), and select Next.

19. Enter a secure password (we used Password1), and check Password never expires.
20. In the pop-up information window, click Accept.
21. Select Finish to close the New Object – User window.
22. Double-click the new user to bring up the Properties window.
23. Under the Member Of tab, click Add.
24. In the Enter the object names to select dialog box, type `Domain Admins; Exchange Organization Administrators` select Check Names to verify, and click OK.
25. Click OK to close the User Properties window and close Active Directory Users and Computers window.
26. Select Start→All Programs→Microsoft Exchange Server 2007→Exchange Management Console.
27. In the left pane of the Exchange Management Console window, select Recipient Configuration; in the right pane, select New Mailbox.
28. In the New Mailbox window, select User Mailbox, and click Next.
29. In the User Type page, select Existing users, and click Add.
30. Select the new account you created earlier, and click OK to add it to selection box.
31. Click Next.
32. In the Mailbox Settings page, leave the Alias textbox with default settings, and select Browse in the Mailbox database selection spot.
33. In the Select Mailbox database window, select Mailbox Database, and click OK.
34. Click through the next screens to create the new mailbox, and close when you have done so.
35. In the left windowpane, expand Server Configuration and Mailbox so the First Storage Group is visible.
36. Right-click First Storage Group, and select Properties.
37. Check the Enable circular logging box.
38. Click OK.
39. Right-click First Storage Group, and select Move Storage Group Path.
40. Click Browse, change the log files and system files path locations to `E:\Logs` and `E:\Database` respectively, and click Move.
41. When the pop-up message appears asking if you want to perform this task, click Yes.
42. Click Finish.
43. Right-click First Storage Group, and select New Mailbox Database.
44. Under Mailbox database name, type `Mailbox Database 2`
45. Click the Browse button, and select `E:\Mailstore`. If there is not a directory with the name of Mailstore, create it.
46. Click the New button to create the database.
47. Click Finish.
48. Right-click Mailbox Database under First Storage Group, and select Properties.
49. Check the box beside This database can be overwritten by a restore.
50. Click Customize next to Maintenance interval.
51. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
52. At the Mailbox Store Properties window, click Apply.
53. Click OK to close the Mailbox Store Properties window.
54. Right-click Mailbox Database under First Storage Group, and select Move Database Path.
55. Click Browse, move the database file path to `E:\Mailstore`, and click Move.
56. When a warning message appears, click Yes.
57. Click Finish.
58. Right-click Mailbox Database 2 under First Storage Group, and select Properties.
59. Check the box beside This database can be overwritten by a restore.
60. Click Customize next to Maintenance interval.
61. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
62. At the Mailbox Database 2 Properties window, click Apply.
63. Click OK to close the Mailbox Database 2 Properties window.
64. Right-click Public Folder Database, and choose Move Database Path.
65. Click Browse, and move the database file path to `E:\Mailstore`. Click Move.
66. When a warning message appears, click Yes.
67. Click Finish.
68. Right-click Public Folder Database under First Storage Group, and select Properties.

69. Check the box beside This database can be overwritten by a restore.
70. Click Customize next to Maintenance interval.
71. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
72. At the Public Folder Database Properties window, click Apply.
73. Click OK to close the Public Folder Database Properties window.
74. Click Start→Administrative Tools→Services.
75. Find the Microsoft Exchange Search Indexer service, right-click the service, and choose Properties.
76. Click Stop, and choose Disabled in the Startup type drop-down menu.
77. Click OK.
78. Close the Services window.

Testing procedure

To perform the test, we used a series of batch files. First, we powered on all virtual machines. We started the scripts, which copied the LoadGen parameter files to the clients. Then, we started our monitoring programs. To start the test, we executed the start batch file on our controller, which copied a file to all clients to start LoadGen. After LoadGen finished, we used another batch file to copy the results from all clients. The batch files simply used the copy command and referred to all clients by their IP addresses. Once a run finished, we used a restore batch file, which restored the MailStore to the original state. This allowed us to start from the same point in testing.

Appendix A – Server configuration information

Figure 7 provides detailed configuration information about the servers.

Servers	Cisco UCS B200 M1 Blade Server	HP ProLiant DL380 G4 legacy server
Enclosure		
Blade enclosure	Cisco UCS 5108	N/A
Power supplies		
Total number	4	2
Wattage of each (W)	2,500	575
Cooling fans		
Total number	8	8
Dimensions (h x w) of each	3-5/8" x 5-1/2"	2-3/4" x 2"
General processor setup		
Number of processor packages	2	2
Number of cores per processor package	4	1
Number of hardware threads per core	2	2
CPU		
Vendor	Intel	Intel
Name	Xeon X5570	Xeon 3.6
Stepping	5	3
Socket type	LGA 1366	604 mPGA
Core frequency (GHz)	2.93	3.60
Bus frequency	6.4 GT/s (QPI)	800 MHz
L1 cache (KB)	128	16
L2 cache (KB)	4 x 256	2,048
L3 cache	8 MB	N/A
Thermal design power (TDP, in watts)	95	100
Platform		
Vendor and model number	Cisco B-200 M1 Blade	HP DL380 G4
Motherboard model number	QC11327030G	P7B840KMQQPIVP
Motherboard chipset	Intel 5500	Intel E7520
BIOS name and version	Intel S5500.86B.01.00.0036-191	HP P51
BIOS settings	Default	Default
Memory modules		
Total RAM in system (GB)	96	4
Number of types of memory modules	1	2
Speed in the system currently running @ (MHz)	1,066	400
Timing/Latency (tCL-tRCD-iRP-tRASmin)	6-6-6-15	3-3-3-11
First memory type		
Vendor and model number	Micron Technology MT72JSZS1G72PZ-1G1	Infineon 72T128000HR5A
Type	DDR3 PC3-8500	DDR2 PC2-3200
Speed (MHz)	1,066	400

Servers	Cisco UCS B200 M1 Blade Server	HP ProLiant DL380 G4 legacy server
Size (GB)	8	1
Number of RAM modules	12	2
Chip organization	Double-sided	Double-sided
Second memory type		
Vendor and model number	N/A	Micron Technology 18HTF12872Y-40EB3
Type	N/A	DDR2 PC2-3200
Speed (MHz)	N/A	400
Size (GB)	N/A	1
Number of RAM modules	N/A	2
Chip organization	N/A	Double-sided
Hard disk		
Vendor and model number	Seagate ST9146802SS	HP MAS3735NC
Number of disks in system	2	6
Size (GB)	146	73
Buffer size (MB)	16	8
RPM	10,000	15,000
Type	SAS	SATA
Controller	LSI Logic SAS1064E	Intel 82801EB (ICH5)
Operating system		
Name	vSphere 4.0	Windows Server 2003 Enterprise Edition R2
Build number	171294	3790
File system	VMFS	NTFS
Kernel	2.6.18-128.ESX	ACPI Multiprocessor x64-based PC
Language	English	English
Network card/subsystem		
Vendor and model number	Intel 82958BE 10 Gigabit AF Dual Port	HP NC7782 Gigabit Server Adapter
Type	Integrated	Integrated
Fibre adapter		
Vendor and Model number	QLogic QLA2432	QLogic QLA2462
Type	PCI-Express	PCI-X
USB ports		
Number	0	3
Type	N/A	2.0

Figure 7: Detailed configuration information for the server systems.

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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.



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