Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

Executive summary

Dell Inc. (Dell) commissioned Principled Technologies (PT) to compare the Microsoft Exchange Server 2007 workload performance of two Intel Xeon processors, each running on the same Dell PowerEdge R710 server:

- Intel Xeon Processor E5540 (2.53GHz Quad-Core Server Processor)
- Intel Xeon Processor X5550 (2.66GHz Quad-Core Server Processor)

> **KEY FINDING**
>
> The Intel Xeon Processor X5550-based Dell PowerEdge R710 server achieved 10.7 percent higher Microsoft Exchange Server 2007 performance than did the Intel Xeon Processor E5540-based Dell PowerEdge R710 server. (See Figure 1.)

In our testing, we used a dual socket Dell PowerEdge R710 server, which we connected to six Dell EqualLogic storage arrays via iSCSI. We installed Microsoft Exchange Server 2007 on the Dell PowerEdge R710 solution and ran Microsoft Exchange Load Generator, a Microsoft-provided tool for benchmarking an Exchange Mail Server. Thus, we measured the performance of the overall solution, both server and storage, as it relates to Microsoft Exchange Server 2007 workload performance. Our goal was to see how many messages Microsoft Exchange Server 20007 could process and deliver per second. The Workload section of this report explains Microsoft Exchange Load Generator 2007 in more detail.

Figure 1 compares the number of messages per second that the Intel Xeon Processor E5540- and Intel Xeon Processor X5550-based Dell PowerEdge R710 server delivered using Microsoft Exchange Server 2007. We present the median results from three test runs. The Intel Xeon Processor X5550-based Dell PowerEdge R710 server delivered 10.7 percent more messages per second than did the Intel Xeon Processor E5540-based Dell PowerEdge R710 server: 181.8 messages per second vs. 164.2 messages per second, respectively.

It is worth noting that these results display a similar performance increase to published SPECint_rate2006 results, which are part of the SPEC CPU2006 benchmark. The SPECint_rate2006 results showed an 11.1 percent performance increase for the Intel Xeon Processor X5550 over that of the Intel Xeon Processor E5540. The difference in percentage increase between the two benchmarks is due mainly to the fact that the Exchange workload is more dependent on storage performance than is SPECint_rate2006. For complete details of the SPECint_rate2006 results, see Appendix C.

SPEC CPU2006 is a Standard Performance Evaluation Corp. (SPEC)-created industry standard benchmark to measure a server's compute-intensive performance. The benchmark consequently stresses the CPU and memory subsystems of the system under test. (For more information on SPEC CPU2006 and other SPEC benchmarks, see www.spec.org) (Note: SPEC and SPEC CPU2006 are

Microsoft Exchange Load Generator workload results on the Dell PowerEdge R710 server with Intel Xeon processors
Higher results are better

Messages per second
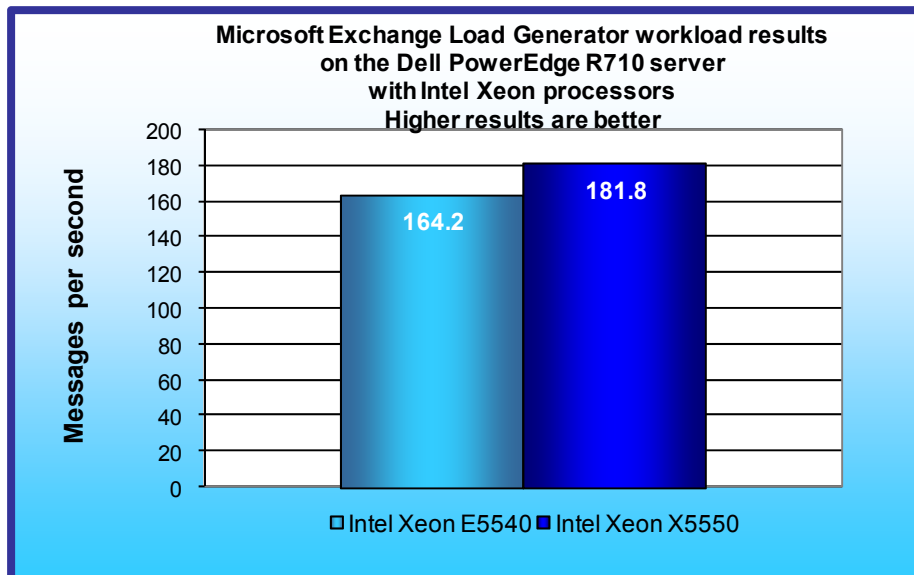
164.2 — Intel Xeon E5540
181.8 — Intel Xeon X5550

Figure 1: Microsoft Exchange Server 2007 workload median performance results, in messages per second, that the Intel Xeon Processor E5540-based Dell PowerEdge R710 server and the Intel Xeon Processor X5550-based Dell PowerEdge R710 server delivered. Higher numbers are better.

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Workload

Our goal was to compare the Microsoft Exchange Server 2007 performance of the Intel Xeon Processor E5540-based Dell PowerEdge R710 server to that of the Intel Xeon Processor X5550-based Dell PowerEdge R710 server. Specifically, we tested to see what increased message-per-second delivery the Intel Xeon X5550 2.66GHz Quad-Core Server Processor would have relative to that of the Intel Xeon E5540 2.53GHz Quad-Core Server Processor.

To test how many messages Microsoft Exchange Server 2007 could process and deliver per second, we used Microsoft Exchange Load Generator running in stress mode. We created a custom workload of 2,000 users distributed across 10 storage groups with one Mailbox database per storage group, which passed SendMail requests from a client machine as fast as the server could handle them.

Microsoft Exchange Load Generator is a simulation tool that measures the impact that various clients (MAPI, OWA, IMAP, POP, and SMTP) have on Exchange servers. This allows users to test how effectively a server running Exchange responds to e-mail loads. The simulator sends multiple message requests to the server running Exchange, resulting in a mail load.

We ran the Microsoft Exchange Load Generator benchmark for 30 minutes and used the time in-between the 10- and 20-minute mark to measure the performance of Microsoft Exchange Server 2007 on the Dell PowerEdge R710 server.

The average CPU usage for the processors was approximately 78 percent, with the CPU maxing out at 100 percent a significant amount of the time. We used the Exchange Analyzer tool to confirm that the performance bottleneck was in the process/memory subsystem and not in the disk subsystem.

Test results

Figure 2 shows the Microsoft Exchange Server 2007 message-per-second results that the Intel Xeon Processor E5540- and X5550-based Dell PowerEdge R710 solutions delivered. We gathered these results by using the MSExchangeIS Mailbox\Messages Delivered/sec counter in Windows Performance Monitor and averaging the results between the 10- and 20-minute marks of the test.

Messages per second	Dell PowerEdge R710 with the Intel Xeon Processor E5540	Dell PowerEdge R710 with the Intel Xeon Processor X5550
Run 1	149.2	168.0
Run 2	164.2	188.1
Run 3	165.2	181.8
Median score	164.2	181.8

Figure 2: The messages-per-second results that the Intel Xeon Processor E5540-based Dell PowerEdge R710 server and the Intel Xeon Processor X5550-based Dell PowerEdge R710 server delivered during runs one through three, with the median score. Higher numbers are better.

Test methodology
Setting up and configuring the storage
Dell EqualLogic storage configuration

Each of the six Dell EqualLogic arrays has 16 drives, for a total of 96 drives. We configured two drives in each array as hot spares so only 84 drives are active simultaneously. We configured all six arrays in RAID 10 mode.

We connected the Dell PowerEdge R710 server to the Dell EqualLogic storage via two 1Gb/s Ethernet cables into a PowerConnect 6248 switch. We configured the Dell EqualLogic storage into two groups and two storage pools. We created one 250GB volume in each storage pool and spread out the Mailstores on these two volumes. We configured the eight internal drives as two RAID 0 volumes consisting of four 73GB 15K RPM SAS drives in each.

The first volume was for the operating system and Exchange Server 2007, and the second was for Exchange Server logging. We used the Microsoft iSCSI Initiator with the EqualLogic Host Integration Toolkit (HIT) to connect the storage to the operating system.

Setting up the internal storage
1. Enter the RAID controller BIOS by pressing Ctrl+R.
2. Create a new RAID 0 volume for the OS by highlighting Controller 0, pressing F2, and selecting Create New VD (Virtual Disk).
3. Choose four physical disks, and set configuration options for the virtual disk.
4. Initialize the volume by selecting the virtual disk and pressing F2→Initialization→Start Init.
5. Repeat steps 2 through 4 for the second volume, and choose a four disk RAID 0.

Setting up the external storage
1. Using the command line, setup a storage group with the following RAID policies:
    a. PS5000XV-1: RAID-10
    b. PS5000XV-2: RAID-10
    c. PS5000XV-3: RAID-10
2. Using the command line, setup a storage group with the following RAID policies:
    a. PS5000XV-4: RAID-10
    b. PS5000XV-5: RAID-10
    c. PS5000XV-6: RAID-10
3. Create a storage pool that you name `database1` with the following members:
    a. PS5000XV-1
    b. PS5000XV-2
    c. PS5000XV-3
4. Create a storage pool that you name `database2` with the following members:
    a. PS5000XV-4
    b. PS5000XV-5
    c. PS5000XV-6
5. Enable all network connections on each PS5000XV using the following IP address scheme:
    a. IP Address: `192.168.1.##` (## being any number between 10 and 60)
    b. Subnet Mask: `255.255.248.0`
6. Create one 250GB volume in each database storage pool with 100 percent snapshot reserve, and name each `load-gen#` (# being 1 and 2)
7. Enable shared access to the iSCSI target from multiple initiators on every volume.
8. Create an access control record for every volume without specifying any limitations.
9. Create a read-only SNMP community name to use for group monitoring.

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. Before following these instructions, make sure to statically assign an IP address for the server under test, and then plug that port into another system or router. This allows the server to correctly add the domain server function.

Installing the operating system
1. Insert the installation DVD for Windows Server 2008 x64 into the DVD drive.
2. Choose the language, time and currency, and keyboard input. Click Next.
3. Click Install Now.
4. Choose Windows Server Enterprise (Full Installation). Click Next.
5. Accept the license terms, and click Next.
6. Click Custom.
7. Click the disk, and click Drive options (advanced).
8. Click New, Apply, Format, and click Next.
9. Let the installation process continue. The server will reboot several times.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

3

10. After the installation completes, click OK to set the Administrator password.
11. Enter the administrator password twice, and click OK.
12. Click Start, Control Panel, and double-click System.
13. Click Change Settings.
14. Click Change.
15. Enter the new computer name, and click OK.
16. Click OK to restart, click Close, and click Restart Now.
17. Right-click the desktop, and select Personalize.
18. Click the Screen Saver link.
19. Click the Screen saver drop-down menu, and select (None).
20. Click Apply.
21. Click Change power settings.
22. Click Change plan settings under Balanced plan.
23. Change the Turn off monitor drop-down menu to Never.
24. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization windows.
25. Open the Start menu, type `regedit` in the search field, and press Enter.
26. To allow the server to automatically log into the OS after a system reboot, change the following Registry key to have the values shown here:

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

27. Restart the server.

Configuring networking
1. Click Start, Control Panel, Network Connections, and click Manage Network Connections.
2. Right-click the NIC, and choose properties.
3. Select TCP/IP (v4), and choose properties.
4. Set the IP address, subnet, gateway, and DNS server for this NIC, which will handle outgoing server traffic (e.g., the public IP). Click OK, and click Close.
5. Repeat steps 2 through 4 twice, but these NICs should be on the same network segment as the Dell EqualLogic storage.

Installing the Host Integration Toolkit
1. Download the Host Integration Toolkit (Setup64.exe).
2. Double-click Setup64.exe.
3. Accept the security warnings, and choose to run the EXE.
4. Click Next.
5. Click Accept, then Next.
6. Click Typical, then Next.
7. You will see a Windows Firewall warning; leave it open for a minute.
8. Click the Start button, and choose Administrative Tools→Windows Firewall with Advanced Security.
9. In the left panel, click Inbound Rules.
10. In the center Inbound Rules panel, right-click iSCSI Service (TCP-In), and choose Enable Rule.
11. In the center Outbound Rules panel, right-click iSCSI Service (TCP-In), and choose Enable Rule.
12. Close the Windows Firewall dialog.
13. Clear the message box.
14. Click Install.
15. Click Yes to install multipath software automatically.
16. Choose to restart the computer when the application prompts you to do so.

Installing Windows updates
1. Click Start, Windows Update.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

4

2. Click View Advanced Options.
3. Click Never Check for Updates.
4. Click OK.
5. Click Check for Updates.
6. Click Install Now when the application prompts you to install an update for Windows Update.
7. Click View available updates to ensure you install the necessary updates.
   Note: We installed the following updates:

   - Hotfix for Windows(KB942288)
   - Security Update for Windows Server 2008 x64 Edition (KB958687)
   - Update for Windows Server 2008 x64 Edition (KB957388)
   - Security Update for Windows Server 2008 x64-based Systems (KB938464)
   - Security Updates for Windows Server 2008 x64 Edition (KB955069)
   - Cumulative Security Update for Internet Explorer 7 for Windows Server 2008 x64 Edition (KB961260)
   - Security Updates for Windows Server 2008 x64 Edition (KB954459)
   - Security Updates for Windows Server 2008 x64 Edition (KB957097)
   - Security Updates for Windows Server 2008 x64 Edition (KB958623)
   - Security Updates for Windows Server 2008 x64 Edition (KB953733)
   - Security Updates for Windows Server 2008 x64 Edition (KB950762)
   - Update for Windows Server 2008 x64 Edition (KB955839)
   - Security Updates for Windows Server 2008 x64 Edition (KB958624)
   - Security Updates for Windows Server 2008 x64 Edition (KB950974)
   - Update for Windows Server 2008 x64 Edition (KB951978)
   - Microsoft .NET Framework 3.5 Service Pack1 and .NET Framework 3.5 Family Update (KB951847) x64
   - Security Updates for Windows Server 2008 x64 Edition (KB954211)
   - Security Update for Windows Mail for Windows Server 2008 x64 Edition (KB951066)
   - Update Rollup for ActiveX Killbits for Windows Server 2008 x64 Edition (KB960715)
   - Security Updates for Windows Server 2008 x64 Edition (KB956841)
   - Security Updates for Windows Server 2008 x64 Edition (KB956802)
   - Update for Windows Server 2008 x64 Edition (KB957321)
   - Update for Windows Server 2008 x64 Edition (KB952287)
   - Windows Malicious Software Removal Tool x64 – Febuary 2009 (KB890830)
   - Security Updates for Windows Server 2008 x64 Edition (KB958644)
   - Security Updates for Windows Server 2008 x64 Edition (KB958644)
   - Update for Windows Server 2008 x64 Edition (KB950050)
   - Cumulative Security Update for ActiveX Killbits for Windows Server2008 x64 Edition (KB950760)
   - Update for Windows Server 2008 x64 Edition (KB955302)
   - Windows Update software 7.2.6001.788

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

Connecting the Microsoft iSCSI Initiator to the storage
1. Click Start, Control Panel, and double-click iSCSI Initiator.
2. Click the Discovery tab.
3. Click Add Portal…
4. Add the IP address of both Dell EqualLogic storage groups.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

5

5. Click OK.
6. Click the Targets tab.
7. Find the two MailStore volume, and select it.
8. Click Log On…
9. Check the checkbox to allow automatic logon on reboot.
10. Click OK.

Configuring additional drives in Disk Management
1. Click Start, Administrative Tools, Computer Management.
2. Click Disk Management.
3. Right-click the uninitialized disks (if any), and choose Initialize Disk.
4. Choose MBR.
5. Right-click the first 250GB volume, and choose New Simple Volume. Click Next.
6. Set the first 250GB drive to drive E:\, and click Next.
7. Choose NTFS, default allocation unit size, and check the Perform a quick format checkbox. Click Next.
8. Click Finish.
9. Repeat steps 5 through 8 for the second 250GB drive.
10. Right-click the unallocated 270GB RAID0 drive, and choose New Simple Volume. Click Next.
11. Set the drive letter to L:\, and click Next.
12. Choose NTFS, default allocation unit size, and check the Perform a quick format checkbox. Click Next.
13. Click Finish.

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 `192.168.0.250` 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 Choose a Deployment Configuration screen, select the Create a new domain in a new forest radio button, and click Next.
    f. At the Name the Forest Root Domain screen, type a domain name (e.g., `mailserver.com`), and click Next.
    g. At the Set Forest Functional Level screen, choose Windows Server 2008 from the drop-down menu, and click Next.
    h. At the Additional Domain Controller Options screen, accept the defaults, and click Next.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

6

i. When the Static IP assignment window pops up, click Yes, the computer will use a dynamically assigned IP address.
j. When the Active Directory domain Services Installation Wizard window pops up, click Yes.
k. At the Location for Database, Log Files, and SYSVOL screen, click Browse next to the Database folder field, and choose the C:\ drive. Click Next.
l. At the Directory Services Restore Mode Administrator Password screen, enter a password, and click Next.
m. At the Summary screen, review the selections, and click Next.
n. When the installation software prompts you to do so, insert the OS CD, and click OK.
o. At the Completing the Active Directory Installation Wizard screen, click Finish.
p. When the system prompts you to reboot the server, click Restart Now.
q. After the server reboots, log into the system.

Installing Internet Information Services 6.0
1. Select Start→Administrative Tools→Server Manager.
2. Click Add Roles.
3. At the Select Server Roles screen, click Web Server (IIS).
4. At the Add features required for Web Server (IIS) pop-up window, click Add Required Features.
5. Click Next.
6. At the Web Server (IIS) screen, click Next.
7. At the Select Role Services screen, select the IIS 6 Metabase Compatibility, IIS 6 Management Console, Basic Authentication, Windows Authentication, Digest Authentication, and Dynamic content Compression checkboxes. Click Next.
8. At the Confirm Installation Selections screen, click Install.
9. At the Installation Results screen, click Close.

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 and 2 complete, and gray them out.
4. Click Step 3: Install Microsoft Windows PowerShell.
5. Select Start→Command Prompt.
6. In the Command Prompt window, type `ServerManagerCmd –I PowerShell` and press Enter.
7. When the installation completes, close the Command Prompt window.
8. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP1.
9. Click Next to go past the introduction screen.
10. Accept the license agreement, and click Next.
11. Select No for error reporting, and click Next.
12. Select Typical Exchange Server Installation, and click Next.
13. Leave the organization name at default (First Organization), and click Next.
14. At the question about client computers running Outlook 2003 and earlier, select No, and click Next.
15. If a warning about a lack of SMTP appears after the check finishes, ignore it.
16. Click Install to start the installation process.
17. Once installation is complete, click Finish. Exchange should automatically open the Exchange Management Console.

Configuring Exchange Server 2007
1. If Exchange does not automatically open the Exchange Management Console, 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` and select the intended use as Internet. 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.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

7

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 Remove.
13. Click Yes.
14. In the Mailserver options, select New Storage Group.
15. Name the Storage Group `Public Folder Storage Group`
16. Set the log and system files paths to L:\.
17. Right-click the Public Folder Storage Group, and select New Public Folder Database.
18. Name the new public folder database `Public Folder Database` and set the database path to E:\.
19. Click New.
20. In the Completion page, click Finish to close the New Public Folder Database window.
21. In the Mailserver options, select New Storage Group.
22. Name the Storage Group `Storage Group #`
23. Set the log and system files paths to L:\Mailbox Database #.
24. Right-click the Storage Group, and select New Mailbox Database.
25. Name the new mailbox `Mailbox Database #` and set the database path to E:\ for Mailboxes 1 through 5 and F:\ for Mailboxes 6 through 10.
26. Click New.
27. Right-click the Storage Group you just created, and select Properties.
28. Check the Enable circular logging box, and click Apply.
29. Right-click the Mailbox Database you just created, and select properties.
30. Click Customize next to Maintenance schedule option.
31. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
32. At the Mailbox Store Properties window, click Apply.
33. Repeat steps 21 through 32 9 more times, for a total of 10 times.
34. Close the Exchange Management Console, and reboot the server.
35. Once the server successfully reboots, log in, and select Start→All Programs→Administrative Tools→Active Directory Users and Computers.
36. In the Active Directory Users and Computers window, select mailserver.com in the left pane, and open Users in the right pane.
37. Right-click a blank area in the Users folder, and select New→User.
38. 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.
39. Enter a secure password (we used Password1), and check Password never expires.
40. In the pop-up information window, click Accept.
41. Select Next to close the New Object – User window.
42. Double-click the new user to bring up the Properties window.
43. Under the Member Of tab, click Add.
44. In the Enter the object names to select dialog box, type `Domain Admins; Exchange Organization Administrators` and select Check Names to verify. Click OK.
45. Click OK to close the User Properties, Active Directory Users, and Computers window.

Installing and configuring the mail client

To create the mail client, you must install several software components. Before following these instructions, make sure to statically assign an 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. We followed this process for each installation:

1. Install Microsoft Windows Server 2003 R2 Enterprise x64 Edition Service Pack 2 on the client machine.
2. Assign a computer name of `Client1` for the mail client.
3. For the licensing mode, use the default setting of five concurrent connections.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

8

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 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 address 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 6.0
1. Select Start→Control Panel→Add or Remove Programs.
2. Click Add/Remove Windows Components.
3. Select Application Servers, and click Details.
4. Click ASP.NET, and make sure a check appears in the check box.
5. Select Internet Information Services (IIS), and click Details.
6. Click OK to close the Application Server window.
7. At the Windows Components Wizard, click Next to begin the installation.
8. When the system prompts you to do so, insert the OS CD, and click OK.
9. At the Completing the Windows Components Wizard window, click Finish.
10. Close the Add or Remove Programs window.

Installing Microsoft Exchange Server 2007 and Load Generator
1. Insert the Microsoft Exchange Server 2007 CD. The CD should automatically launch the installation software.
2. Click the link to Step 1: Install .NET Framework 2.0.
3. When you arrive at the download link, download the x64 version of the .NET Framework, and install.
4. Click the link to Step 3: Install Microsoft Windows PowerShell; this takes you to the download link.
5. When you arrive at the download link, download Microsoft Windows PowerShell, and install with defaults.
6. Search for and download SP1 for .NET Framework 2.0.
7. Install SP1 with all defaults.
8. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP1.
9. Click Next to go past the introduction screen.
10. Accept the license agreement, and click Next.
11. Select No for error reporting, and click Next.
12. Select Custom Exchange Server Installation, and click Next.
13. Check Management Tools, and click Next.
14. After the check finishes, click Install to start the installation process.
15. Once installation is complete, click Finish.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

9

16. Download and install Load Generator using 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. Set the length of a simulation day to 8 hours.
6. Set the total length of the simulation to 30 minutes.
7. Check the Stress mode checkbox.
8. Type `Tester` as the Directory Access Username.
9. Type `Password1` as the Directory Access Password.
10. Type `Password1` as the Mailbox Account Master Password.
11. Click Continue with recipient management.
12. Make 200 users in each Mailbox Database, and click Continue.
13. To accept defaults for Advanced recipient settings, click Continue.
14. In the Specify test user groups window, select the plus sign to add a user group.
15. Change the Client Type to Outlook 2007 Cached and the Action Profile to Custom.
16. Uncheck the PreTestLogon check box, and click Continue.
17. Leave defaults in Remote configurations, and click Continue.
18. Click Save the configuration file as, and name it `Loadgencfg`
19. Modify the configuration file, and set the following parameters:

```
<InboxMessageCount>100</InboxMessageCount>
<DeletedMessageCount>5</DeletedMessageCount>
<NewFolderCount>5</NewFolderCount>
<NewFolderMessageCount>20</NewFolderMessageCount>
<SmartFolderCount>3</SmartFolderCount>
<InboxRuleCount>8</InboxRuleCount>
<AppointmentCount>5</AppointmentCount>
<ContactCount>3</ContactCount>
<BrowseCalendarActionCount>0</ BrowseCalendarActionCount>
<BrowseContactsActionCount>0</ BrowseContactsActionCount
<BrowsePublicFolderActionCount>0</ BrowsePublicFolderActionCount>
<BrowseTasksActionCount>0</ BrowseTasksActionCount >
<CreateContactActionCount>0</CreateContactActionCount>
<CreateFolderActionCount>0</CreateFolderActionCount>
<CreateTaskActionCount>0</CreateTaskActionCount>
<DeleteFolderActionCount>0</DeleteFolderActionCount>
<DeleteMailActionCount>0</DeleteMailActionCount>
<DownloadOabActionCount>0</DownloadOabActionCount>
<EditRulesActionCount>0</EditRulesActionCount>
<EditSmartFoldersActionCount>0</EditSmartFoldersActionCount>
<ExportMailActionCount>0</ExportMailActionCount>
<LogoffActionCount>0</LogoffActionCount>
<LogonActionCount>0</LogonActionCount>
<MailboxStoreProfileActionCount>0</MailboxStoreProfileActionCount>
<MakeAppointmentActionCount>0</MakeAppointmentActionCount>
<MoveMailActionCount>0</MoveMailActionCount>
<PostFreeBusyActionCount>0</PostFreeBusyActionCount>
<PublicFolderPostActionCount>0</PublicFolderPostActionCount>
```

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

10

```
<PublicStoreProfileActionCount>0</PublicStoreProfileActionCount>
<ReadAndProcessMessagesActionCount>0</ReadAndProcessMessagesActionCount>
<RequestMeetingActionCount>0</RequestMeetingActionCount>
<SendMail>8</SendMail>
<SearchActionCount>0</SearchActionCount>
```

20. Load the configuration file, and start the initialization process.
21. After the initialization is complete, dismount the Mailbox databases on the Mailserver, and create a snapshot of the database volumes using the EqualLogic Group Manager.

Testing procedure

To perform the test, we used the Microsoft Exchange Load Generator Windows interface to run the custom configuration file we generated. In between runs, we dismounted the databases, restored the databases to their original state using EqualLogic snapshots, mounted the databases, manually cleared the Mail queue, and waited 10 minutes. We used perfmon on the server to monitor various performance counters and Messages delivered per second.

The testing procedure consisted of the following steps:
1. On the Mailserver, open the Exchange Management Console.
2. Select the Toolbox in the left pane.
3. Double-click the Queue Viewer.
4. Right-click Mailserver.com, and select Remove (without Sending NDR).
5. Close the Queue Viewer.
6. Dismount the Mailbox databases on the mailserver.
7. Restore the original snapshot of the Mailbox databases using the EqualLogic Group Manager.
8. Mount the Mailbox databases on the mailserver.
9. Start LoadGenWin.exe on the client computer.
10. Click Start a New Test.
11. Select use the following saved configuration file.
12. Load the Loadgencfg configuration file, and click Continue.
13. Click Skip recipient management, and continue with user group configuration.
14. Click Continue.
15. Click Continue.
16. Start the perfmon counter on the Mailserver.
17. Click Skip the initialization and run the simulation immediately.
18. Stop the perfmon counter on the Mailserver after the run is over.

Disabling Logical Processor

We disabled Logical Processor (hyper-threading) on the Intel Xeon Processor X5550 and Intel Xeon Processor E5540.

1. Power on the server.
2. Press F2 to enter the system setup.
3. Select Processor Settings.
4. Set Logical Processor to Disabled.
5. Press Enter.
6. Press Esc.
7. Select Save Changes and Exit.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

11

Appendix A – Server configuration information

This appendix provides detailed configuration information about each Dell PowerEdge R710 server, which we present in Figure 3.

Servers	Intel Xeon Processor E5540-based Dell PowerEdge R710 server	Intel Xeon Processor X5550-based Dell PowerEdge R710 server
General dimension information		
Height (inches)	3.5	3.5
Width (inches)	17.0	17.5
Depth (inches)	27.0	27.0
U size in server rack (U)	2	2
Power supplies		
Total number	2	2
Wattage of each (W)	870	870
Cooling fans		
Total number	5	5
Dimensions (h x w) of each	2.5" x 2.5"	2.5" x 2.5"
Voltage (V)	12	12
Amps (A)	1.60	1.60
General processor setup		
Number of processor packages	2	2
Number of cores per processor package	4	4
Number of hardware threads per core	2	2
System power management policy	OS control	OS control
CPU		
Vendor	Intel	Intel
Name	Xeon E5540	Xeon X5550
Stepping	D0	D0
Socket type	LGA1366	LGA1366
Core frequency (GHz)	2.53	2.66
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	1 MB (4 x 256 KB)	1 MB (4 x 256 KB)
L3 cache	1 x 8 MB	1 x 8 MB
Platform		
Vendor and model number	Dell PowerEdge R710	Dell PowerEdge R710
Motherboard model number	PWBYN967	PWBYN967
Motherboard revision number	X08	X08
BIOS name and version	Dell 0.2.15	Dell 0.2.15
BIOS settings	Default (logical processor disabled)	Default (logical processor disabled)
Memory modules		
Total RAM in system (GB)	24	24

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

12

Servers	Intel Xeon Processor E5540-based Dell PowerEdge R710 server	Intel Xeon Processor X5550-based Dell PowerEdge R710 server
Number of types of memory modules	1	1
Vendor and model number	Crucial CT51272BB1339	Crucial CT51272BB1339
Type	PC3-10600 DDR3	PC3-10600 DDR3
Speed (MHz)	1,333	1,333
Speed in the system currently running @ (MHz)	1,066	1,333
Timing/latency (tCL-tRCD-iRP-tRASmin)	7-7-7-20	9-9-9-24
Size (GB)	24	24
Number of RAM modules	6 x 4 GB	6 x 4 GB
Chip organization	Double-sided	Double-sided
Hard disk		
Vendor and model number	Seagate ST973451SS	Seagate ST973451SS
Number of disks in system	8	8
Size (GB)	73	73
Buffer size (MB)	16	16
RPM	15,000	15,000
Type	SAS	SAS
Operating system		
Name	Windows Server 2008 Enterprise Edition x64	Windows Server 2008 Enterprise Edition x64
Build number	6001	6001
File system	NTFS	NTFS
Language	English	English
Network card/subsystem		
Vendor and model number	Intel PRO/1000 Dual Port Server Adapter D33682	Intel PRO/1000 Dual Port Server Adapter D33682
Type	PCI-E	PCI-E
Optical drive		
Vendor and model number	TEAC DV-28S-VDB	TEAC DV-28S-VDB
USB ports		
Number	4	4
Type	2.0	2.0

Figure 3: Detailed system configuration information for the two test servers.

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

13

Appendix B – Storage array configuration information

This appendix provides detailed configuration information about the Dell EqualLogic storage array systems, which we present in Figure 4.

Storage	Dell EqualLogic iSCSI SAN
Arrays	Six Dell EqualLogic PS5000XV arrays
Disks	96 15,000RPM SAS disks total for the three shelves
Active storage cache	3 GB (512 MB per array)
Passive storage cache	3 GB (512 MB per array)
Number of active storage controllers	6 (1 per array)
Number of passive storage controllers	6 (1 per array)
Number of active storage ports	18 (3 per array)
Number of passive storage ports	18 (3 per array)
Firmware revision	v4.1.1
Switch type/ model/firmware revision	Two Dell PowerConnect 6248 v2.2.0.3
Disk vendor and model number	64x Seagate ST3146855SS 32x Maxtor ATLAS15K2_147SAS
Disk size (GB)	146
Disk buffer size (MB)	16
Disk RPM	15,000
Disk type	SAS
RAID type	RAID 10

Figure 4: Detailed configuration information for the storage arrays.

Appendix C – SPECint_rate2006 results

For percentage win comparison purposes, we found results on SPEC's website using SPECint_rate2006 using the Intel Xeon Processor E5540 and Intel Xeon Processor X5550. The Intel Xeon Processor X5550 achieved a score of 241, while the Intel Xeon Processor E5540 achieved a score of 217. Thus, the Intel Xeon Processor X5550 achieved an 11.1 percent performance increase over the Intel Xeon Processor E5540 using SPECint_rate2006. SPEC published these results on their website in March 2009. Here are the links for the results:

Intel Xeon Processor E5540: http://www.spec.org/cpu2006/results/res2009q1/cpu2006-20090316-06749.html
Intel Xeon Processor X5550: http://www.spec.org/cpu2006/results/res2009q1/cpu2006-20090316-06737.html

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

14

About Principled Technologies

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

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

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

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

Principled Technologies, Inc.: Exchange Server 2007 workload performance comparison: Intel Xeon Processor E5540-based Dell PowerEdge R710 server vs. Intel Xeon Processor X5550-based Dell PowerEdge R710 server

15