

1 Dell can replace 2 HP servers AND support 2X the users!



 **PowerEdge™ T410**
Microsoft® Windows
Server® 2008 R2



2 HP ProLiant ML110 G5
Microsoft Windows
Small Business Server® 2003 R2

OUR FINDINGS

Upgrading from HP ProLiant ML110 G5 servers to a single, newer Dell PowerEdge T410 can yield significant benefits for small and medium businesses (SMBs). In tests in our labs, we migrated an older HP database server and email server, both running in a Microsoft Windows Small Business Server 2003 R2 environment, to a single Dell PowerEdge T410 server running Microsoft Windows Server 2008 R2 Standard Edition. Our goal was to simulate typical SMB applications and demonstrate how consolidating older systems to a single new system can maximize productivity and prepare a business for future growth. The benefits of migrating to the new Dell PowerEdge T410 from the

legacy servers included almost 18 times the database performance, over 75% better email performance, the ability to handle more than twice as many users, and headroom for future growth by having processor power and memory to spare.

OUR PROCESS

We measured performance with two workloads that exercised common SMB functions: database and email services. We used the open-source DVD Store Version 2 (DS2) test tool as our sample database application and Microsoft Exchange Load Generator (LoadGen) to simulate email activity. We then measured the performance of both the existing servers and the new Dell PowerEdge T410.

WORKLOAD

When we tested the HP ProLiant ML110 G5 servers running in a Microsoft Windows Small Business Server 2003 R2 environment (the legacy servers), we ran the two benchmark workloads on two separate servers, as a small or medium business with increasing demands might do. The primary server acted as our mail server and ran Microsoft Windows Small Business Server 2003 R2 Premium, which includes Microsoft Exchange Server 2003. The secondary server was a member server and held our database. It ran Microsoft Windows Server 2003 R2 Standard and Microsoft SQL Server® 2005 Workgroup edition.

When we tested the new Dell PowerEdge T410 server running Microsoft Windows Server 2008 R2 Standard Edition, we ran the two workloads simultaneously. We used Microsoft Exchange Server 2010 for the mail server role and Microsoft SQL Server 2008 R2 Standard for the database.

DVD Store

DVD Store Version 2 (DS2) is an open-source application with a back-end database component, a front-end Web application layer, and a driver layer that operates as the middle tier and actually executes the workload.

Because our goal was to isolate and test database server and storage, we did not use the Web application layer. Instead, we ran the driver application on client machines directly via its command-line interface.

DS2 models an online DVD store. Simulated customers log in; browse movies by actor, title, or category; and purchase movies. The workload also creates new customers. Browsing movies involves select operations, some of which use SQL Server full-text search and some of which do not. The purchase, login, and new customer stored procedures involve update and insert statements, as well as select statements. The workload's main reporting metric is orders per minute (OPM).

For the client machine, we used a desktop-class system running Microsoft Windows Server 2003 R2 Enterprise Edition x86. The client machine ran a single instance of DS2, which spawned 75 or 150 threads depending on the workload specifications, with 0.15 seconds think time. This simulated a realistic business environment. We used the default DS2 parameters and setup configuration, with the exceptions we note above and in the Configuring the database server (DVD Store) section in the How we tested section of this report.

The DS2 driver application creates an orders-per-minute performance counter on the client machine, measuring a running average of OPM count during the test run. While the DVD Store client application visually outputs OPM at 10-second intervals, we chose to collect this OPM metric via a performance monitor counter on each client machine at 1-second intervals.

We ran this workload on two of the servers, the Dell PowerEdge T410 and one of the HP ProLiant ML110 G5 servers, for 40 minutes each per test run.

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

Microsoft Exchange Load Generator

Microsoft Exchange Load Generator (LoadGen) is an industry-standard tool for benchmarking a Microsoft Exchange 2003 or 2010 mail server. LoadGen performs tasks to simulate a standard user generating mail activity. While the workload was ongoing, we measured response time, or the time in milliseconds necessary for the Exchange mail server to complete a request, using a remote procedure call (RPC) performance counter. Specifically, we used the RPC Averaged Latency counter, which records the average time it takes the server to process the last 1024 packets. In other words, the counter provides data about the shortest time period that client computers wait for a response from the server.

LoadGen 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 email loads. The simulator uses a client machine to send multiple message requests to the server running Exchange, resulting in a mail load.

We created a custom workload and adjusted it for 75 or 150 users that LoadGen distributed across a single storage group with one mailbox database. We ran the Microsoft Exchange Load Generator benchmark for 30 minutes on the servers. For the client machine, we used a server running Microsoft Windows Server 2003 R2 Enterprise Edition x86 for testing the HP ProLiant ML110 G5, and Microsoft Windows Server 2008 Enterprise Edition x64 for testing the Dell PowerEdge T410.

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

SYSTEM COMPARISON

Figure 1 highlights the key differences between the servers. Appendix A provides detailed configuration information.

Hardware specifications	Dell PowerEdge T410 server	HP ProLiant ML110 G5 servers
CPU	Intel® Xeon® Processor X5660	Intel Xeon Processor 3075
CPU speed (GHz)	2.80	2.66
Number of processor packages	2	1
Number of cores per processor package	6	2
Number of hardware threads per core	2	1
Memory type	PC3-10600R	PC2-6400E
Total memory installed	16 GB (4 x 4 GB) Note: The Dell PowerEdge T410 supports 128 GB maximum.	4 GB (4 x 1 GB)
Hard drive	6 x 300 GB SAS, 15,000 RPM, 6Gb, 3.5" hot plug	4 x 160 GB SATA 7,200 RPM, 3Gb, 3.5" non-hot plug
Operating system	Microsoft Windows Server 2008 Standard Edition	Primary server: Microsoft Windows Small Business Server 2003 R2 Premium Member server: Microsoft Windows Server 2003 Standard x86

Figure 1: System configuration information for the test servers.

WHAT WE FOUND

For testing on the legacy servers, we ran LoadGen on the primary server for 30 minutes, and DVD Store on the member server for 40 minutes. Each benchmark simulated 75 users.

For testing both benchmarks simultaneously on the Dell PowerEdge T410 server running Microsoft Windows Server 2008 R2 Standard Edition, we staggered the starting times of the benchmarks to allow each one to ramp up slowly. In this case, we adjusted the benchmark workloads to simulate 150 users to demonstrate the additional users that Microsoft Windows Server 2008 R2 Standard Edition can support. As the results in this section show in detail, this system achieved better email performance and dramatically better database performance. It did so while utilizing only 19.4 percent of the CPU capacity, which indicates room for additional growth.

We began DVD Store and allowed it to ramp up for 10 minutes before starting LoadGen. Figure 2 shows the timeline for the benchmark runs. We computed the final result based on the 30 minutes of peak performance during the LoadGen run.

Multiple benchmark timeline
40 minutes total time

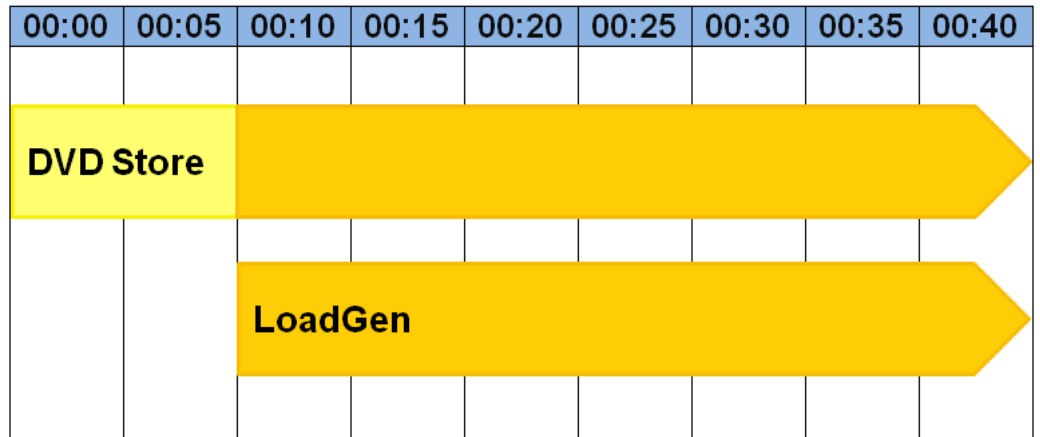


Figure 2: The timeline we followed when starting the benchmarks for the multiple-benchmark runs on the Dell PowerEdge T410 server. The orange-shaded areas from 00:10 to 00:40 represent the period during which we measured performance.

To make sure each

server achieved its optimum results, we allowed each to sit idle for 10 minutes before starting the workload.

Database results

Figure 3 shows the number of OPM the test servers achieved during our measurement period of the DS2 test on the median run. We calculated the scores by taking the last OPM data point within the 30-minute period.

The Dell PowerEdge T410 server running Microsoft Windows Server 2008 R2 Standard Edition running 150 simulated users, with a score of 47,237, performed

almost 18 times more orders per minute than the HP ProLiant ML110 G5 server running Microsoft Windows Server 2003 R2 Standard running 75 simulated users, with an OPM score of 2,644.

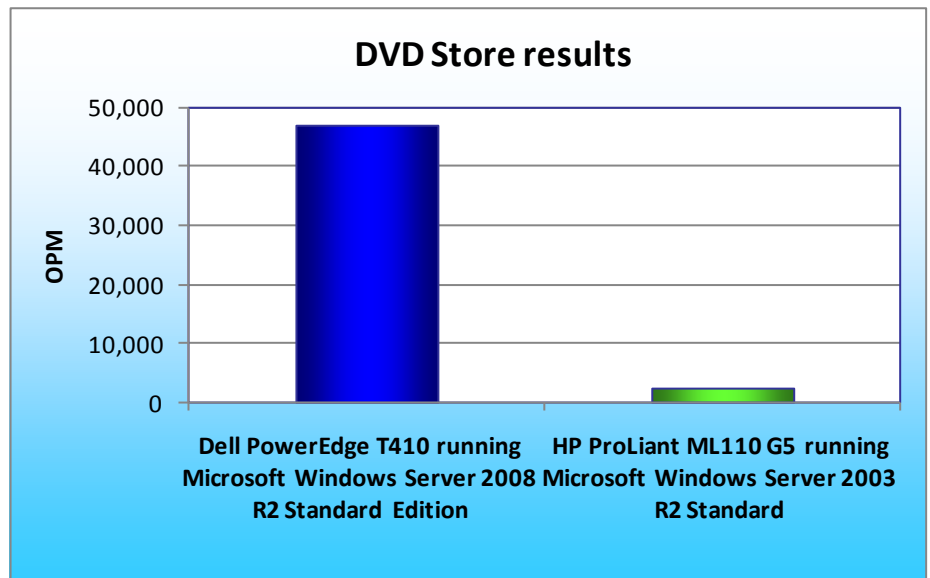


Figure 3: Median DVD Store Version 2 results for the test servers. Higher numbers are better.

Email results

LoadGen results show the response time each for each server, which is the time in milliseconds it took to complete a request. We used the RPC Averaged Latency performance counter to compare the performance of the HP legacy server running Microsoft Windows Small Business Server 2003 R2 Premium with the new Dell PowerEdge T410 server running Microsoft Windows

Server 2008 R2 Standard Edition. Lower scores are better, as they indicate that a server is able to maintain a satisfactory response time for the end user.

For testing, we used a workload of 75 Microsoft Exchange mailboxes for the legacy server running Microsoft Windows Small Business Server 2003 R2 Premium, the maximum number of users permitted by the operating system, and 150 Microsoft Exchange mailboxes for the new Dell PowerEdge T410 server running Microsoft Windows Server 2008 R2 Standard Edition.

Figure 4 shows the RPC Averaged Latency results, in milliseconds, for the median run of each of the servers. Lower numbers are better.

The Dell PowerEdge T410 server running Microsoft Windows Server 2008 R2 Standard Edition, with a score of 3.19 milliseconds RPC Averaged Latency, outperformed the HP ProLiant ML110 G5 server running Microsoft Windows Small Business Server 2003 R2 Premium, with a score of 12.79 milliseconds, by 75.1 percent.

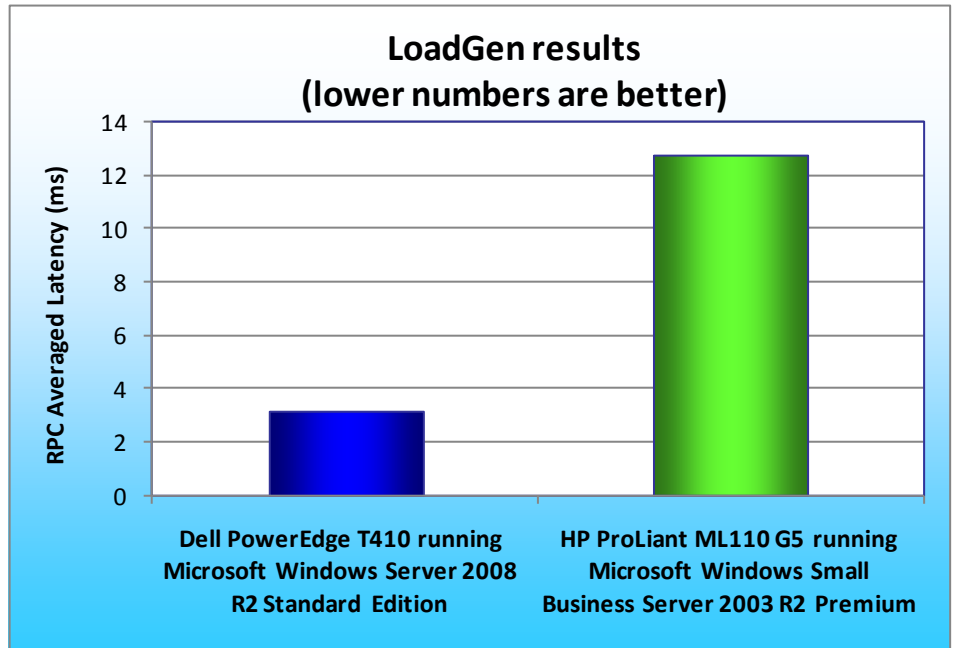


Figure 4: Median LoadGen results for the test servers. Lower numbers are better.

HOW WE TESTED

To perform the test, we used a series of batch files, which we stored in the C:\ServerShare folder on the server or in the C:\ClientShare folder on the clients. We used simple file sharing to copy files from machine to machine as needed.

We added the client batch files to the startup folders on the LoadGen and DS2 clients in such a way that when we rebooted the systems, the batch files would automatically start. The client batch files ran a loop script waiting for the server to copy a semaphore file to the client. To begin the test, we then executed a script on the server, which passed the semaphore file to the clients and started the benchmarks.

Between tests, we restored the Mailbox and Public Folder stores by temporarily dismounting them and restoring them from a backup. We used a script to restore the DVD Store database, which dropped the existing database and restored it from the backup. After the restore finished, we rebooted the servers and clients.

Starting LoadGen

1. Restart the Mail Client.
2. Allow the machine to boot up completely (this starts the looping batch file).

Starting DVD Store

We created a batch file to run the following parameters to begin the DVD Store test. We used the parameters below in the batch file for testing the legacy server. The new server test parameters differed only in target IP address and number of threads.

```
ds2sqlserverdriver.exe --target=192.168.16.4 --ramp_rate=10 --  
run_time=42 --n_threads=75 --db_size_str=V --think_time=0.15 --  
database_name=DS2
```

1. Restart the DVD Store client.
2. Allow the machine to boot up completely (this starts the looping batch file).

Starting the test

1. Restart the system under test (SUT).
2. Let the SUT idle for 10 minutes.
3. Run the run.bat script on the SUT. This copies the semaphore file to the clients. DVD Store begins immediately, followed by LoadGen beginning 10 minutes later.
4. After the test is complete, restore the Exchange and SQL Server databases, and restart the servers and clients.

Setting up the legacy servers

We used the BIOS RAID configuration utility to create two RAID 1 partitions in each server, one for the operating system and the other for the mailbox and SQL server databases. Following the operating system installation, we installed all recommended Windows Updates through June 16, 2010.

Preparing the primary server

Installing Windows Small Business Server 2003 R2 Premium

1. Insert the first installation CD into the drive, attach an external USB floppy drive if necessary, and boot the system.
2. At the Welcome to Setup screen, press Enter.
3. At the Windows Licensing Agreement screen, press F8 to agree to the terms.
4. Select the appropriate unpartitioned space, and press C to create a partition.
5. Select Format the partition using NTFS file system, and press Enter.
6. At the Regional and Language Options screen, click Next.
7. Enter Name and Organization, and click Next.
8. At the Your Product Key screen, enter your product key, and click Next.
9. At the Computer Name and Administrator Password screen, choose an appropriate name and password, and click Next.
10. At the Date and Time Settings screen, change the Date & Time and Time Zone if appropriate, and click Next.
11. At the Continuing Microsoft Windows Small Business Server Setup window, click Next.
12. If prompted by Setup Requirements, install network adapter drivers, and click Next.
13. At the Company Information window, enter the requested information, and click Next.
14. At the Internal Domain Information window, enter an appropriate DNS and NetBIOS name, and click Next.
15. At the Local Network Adapter Information window, select the appropriate network adapter, and click Next.
16. At the Local Network Adapter Configuration window, verify that the IP is set to 192.168.16.2 and the subnet mask is set to 255.255.255.0, and click Next.
17. At the Logon Information page, enter your password, select to allow it to log in automatically, and click Next.
18. At the Component Selection window, accept all defaults, and click Next.
19. At the Data Folders, click Next.
20. Click Next.
21. When the application prompts you to do so, insert Windows Small Business Server 2003 Disk 2, and click OK.
22. When the application prompts you to do so, insert Windows Small Business Server 2003 Disk 3, and click OK.
23. When the application prompts you to do so, insert Windows Small Business Server 2003 Disk 4, and click OK.
24. When the application prompts you to do so, insert Windows Small Business Server 2003 Disk 5, and click OK.

25. Click Finish.
26. Click OK to restart your computer.

Installing Windows Small Business Server 2003 R2 Technologies

1. Insert the Windows Small Business Server 2003 R2 setup disk.
2. At the setup window, click Install Service Pack 2 for Exchange Server 2003.
3. At the Microsoft Exchange 2003 welcome window, click Next.
4. Select I agree in the License Agreement window, and click Next.
5. At the Component Selection window, leave default options, and click Next.
6. Click Next at Installation Summary.
7. Click Finish.
8. Returning to the setup window, click Install Service Pack 2 for Windows SharePoint Services 2.0.
9. Click Yes.
10. Click Yes.
11. Click OK.
12. Returning to the setup window, click Install Windows Small Business Server 2003 R2.
13. At the welcome screen, click Next.
14. At the License Agreement window, select I agree, and click Next.
15. At the Update Services window, click Next.
16. Click Next.
17. At the Setup Successful! window, click Finish.
18. Reboot the server.

Selecting general OS settings

1. Click Start→Control Panel→Display.
2. Click the Screen Saver tab.
3. At the drop-down menu under Screen saver, select (None).
4. Click OK.
5. Click Start→Control Panel→System.
6. On the Automatic Updates tab, click the Turn off Automatic Updates radio button.
7. Click OK.

Adding client licenses

1. At the Welcome window, click Next.
2. At the License Agreement window, select I agree, and click Next.
3. At Contact Method, select Internet, and click Next.
4. Enter the license codes, and click Next.
5. Click Finish.

Changing Exchange mode to Native

1. Click Start→All Programs→Microsoft Exchange→System Manager.
2. Right-click the Exchange organization on the left pane, and select Properties.
3. In the General tab, click Change Mode under Change operation mode.
4. If a warning appears, click Yes.
5. Click OK.

Adding the tester user

1. Click Start→Administrative Tools→Active Directory Users and Computers.
2. In Active Directory Users and Computers, expand your domain name, and click the Users folder.
3. Click the Create a new user in the current container button.
4. Enter an appropriate first and last name, type `tester` for the user logon name, and click Next.
5. Enter an appropriate password, uncheck the User must change password at next logon option, check the Password never expires option, and click Next.
6. Leave all defaults for creating an Exchange mailbox, and click Next.
7. Click Finish.

Adding the Exchange database partition

1. Click Start→Administrative Tools→Computer Management.
2. In the left hand pane of Computer Management, click Disk Management.
3. If the application prompts you to initialize a new disk, click Yes, select the appropriate disk to initialize, and click OK.
4. Right-click the appropriate Unallocated space within the initialized disk, and select New Partition...
5. Click Next.
6. At the Select Partition Type window, accept default selections, and click Next.
7. At the Specify Partition Size window, accept defaults, and click Next.
8. Assign an appropriate drive letter, and click Next.
9. At the Format Partition window, leave all defaults, check the Perform a quick format option, and click Next.
10. Click Finish.

Enabling Circular Logging

1. Click Start→Programs→Microsoft Exchange→System Manager.
2. Expand servers and server name.
3. Right-click First Storage Group, and click Properties.
4. Check the box beside Enable circular logging, and click OK.

Disabling Maintenance Schedule

1. Click Start→Programs→Microsoft Exchange→System Manager.
2. Expand servers and server name.
3. Expand First Storage Group.
4. Right-click Mailbox Store (servername), and click Properties.
5. Click the Database tab.
6. Click Customize... next to Maintenance Interval.
7. Double-click the empty gray box above Sunday.
8. Ensure that all cells on the graph turn white, and click OK.
9. Right-click Public Folder Store (servername), click Properties, and repeat steps 5 through 8.

Changing the default location of your mail database

1. Click Start→All Programs→Microsoft Exchange→System Manager.
2. In Exchange System Manager, expand the Servers folder in the left pane.
3. Expand the First Storage Group, right-click Mailbox Store, and select Properties.

4. Click the Database tab, and click Browse... under Exchange Database, browse over to the designated Exchange database partition, create a new folder named Mailbox Store and click Save.
5. Click Browse... under Exchange streaming database, browse over to the designated Exchange database partition, select the Mailbox Store folder, and click Save.
6. Click OK.
7. If a warning appears, click Yes to continue.
8. Click OK.
9. Under the First Storage Group, right-click Public Folder Store, and select Properties.
10. Click the Database tab, and click Browse... under Exchange Database, browse over to the designated Exchange database partition, create a new folder named Public Folder Store and click Save.
11. Click Browse... under Exchange streaming database, browse over to the designated Exchange database partition, select the Public Folder Store folder, and click Save.
12. Click OK.
13. If a warning appears, click Yes to continue.
14. Click OK.

Preparing the member server

Installing Windows Server 2003 Standard R2 SP2 x86

1. Insert the first installation CD into the drive, and boot the system.
2. At the Welcome to Setup screen, press Enter.
3. At the Windows Licensing Agreement screen, press F8 to agree to the terms.
4. Select the appropriate unpartitioned space, and press C to create a partition.
5. Select Format the partition using the NTFS file system, and press Enter.
6. At the Regional and Language Options screen, click Next.
7. Enter Name and Organization, and click Next.
8. At the Your Product Key screen, enter your product key, and click Next.
9. At the Licensing Modes screen, click Next.
10. At the Computer Name and Administrator Password screen, choose an appropriate name and password, and click Next.
11. At the Date and Time Settings screen, change the Date & Time and Time Zone if appropriate, and click Next.
12. After the system restarts automatically, follow the prompt to log into the server.
13. At the Windows Setup screen, insert the second installation CD when prompted, and click OK.
14. At the Windows Server 2003 R2 Setup Wizard Welcome screen, click Next.
15. At the Windows Server 2003 R2 Setup Wizard Summary screen, click Next.
16. Click Finish.

Selecting general OS Settings

1. Click Start→Control Panel→Display.
2. Click the Screen Saver tab.
3. At the drop-down menu under Screen saver, select (None).
4. Click OK.
5. Click Start→Control Panel→System.
6. On the Automatic Updates tab, click the Turn off Automatic Updates radio button.
7. Click OK.

Setting the IP address

1. Click Start → Control Panel, and right-click Network Connections.
2. Click Open.
3. Double-click Server Local Area Connection.
4. Click Internet Protocol (TCP/IP), and click Properties.
5. In the IP address field, type 192 . 168 . 16 . 4, and 255 . 255 . 255 . 0 for the subnet mask.
6. Click OK.
7. Click OK.
8. Close the Network Connections window.

Joining the domain

1. Right-click My Computer, and select Properties.
2. Under the Computer Name tab, click Change.
3. In the Computer Name Changes window, under the Member of section, select the Domain radial box, and type test . local
4. To start joining the domain, select OK.
5. When the window appears asking for a person qualified on the domain, type Administrator as the username and Password1 as the password.
6. At the Welcome pop-up window and the window warning that you must reset the computer for the changes to take effect, click OK.
7. At the System Properties window, click OK.
8. When a pop-up appears asking if you want to restart now, click Yes.

Installing SQL Server 2005 Workgroup Edition

1. Insert the Windows Small Business Server 2003 Premium Technologies CD 1.
2. At the Windows Small Business Server 2003 R2 Premium Technologies Setup window, click Install Microsoft SQL Server 2005.
3. Select I accept the licensing terms and conditions, and click Next.
4. After installing the prerequisites, click Next.
5. At the Welcome screen, click Next.
6. At the System Configuration Check, click Next. For this installation, you may ignore the possible warning regarding IIS, as it is unnecessary for this configuration.
7. At the Registration Screen, enter the appropriate name and company.
8. At the Components to Install screen, select Data Files, Full-Text Search, and Shared Management Tools under SQL Server Database Services. Under Client Components, select Connectivity Components, Management Tools, SDK, SQLXML Client Features, and Legacy Components.
9. Click Next to start the installation.
10. At the Instance Name screen, click the Default instance radio button, and click Next.
11. At the Service Account screen, select the Use the built-in System account radio button.
12. Select Local system, and click Next.
13. At the Authentication Mode screen, select Mixed Mode.
14. Specify the "sa" logon password by entering a password in both fields, and click Next.
15. At the Collation Settings screen, click Next.
16. Accept the default Error and Usage Report Settings, and click Next.
17. At the Ready to Install screen, click Install to begin the installation.

18. When the application prompts you to do so, insert the second Windows Small Business Server 2003 Premium Technologies disk, and click OK.
19. At the end of the installation in the Setup Progress screen, click Next.
20. Click Finish to complete the installation.
21. Click Start → All Programs → Microsoft SQL Server 2005 → SQL Server Management Studio. Connect to the SQL Server instance.
22. Create a SQL Server login for the ds2user (see Configuring the database server (DVD Store) section below for the specific script to use).
23. Close Microsoft Server Management Studio.
24. Restart the server before installing SQL Server 2005 SP3.

Installing Service Pack 3 for Microsoft SQL Server 2005

Service Pack 3 is available for download from

<http://www.microsoft.com/downloads/details.aspx?FamilyID=ae7387c3-348c-4faa-8ae5-949fdfbe59c4&displaylang=en>.

1. Run SQLServer2005SP3-KB955706-x86-ENU.exe.
2. At the Welcome window, click Next.
3. At the License Terms window, select I accept the agreement, and click Next.
4. At the Feature Selection window, accept default selections, and click Next.
5. At the Authentication window, click Next.
6. At the Error and Usage Reporting Settings window, click Next.
7. At the Running Processes window, click Next.
8. Click Install.
9. If a message to reboot the computer appears, click OK.
10. At the Installation Progress window, click Next.
11. At the Installation Complete window, click Next.
12. Uncheck the Launch the User Provisioning Tool for Windows Vista after SP3 installation completes option, and click Finish.
13. Reboot the server.

Adding the SQL Server database partition

1. Click Start → Administrative Tools → Computer Management.
2. In the left hand pane of Computer Management, click Disk Management.
3. If the application prompts you to initialize a new disk, click Yes, select the appropriate disk to initialize, and click OK.
4. Right-click the appropriate Unallocated space within the initialized disk, and select New Partition...
5. Click Next.
6. At the Select Partition Type window, accept the default selections, and click Next.
7. At the Specify Partition Size window, accept the default selections, and click Next.
8. Assign an appropriate drive letter, and click Next.
9. At the Format Partition window, leave all defaults, check the Perform a quick format option, and click Next.
10. Click Finish.

Configuring the database server (DVD Store)

Data generation overview

We built the database schema using the scripts in the DS2 distribution package, though we made a few minor modifications. The DS2 stress tool provides options to generate 10MB, 1GB, or 100GB datasets. To get the tool to generate the 5 GB of user data we used in this test, we had to make a few straightforward changes to the source code and to the DVD Store application's scripts. Note: We created our test data on a Linux system to take advantage of the larger RAND MAX.

Editing the `ds2_create_orders.c` module

The module `ds2_create_orders.c` defines constants that define the maximum values for the customer ID and the product ID. The constants for the 5GB database size did not exist. We added the constants for this size.

On the command line for the `ds2_create_orders.c` module, we specified the size. The available options were S (small), M (medium), and L (large). We added the case V for the 5GB database. In the switch statement that sets the values for the variables `max_cust_id` and `max_prod_id`, we added cases that assigned them the proper values for the 5GB database size.

We recompiled the `ds2_create_orders.c` module on Linux, following the instructions in the header comments. We used the following command line:

```
gcc -o ds2_create_orders ds2_create_orders.c -lm
```

Editing the `ds2_create_cust.c` module

We had to make the same changes to the `ds2_create_cust.c` module that we made to the `ds2_create_orders.c` module. On the command line for the `ds2_create_cust.c` module, we specified the size. The available options were S (small), M (medium), and L (large). We added the case V for the 5GB database. In the switch statement that sets the values for the variables `max_cust_id` and `max_prod_id`, we added cases that assigned them the proper values for the 5GB database size.

We recompiled the `ds2_create_cust.c` module on Linux, following the instructions in the header comments. We used the following command line:

```
gcc -o ds2_create_cust ds2_create_cust.c -lm
```

Generating the data for the 5GB database

We used shell scripts to run all four of the executables that generate the data. The distribution did not include shell scripts for the 5GB size. We wrote shell scripts based on the `ds2_create_cust_large.sh` and `ds2_create_orders_large.sh` scripts. The `ds2_create_prod` and `ds2_create_inv` executables did not ship with associated shell scripts, so we created shell scripts using the instructions in the readme files. We ran the shell scripts in the following order to generate the data for the 5GB database:

1. `ds2_create_orders_5gb.sh`
2. `ds2_create_inv_5gb.sh`
3. `ds2_create_prod_5gb.sh`
4. `ds2_create_cust_5gb.sh`

We waited until the processes finished before we moved onto the next step.

Creating the database

We modified the database creation SQL Server scripts in the DVD Store distribution package to build the database schema, which includes the file structure, tables, indices, stored procedures, triggers, and so on. We built the 5GB database in SQL Server 2005, and then performed a full backup, storing the backup file on the C: drive for quick access. We used that backup file to restore on both servers between test runs.

We followed these steps to create the database:

1. We created the database and file structure using database creation scripts in the DS2 download. We made size modifications specific to our 5GB database and the appropriate changes to drive letters.
2. We created database tables, stored procedures, and objects.
3. We set the database recovery model to bulk-logged to prevent excess logging.
4. We loaded the data we generated into the database. For data loading, we used the import wizard in SQL Server Management Studio. Where necessary, we retained options from the original scripts, such as Enable Identity Insert.
5. We created indices, full-text catalogs, primary keys, and foreign keys using the database-creation scripts.
6. We updated statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
7. On the default SQL Server instance, we created a `ds2user` SQL Server login using the following Transact SQL (TSQL) script:

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

```
CHECK_POLICY=OFF
GO
```

8. We set the database recovery model back to full.
9. We made the following changes in the build scripts:
 - Because we varied the size of the datasets, we sized the files in our scripts to reflect the database size and the number of files per filegroup. We allowed for approximately 40 percent free space in our database files to ensure that filegrowth activity did not occur during the testing.
 - We followed Microsoft's recommendation of having 0.25 to 1 file per filegroup per core. The HP ProLiant ML110 G5 server has four cores and the Dell PowerEdge T410 has eight cores. We used two files per filegroup for the HP ProLiant ML110 G5 testing and six files per filegroup for the Dell PowerEdge T410 to maintain an equivalent ratio of 0.5 files per filegroup per core across both servers .
 - We did not use the DBCC PINTABLE command for the CATEGORIES and PRODUCTS tables, both because Microsoft recommends against this practice and because the commands do nothing in SQL Server 2005 or SQL Server 2008.
 - When running tests in SQL Server 2008, we added the FORCESEEK hint in the BROWSE_BY_ACTOR and BROWSE_BY_TITLE stored procedures because in initial testing we found that SQL Server 2008 was choosing an index scan instead of the preferred index seek, adding unnecessary overhead. We included this in the initial build and backup process we describe above.
 - We created a SQL Server login we called `ds2user` and mapped a database user to this login. We made each such user a member of the `db_owner` fixed database role.
 - Using the DVD Store scripts as a reference, we created the full-text catalog and index on the PRODUCTS table manually in SQL Server Management Studio.

We then performed a full backup of the database. This backup allowed us to restore the databases to a pristine state relatively quickly between tests.

[Editing the workload script - ds2sqlserverfns.cs module](#)

We changed the connection string to increase the number of available connections, to not use the default administrator ("sa") account, and to include a parameter for the database name. We raised the available connections limit from the default of 100 to 200 to allow room for experimentation. We created a user account we called `ds2User` and used that account.

The `ds2connect` routine in the `ds2sqlserverfns.cs` module defines `sConnectionString`. We used the following string; the changes we made appear in bold:

```
string sConnectionString = "User ID=ds2User;Initial
Catalog="+dbname+";Max Pool Size=200;Connection Timeout=120;Data
Source=" + Controller.target;
```


Recompiling the ds2sqlserverdriver.exe executable

We recompiled the ds2xdriver.cs and ds2sqlserverfns.cs module in Windows by following the instructions in the header comments. Because the DS2 instructions were for compiling from the command line, we used the following steps:

1. Open a command prompt.
2. Use the cd command to change to the directory containing our sources.
3. Run the batch file C:\Program Files\Microsoft Visual Studio 9.0\Common7\Tools\vsvars32.bat. This sets up the environment variables for us.
4. Execute the following command:

```
csc /out:ds2sqlserverdriver.exe ds2xdriver.cs ds2sqlserverfns.cs  
/d:USE_WIN32_TIMER /d:GEN_PERF_CTRS
```

Setting up the new server

We used the BIOS RAID configuration utility to create three RAID 1 partitions on the Dell PowerEdge T410 server, one for the operating system and the other two for the mailbox and SQL Server databases, respectively. Following the operating system installation, we installed all important Windows updates through June 16, 2010.

Installing Windows Server 2008 R2

1. Insert the installation DVD for Windows Server 2008 R2 into the DVD drive.
2. Choose the language, time and currency, and keyboard input. Click Next.
3. Click Install Now.
4. Choose Windows Server Standard (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. After the installation completes, click OK to set the Administrator password.
10. Enter the administrator password twice, and click OK.
11. Click Start, type `change power-saving settings` and press Enter.
12. Click Change plan settings.
13. Change the Turn off the display drop-down menu to Never.
14. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization windows.

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 . 16 . 3 in the IP address field.
 - f. Press Tab to auto-fill 255.255.255.0 in the Subnet mask field.
 - g. 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 `new-server` 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 mail server 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 (i.e., `mailserver.com`), and click Next.
 - g. At the Set Forest Functional Level screen, choose Windows Server 2003 from the drop-down menu, and click Next.
 - h. At the Set Domain Functional Level screen, choose Windows Server 2003 from the drop-down menu, and click Next.
 - i. At the Additional Domain Controller Options screen, accept the defaults, and click Next.
 - j. When the Static IP assignment window pops up, click Yes, the computer will use a dynamically assigned IP address.
 - k. When the Active Directory domain Services Installation Wizard window pops up, click Yes.
 - l. At the Location for Database, Log Files, and SYSVOL screen, 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.

Adding storage volumes

1. Click Server Manager→Storage→Disk Management.
2. When the wizard prompts you to initialize new disks, click OK. Note: If you must select a partition table, select MBR.
3. Right-click the first unallocated disk partition, and select New Simple Volume...
4. Click Next.

5. Use the entire storage space (this should be the default), and click Next.
6. Select the drive letter to assign to the new partition, and click Next.
7. Label the volume appropriately (e.g., DB1 and DBBackup), make sure Perform a quick format is checked, and click Next.
8. Click Finish.
9. Repeat steps 3 through 8 for any remaining partitions.

Installing .NET Framework 3.5.1 Features and Internet Information Services

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

Installing Microsoft Filter Pack 1.0

1. Download the Microsoft Filter Pack 1.0 (<http://www.microsoft.com/downloads/details.aspx?familyid=60c92a37-719c-4077-b5c6-cac34f4227cc&displaylang=en>).
2. Run FilterPackx64.EXE.
3. Click Next.
4. Click I accept the terms in the License Agreement, and click Next.
5. Click OK once installation is complete.

Installing Exchange Server 2010

1. Click Start, type `services` and press Enter.
2. Right-click the Net.Tcp Port Sharing service, and click properties.
3. Change the Net.Tcp Port Sharing startup type to Automatic, and click OK.
4. Double-click Exchange2010-RC1-x64.EXE.
5. Select a folder to extract the installation files to, and click OK.
6. Run Setup.EXE.
7. The installer should consider Steps 1 and 2 complete, and gray them out.
8. Click the link to Step 3: Choose Exchange Language Option.
9. Click Install only languages from the DVD.
10. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP1.
11. Click Next to go past the introduction screen.
12. Accept the license agreement, and click Next.
13. Select No for error reporting, and click Next.
14. Select Custom Exchange Server Installation, and click Next.

15. Select Mailbox, Client Access Services and Hub Transport (Exchange will automatically select Exchange Management Tools as well). Add mailbox.
16. Leave the organization name at default (First Organization), and click Next.
17. At the question about client computers running Outlook 2003 and earlier, select Yes, and click Next.
18. Click Next to accept defaults for Configure Client Access server external domain.
19. At the Customer Experience Improvement Program screen, select I don't wish to join the program at this time, and click Next.
20. If a warning about a lack of SMTP appears after the check finishes, ignore it.
21. Click Install to start the installation process.
22. Once installation is complete, click Finish. Exchange should automatically open the Exchange Management Console.

Configuring Exchange Server 2010 roles

1. If Exchange does not automatically open the Exchange Management Console, select Start→All Programs→Microsoft Exchange Server 2010→Exchange Management Console.
2. In the left pane, click Microsoft Exchange On-Premises.
3. In the left pane, expand Organization Configuration, and select Hub Transport.
4. In the action pane on the far right, select New Send Connector.
5. Name the send connector SMTP, select the intended use as Internet, and click Next.
6. In the Address space window, click Add.
7. In the SMTP Address Space window, type * as the address, ensure that the installer has checked Include all subdomains, and click OK.
8. Click Next.
9. Accept defaults for the next two pages by clicking Next.
10. At the New Connector page, click New to create the connector.
11. Click Finish to close the New SMTP Send Connector wizard.

Configuring the Exchange Server 2010 Mailbox role

1. Once the server successfully reboots, log in, and select Start→All Programs→Administrative Tools→Active Directory Users and Computers.
2. In the Active Directory Users and Computers window, select the server in the left pane, and open Users in the right pane.
3. Right-click a blank area in the Users folder, and select New→User.
4. 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.
5. Enter a secure password (we used Password1), and check Password never expires.
6. In the pop-up information window, click Accept.
7. Select Next to close the New Object – User window.
8. Double-click the new user to bring up the Properties window.
9. Under the Member Of tab, click Add.
10. In the Enter the object names to select dialog box, type Domain Admins; Enterprise Admins; Organization Management select Check Names to verify, and click OK.
11. Click OK to close the User Properties window and close the Active Directory Users and Computers window.
12. Select Start→All Programs→Microsoft Exchange Server 2010→Exchange Management Console.

13. In the left pane of the Exchange Management Console window, select Recipient Configuration; in the right pane, select New Mailbox.
14. In the New Mailbox window, select User Mailbox, and click Next.
15. In the User Type page, select Existing users, and click Add.
16. Select the new account you created earlier, and click OK to add it to selection box.
17. Click Next.
18. In the Mailbox Settings page, type `tester` in the Alias textbox, check the box next to Specify the mailbox database rather than using a database automatically selected, and select Browse in the Mailbox database selection spot.
19. In the Select Mailbox database window, select Mailbox Database, and click OK.
20. Click Next.
21. Click Next.
22. Click Finish.
23. In the left windowpane, expand Organization Configuration and Mailbox so Database Management tab is visible.
24. Right-click Mailbox Database, and select Properties.
25. Select the Maintenance tab.
26. Check the Enable circular logging box.
27. Check the box beside This database can be overwritten by a restore.
28. Click Customize next to Maintenance interval.
29. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
30. Click OK.
31. Click OK to any warnings about circular logging being applied after the database is remounted.
32. Click Move Database on the far right panel.
33. Change the Database file and Log folder path locations to `F:\Database\filename` and `F:\Maillogs` respectively, and click Move.
34. Click Yes if the application prompts you to dismount.
35. Click Finish.
36. In the right pane, click New Public Folder Database.
37. At the New Public Folder Database screen, enter Public Folder Database for the name, and click Next.
38. Under Server Name, click browse, select the appropriate server, and click OK.
39. Click Next.
40. Set the appropriate paths for the database file path and the log folder path, and click Next.
41. Click New.
42. Click Finish.
43. Right-click Public Folder Database, and select Properties.
44. Check the Enable circular logging box.
45. Check the This database can be overwritten by a restore box.
46. Click Customize next to Maintenance interval.
47. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
48. Click OK.
49. Click OK to any warnings about circular logging being applied after the database is remounted.
50. Click Move Database on the far right panel.

51. Change the Database file and Log folder path locations to E:\Database\filename) and D:\Publiclogs respectively, and click Move.
52. Click Yes if the application prompts you to dismount.
53. Click Finish.

Installing SQL Server 2008 R2 on the server

1. Insert the DVD.
2. At the AutoPlay menu, click Run SETUP.EXE.
3. Click Installation in the left pane.
4. Click New installation or add features to an existing installation.
5. At the Setup Support Rules screen, wait for the check to complete. If there are no failures or relevant warnings, click OK.
6. Select the Enter the product key radio button, and type in the product key. Click Next.
7. Click the checkbox to accept the license terms. Click Next.
8. Click Install to install the setup support files.
9. If there are no failures displayed, click Next. You may see a Computer domain controller warning and a Windows Firewall warning. For now, ignore these.
10. At the Setup Role screen, choose SQL Server Feature Installation.
11. At the Feature Selection screen, select Database Engine Services, Full-Text Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools –Basic, and Management Tools – Complete. Click Next.
12. At the Installation Rules screen, click Next once the check completes.
13. At the Instance configuration screen, leave the default selection of default instance, and click Next.
14. At the Disk space requirements screen, click Next.
15. At the Server configuration screen, choose NT AUTHORITY\SYSTEM for SQL Server Agent, and choose NT AUTHORITY\SYSTEM for SQL Server Database Engine. Click Next.
16. At the Database Engine Configuration screen, select Mixed Mode.
17. Enter and confirm a password for the system administrator account.
18. Click Add Current user. This may take several seconds.
19. Click Next.
20. At the Error and usage reporting screen, click Next.
21. At the Installation Configuration rules screen, check that there are no failures or relevant warnings, and click Next.
22. At the Ready to Install screen, click Install.
23. After installation completes, click Next.
24. Click Close.
25. Create a SQL Server login for the ds2user (see the Configuring the database server (DVD Store) section below for the specific script to use).
26. Place the DVD Store backup file you prepared in the default location for SQL Server: C:\Program Files\Microsoft SQL Server\MSSQL10.MSSQLSERVER\MSSQL\Backup.

Installing and configuring the Exchange 2003 mail test client (LoadGen)

We began our testing by installing a fresh copy of Microsoft Windows Server 2003 R2, Enterprise x86 Edition Service Pack 2 on the test client and installed all recommended Windows Updates as well as the

optional .NET Framework and Windows PowerShell installations. Before following these instructions, make sure to statically assign an IP address for the client, and then plug that port into the private network with the system under test. This allows the client to join the domain correctly. We followed this process for the installation:

1. Assign a computer name of `Clientx` for the mail client, where `x` is the client number.
2. For the licensing mode, use the default setting of five concurrent connections.
3. For the administrator log on, enter a password.
4. Select Eastern Time Zone.
5. Use typical settings for the Network installation.
6. Assign a name of `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. Right-click My Computer, and select Properties.
2. Under the Computer Name tab, click Change.
3. In the Computer Name Changes window, under the Member of section, select the Domain radial box, and type `test.local`
4. To start joining the domain, select OK.
5. When the window appears asking for a person qualified on the domain, type `Administrator` as the username and `Password1` as the password.
6. At the Welcome pop-up window and the window warning that you must reset the computer for the changes to take effect, click OK.
7. At the System Properties window, click OK.
8. When a pop-up appears asking if you want to restart now, click Yes.

Installing Internet Information Services

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

Adding an additional domain controller on an existing domain

1. Click Start→Run, type `CMD` and click OK.

2. At the command prompt screen, type `dcpromo`
3. At the Welcome to the Active Directory Installation Wizard window, click Next.
4. At the Operating System Compatibility window, click Next.
5. Select Additional Domain Controller at the Domain Controller Type window, and click Next.
6. At the Network Credentials, enter a user name and corresponding password with administrative privileges, and click Next.
7. Leave test.local as the Domain name, and click Next.
8. Leave the default options in the Database and Log Folders window, and click Next.
9. Leave defaults at the Shared System Volume, and click Next.
10. Enter an appropriate Restore Mode Password, and click Next.
11. At the Summary window, click Next.
12. Click Finish.

Installing Exchange Server 2007 and Load Generator

1. Insert the Microsoft Exchange Server 2007 x86 Management Tools CD. The CD should automatically launch the installation software.
2. If Windows Updates did not offer these options, install the latest versions of .NET Framework and Windows PowerShell.
3. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP1.
4. Click Next to go past the introduction screen.
5. Accept the license agreement, and click Next.
6. Select No for error reporting, and click Next.
7. Select Custom Exchange Server Installation, and click Next.
8. Check Management Tools, and click Next.
9. After the check finishes, click Install to start the installation process.
10. Once the installation completes, click Finish.
11. Download and install Load Generator using all defaults.

Preparing Load Generator

1. Select Start→All Programs→Microsoft Exchange→Exchange Load Generator.
2. When the Load Generator window appears, select Start a new test.
3. Select Create a new test configuration, and click Continue.
4. In the Specify test settings window, change the total length of the simulation to 30 minutes, type `Password1` as the Directory Access Password and Mailbox Account Master Password, and click Continue with recipient management.
5. Enter the appropriate number of users in the Mailbox Database, and click Continue.
6. To accept defaults for Advanced recipient settings, click Continue.
7. In the Specify test user groups window, select the plus sign (+) to add a user group.
8. Change the Client Type to Outlook 2003 Cached for testing Windows Small Business Server 2003, or Outlook 2007 Cached for testing Windows Small Business Server 2008, and the Action Profile to Average, and click Continue.
9. Leave defaults in Remote configurations, and click Continue.
10. Click Save the configuration file as, and name it `lightcfg.xml`
11. Click Start the initialization phase (recommended before running the test) to start initialization. The initialization process might take a few hours.

Installing and configuring the Exchange 2010 mail test client (LoadGen)

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:

Installing Windows Server 2008 SP2 x64

1. Insert the installation DVD for Windows Server 2008 SP2 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. After the installation completes, click OK to set the Administrator password.
10. Enter the administrator password twice, and click OK.
11. Click Start, type `change power-saving settings` and press Enter.
12. Click Change plan settings.
13. Change the Turn off the display drop-down menu to Never.
14. Click Save changes, and close the Power Options, Screen Saver Settings, and Personalization windows.

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

Joining the domain

1. Select Start→Control Panel→Network Connections→Local Area Connection.
2. Click Properties.
3. Highlight Internet Protocol (TCP/IP), and click Properties.
4. Select the Use the following DNS server addresses radio button, and enter the IP of the DNS server in the Preferred DNS server field. Click OK.
5. Right-click My Computer, and select Properties.
6. Under the Computer Name tab, click Change.
7. In the Computer Name Changes window, under the Member of section, select the Domain radial box, and type `exchange2010.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

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

Installing Load Generator

Download and install Load Generator using all defaults.

Preparing Load Generator

1. Log into the MailClient using the tester account.
2. Select Start→All Programs→Microsoft Exchange→Exchange Load Generator 2010 Beta.
3. When the Load Generator window appears, select Start a new test.
4. Select Create a new test configuration, and click Continue.
5. Change total length of simulation to 30 minutes.
6. Verify that tester is the account name.
7. In the Specify test settings window, type `Password1` as the Directory Access Password and Mailbox Account Master Password, and click Continue with recipient management.
8. Make 150 users in each Mailbox Database, and click Continue.
9. To accept defaults for Advanced recipient settings, click Continue.
10. In the Specify test user groups window, select the plus sign to add a user group.
11. Change the Client Type to Outlook 2003 Cached, the Action Profile to Light, and the Mailbox size to 100MB.
12. Check the PreTestLogon check box, and click Continue.
13. Leave defaults in Remote configurations, and click Continue.
14. Click Save the configuration file as, and name it `lightcfg.xml`
15. After saving the configuration file, check the Initialize public store as well checkbox and click Start the initialization phase (recommended before running the test).

Backing up the mail database

On the test server, once you have set up LoadGen and created its initial mail database, you need to back up that database so you can have clean copies for each test.

For Windows Small Business Server 2003 R2

1. Click Start → All Programs → Microsoft Exchange → System Manager.
2. In Exchange System Manager, expand Administrative Groups, then first administrative group, then servers, then server name in the left pane.
3. Expand the First Storage Group, right-click Mailbox Store, and select Dismount store from the menu.
4. On the Do you want to continue? pop-up message, click Yes.
5. Right-click Public Folder store, and select Dismount store from the menu.
6. On the Do you want to continue? pop-up message, click Yes. The red arrow appears when you have dismounted the Public Folder Store.
7. Using Windows Explorer, create two new folders: C:\backup\Mailbox Store and C:\backup\Public Folder Store.
8. With Windows Explorer, copy priv1.edb and priv1.stm from E:\Mailstore, and pub1.edb and pub1.stm from D:\Publicstore to C:\backup\Public Folder Store. This process may take several minutes.
9. Close Windows Explorer.
10. In System Manager console, right-click Mailbox Database, and select Mount Database from the menu.
11. Right-click the Public Folder Database, and select Mount Database from the menu.
12. Close Exchange System Manager.

For Windows Server 2008 R2

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

APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 5 provides detailed configuration information about the two test servers.

Servers	Dell PowerEdge T410	HP ProLiant ML110 G5
General dimension information		
Height (inches)	18	14.5
Width (inches)	8.5	6.9
Depth (inches)	23.5	16.8
Power supplies		
Total number	1	1
Wattage of each (W)	525	365
Cooling fans		
Total number	1	1
Dimensions (h x w)	4.75" x 4.75"	3.50" x 3.75"
General processor setup		
Number of processor packages	2	1
Number of cores per processor package	6	2
Number of hardware threads per core	2	1
System power management policy	Balanced	Always On
CPU		
Vendor	Intel	Intel
Name	Xeon X5660	Xeon 3075
Stepping	B1	G0
Socket type	LGA1366	LGA775
Core frequency (GHz)	2.80	2.66
L1 cache	32 KB + 32 KB (per core)	32 KB +32KB (per core)
L2 cache	6 x 256 KB	4 MB
L3 cache	12 MB	N/A
Platform		
Vendor and model number	Dell PowerEdge T410	HP ProLiant ML110 G5
Motherboard model number	0M638F	445072-001
Motherboard revision number	A00	H1
BIOS name and version	Dell Inc. 1.3.9 (04/07/2010)	HP O15 (10/09/2009)
BIOS settings	Default	SATA RAID Enabled
Memory modules		
Total RAM in system (GB)	16	4
Number of types of memory modules	1	1
Vendor and model number	Crucial CT51272BB1339.36SFD1	HP 445166-051
Type	PC3-10600R	PC2-6400E

Servers	Dell PowerEdge T410	HP ProLiant ML110 G5
Speed (MHz)	1,333	800
Speed in the system currently running @ (MHz)	1,333	800
Timing/latency (tCL-tRCD-iRP-tRASmin)	9-9-9-24	6-6-6-18
Size (GB)	4	1
Number of RAM modules	4	4
Chip organization	Double-sided	Double-sided
Hard disk		
Vendor and model number	Seagate ST3300657SS	HP GB0160CAABV
Number of disks in system	6	4
Size (GB)	300	160
Buffer size (MB)	16	8
RPM	15,000	7,200
Type	SAS	SATA
Operating system		
Primary server		
Name	Windows Server 2008 R2 Standard Edition	Windows Small Business Server 2003 R2 Premium
Build number	7600	3790
File system	NTFS	NTFS
Language	English	English
Member server		
Name	N/A	Windows Server 2003 Standard R2 SP2
Build number	N/A	3790
File system	N/A	NTFS
Language	N/A	English
Network card/subsystem		
Vendor and model number	Broadcom BCM5716C NetXtreme II GigE	HP NC105i Gigabit Server Adapter
Type	Integrated	Integrated
Optical drive		
Vendor and model number	Hitachi-LG Data Storage DH20N	HP GH40L
RAID controller		
Type	Dell PERC H700 RAID Controller	Embedded SATA-RAID
USB ports		
Number	6	6
Type	2.0	2.0

Figure 5: Configuration information for the test servers.

ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.
1007 Slater Road, Suite 300
Durham, NC, 27703
www.principledtechnologies.com

We provide industry-leading fact-based marketing and technology assessment services that help technology vendors and buyers understand the real differences among products. We bring to every assignment extensive experience with and expertise in all aspects of technology marketing, testing, and analysis; from researching new technologies, to developing new methodologies, to testing with existing and new tools, to delivering the results in whatever form best communicates them.

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, white papers, PowerPoint presentations, and videos. Every piece of collateral reflects the results of our trusted independent analysis.

We customize our services to focus on each client's requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to assess how it will fare against its competition and to highlight its strengths.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for 25 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 is a registered trademark of Principled Technologies, Inc.
All other product names are the trademarks of their respective owners.

Disclaimer of Warranties; Limitation of Liability:

PRINCIPLED TECHNOLOGIES, INC. HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, PRINCIPLED TECHNOLOGIES, INC. SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND AGREE THAT PRINCIPLED TECHNOLOGIES, INC., ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC. BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC.'S LIABILITY, INCLUDING FOR DIRECT DAMAGES, EXCEED THE AMOUNTS PAID IN CONNECTION WITH PRINCIPLED TECHNOLOGIES, INC.'S TESTING. CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES ARE AS SET FORTH HEREIN.
