

## Dell™ PowerVault™ DL Backup to Disk Appliance powered by Symantec™ Backup Exec™ 2010 R3 dramatically reduced backup time and data storage needs in a virtualized scenario



compared to disk-based backup without deduplication



Companies of all sizes are looking to move away from traditional inefficient and costly backup technologies. Such methods back up data indiscriminately, failing to differentiate between new and previously saved data. This is particularly problematic with remote offices, where the dutiful transfer of all backup data to the central office wastes time, WAN bandwidth, and storage resources. By comparison, source deduplication methods back up only changed or new data to the central office, saving time, improving bandwidth utilization, using storage more efficiently, and thus lowering storage costs.

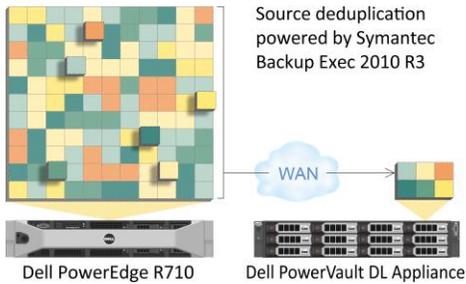
Symantec Backup Exec 2010 R3 includes powerful source deduplication technologies that let companies back up their data efficiently. Symantec Backup Exec 2010 R3, combined with the Dell PowerVault DL Backup to Disk Appliance, is a full-featured data protection solution that eliminates the waste of less efficient systems.

We measured firsthand the advantages that the Dell-Symantec solution delivers when using source deduplication to back up databases, mail, and other files running on Microsoft® Hyper-V™ virtual machines. The solution drastically reduced both backup time and data storage needs in our tests, compared to data backup without source deduplication. For instance, in our file server virtual machine testing, we experienced an average deduplication ratio of 32.3 to 1. We also experienced an average time reduction of 3 hours to complete the backup. Because Symantec Backup Exec 2010 R3 backs up the entire virtual machine (VM) and all associated virtual disks, we have found that timing and deduplication ratios are even higher in the Microsoft Hyper-V testing scenarios than in a stand-alone application-server testing scenario.

These results show the types of storage and time savings that the Dell-Symantec solution can deliver.



## DATA BACKUP 101: SOURCE DEDUPLICATION EXPLAINED



**Source deduplication eliminates backup inefficiencies by transferring only unique blocks of data across the WAN.**

Source deduplication offers an efficient way for companies to back up their data. After an initial full backup, deduplication software searches for duplicate data in subsequent backups and then only backs up blocks of data that are new or changed. “Source” means the data is deduplicated at its source, likely a server or desktop at a remote location, before it is passed to the central backup site.

Because the large majority of data typically remains constant from day to day, transferring only new or changed blocks of data from the remote office to the central office with source deduplication is the wise choice when bandwidth, time, and space are at a premium.

## THE DELL-SYMANTEC ADVANTAGE

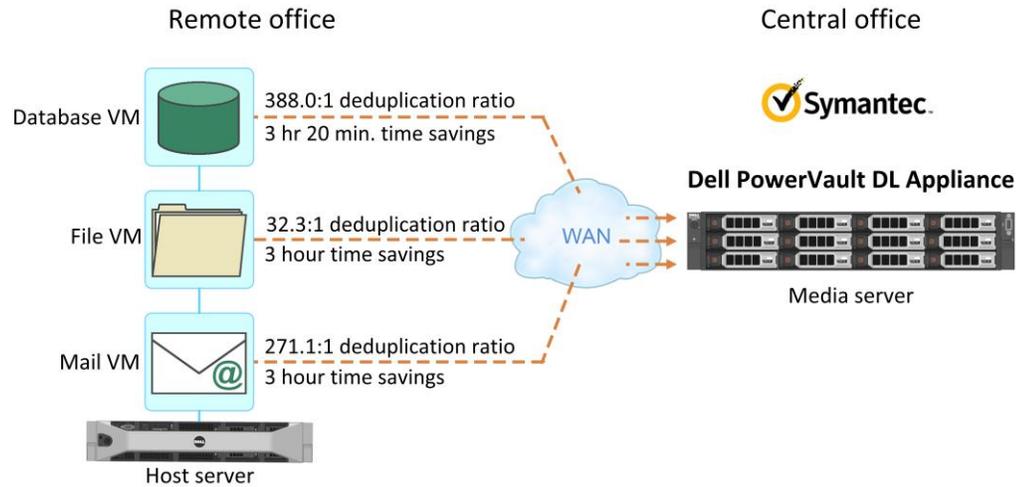
Dell and Symantec have partnered to offer an integrated disk-based backup solution. Symantec Backup Exec 2010 R3 is already fully installed on the Dell PowerVault DL Appliance, and an automated setup wizard guides you through setup, configuration, and deployment. This solution offers features such as granular recovery (allowing you to back up specific files without running a full restore) and remote backup, monitoring, and maintenance. For a full list of features, see <http://i.dell.com/sites/content/shared-content/data-sheets/en/Documents/ss703-powervault-dl-backup-to-disk-appliance-symantec.pdf>.

## LESS DATA SAVED, LESS TIME SPENT

By deduplicating the data at the source, the Dell-Symantec solution was far more efficient than disk-based backup without source deduplication, which we also tested. The Dell-Symantec solution reduced the amount of data traveling over the WAN by a factor of more than 32 when backing up a file server virtual machine and even more when backing up the database-and mail-server virtual machines.

By backing up only new data, the Dell-Symantec solution reduced the database backup window from over 6.5 hours to an average of around 3 hours, reduced the file server backup window from over 6 hours to an average of 3 hours, and reduced the mail server backup window from over 6 hours to an average of 3 hours.

**Figure 1: The Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 made good on its promise to significantly reduce the amount of data storage and time needed during data backups.**



The Symantec Remote Agent compared the data on the remote server to the existing backup data on the media server. When it found a duplicate, it sent only a marker to the media server at the central office. As a result, the remote server transmitted far less data to the media server. This not only saved WAN bandwidth, but also decreased the volume of data the media server had to store—both of which add up to savings. In a straightforward process, we used the Symantec Backup Exec console to simply select the deduplication storage folder and select the option for remote access of the media server while configuring the backup job.

**The Symantec Backup Exec console made backing up data from a remote location easy.**

The difference between the volume of data and the volume of data actually stored increases over time, benefiting the business by requiring significantly less long-term storage capacity.

Detailed information on the hardware and test bed configuration is located in [Appendix B](#) and [Appendix C](#). Detailed results of the test scenarios that follow are located in [Appendix E](#).

## Database server backup scenario

The initial complete database backup took almost 5 hours. Subsequent full database backups using source deduplication took an average of 3 hours and 13 minutes, achieving a deduplication ratio of at least 179.8:1. For comparison, we ran a single backup using a backup-to-disk storage device on the Dell PowerVault DL Appliance without source deduplication, which took roughly 6 hours and 41 minutes.

Figure 2 shows the comparison of protected data versus actual deduplication data stored for our virtualized database server scenario.

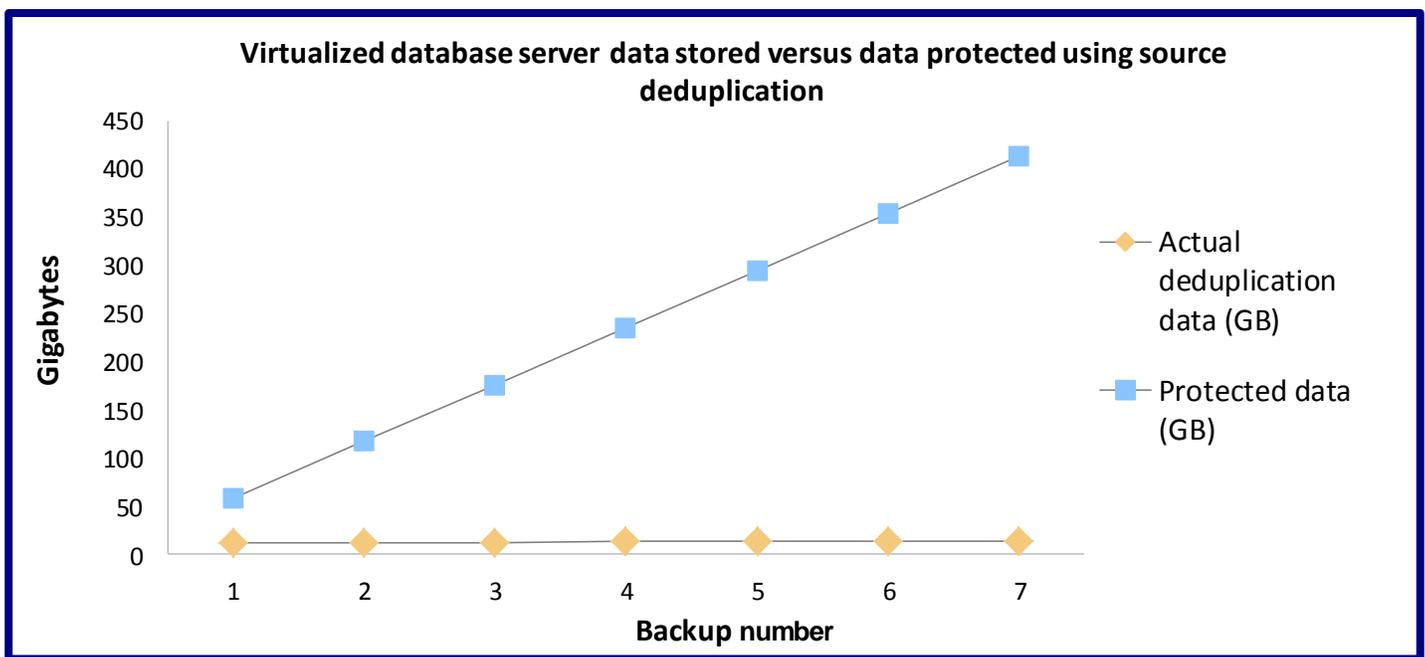


Figure 2: Comparison of protected data versus the actual data stored from our 7-day database backup simulation of a virtualized SQL Server database.

## File server backup scenario

The initial complete backup of our file server took just over 6 hours. Subsequent full file server backups using source deduplication took an average of just over 3 hours, achieving a deduplication ratio of at least 24.4:1. For comparison, we ran a single backup using a backup-to-disk storage device on the Dell PowerVault DL Appliance without source deduplication, which took just over 6 hours.

Figure 3 shows the comparison of protected data versus actual deduplication data stored for our virtualized file server scenario.

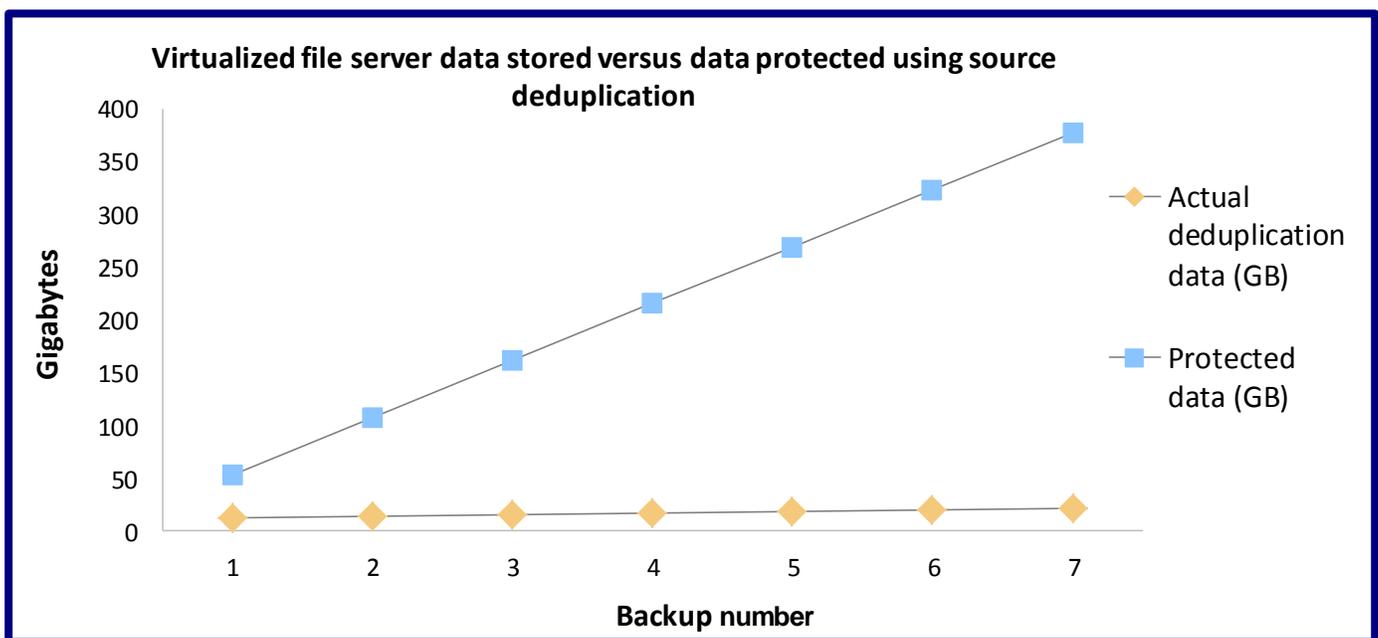


Figure 3: Comparison of protected file server data versus the actual data stored from our 7-day virtualized file server backup simulation.

## Mail server backup scenario

The initial complete backup took just 7 hours. Subsequent full mail-storage-group backups using source deduplication took an average of 3 hours, achieving a deduplication ratio of at least 177.4:1. For comparison, we ran a single backup using a backup-to-disk storage device on the Dell PowerVault DL Appliance without source deduplication, which took roughly 6 hours.

Figure 4 shows the comparison of protected data versus actual deduplication data stored for our virtualized mail server scenario.

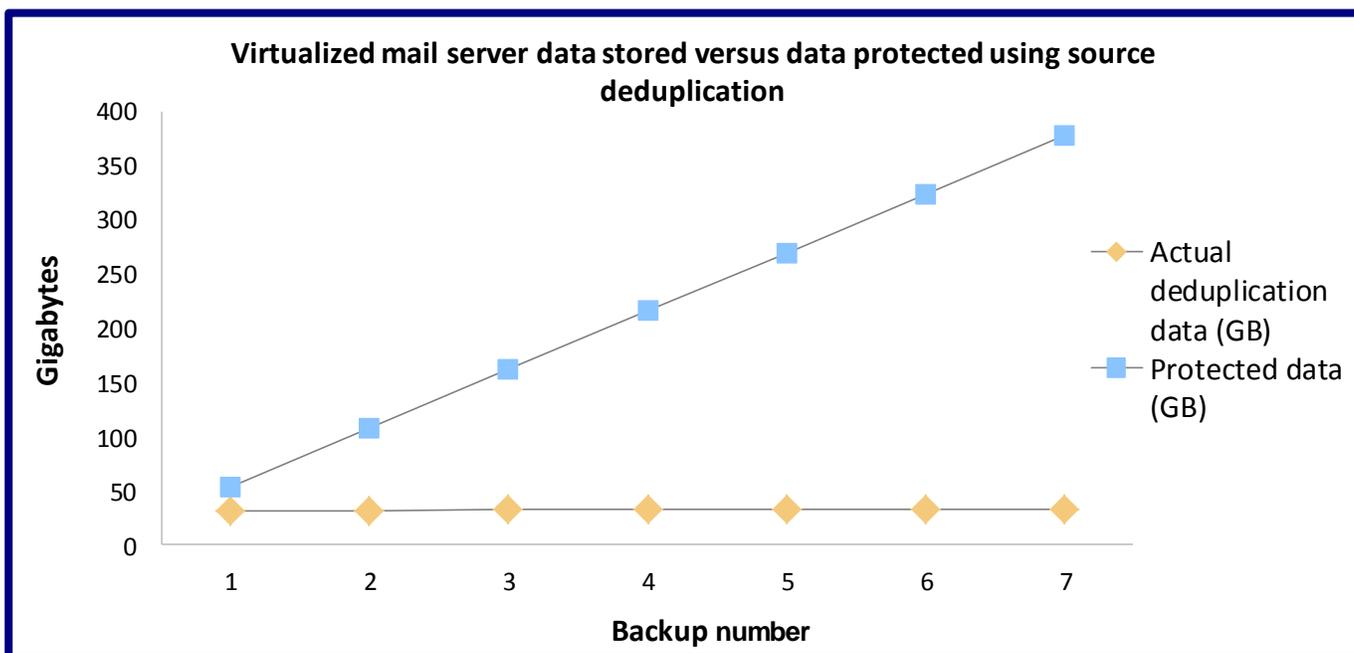


Figure 4: Comparison of protected mail server data versus the actual data stored from our 7-day virtualized Exchange 2007 backup simulation.

## SUMMARY

The Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 saved considerable amounts of storage space, bandwidth, and time in our tests. Compared to backup without source deduplication in a virtualized scenario, it reduced the amount of data transmitted over the WAN by an average factor of 230.5 to 1 and saved an average of 3 hours.

## APPENDIX A – DETAILED WORKLOAD & TEST DESCRIPTIONS

All three test scenarios included an Active Directory® server, a client machine on the “remote office” side of the WAN, and the Hyper-V host server with the application-specific virtual server (i.e., the database server, file server, or mail server). We set our WAN emulator to use a T3 bandwidth with 15ms latency. We installed a Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 on the “central office” side of the WAN. On the Hyper-V host and all three virtual machines, we performed a full backup of the relevant data, and then we executed the workload and backup operations, using full backups each time.

We allowed the Dell PowerVault DL Appliance backup appliance to auto-provision the storage for deduplication, and configured the remote agent on the database server, file server, or mail server virtual machines to have direct access to the Dell PowerVault DL Appliance, for the purposes of source deduplication.

### Database server backup scenario

To build the workload, we used DVD Store Version 2 (DS2). DS2 is an open-source simulation of an online e-commerce DVD store, where customers log in, browse, and order products. DS2 has database components and Web server components, and includes driver programs that put heavy loads on these components. We used the included driver program to perform the workload only against the database component. The Dell PowerEdge™ R710 server under test ran a Microsoft SQL Server 2008 workload once per backup period, and we repeated this workload-plus-backup iteration 7 times to simulate 7 days of activity. One copy of the DS2 database was on the server, with a 1GB database.

The DS2 benchmark’s main metric is orders per minute, or OPM. We used the OPM output by the benchmark to determine when we had reached at least 10,000 orders for the benchmark run. For the purposes of this testing scenario, we analyzed the deduplication ratio and the elapsed time of each full backup source deduplication turned off, and then on.

We found we could achieve our target daily order rate of 10,000 orders by using specific DVD Store parameters. To mimic a business day where a company fulfilled 10,000 orders, we adjusted the DVD Store parameters to run with five execution threads, each executing with 0.1 seconds of think time. This mix of workload parameters, on average, achieved an orders-per-minute throughput of just over 2,000. Therefore, we ran this workload for at least 5 minutes to simulate the full business day, resulting in at least 10,000 orders. The test placed a moderate to heavy load on the server, modifying realistic amounts of data at the source for the Symantec Backup Exec 2010 R3 software to deduplicate and then back up.

When DS2 is executing, simulated customers log in; browse movies by actor, title, or category; and purchase movies. Each DS2 order consists of a customer login, a number of searches for movies, and a purchase. Each search is by title, actor, or category. The title and actor searches use full-text search. The other customer actions, including adding new customers, exercise a wide range of database functions.

We ran the included driver application on client machines directly via its command-line interface. We used the default DS2 parameters and setup configuration, with the exceptions we note in the DVD Store setup section in the Test methodology section of this report. For more details about the DS2 tool, see

<http://www.delltechcenter.com/page/DVD+Store>.

To measure the deduplication ratio and elapsed time from Symantec Backup Exec 2010 R3, we created a backup job, targeted our specific 1GB database on the Dell PowerEdge R710 running SQL Server 2008, selected the

deduplication storage folder as the destination, and selected the option to allow the remote agent to have direct access to the media server. We then executed this same backup job between workload iterations to gather the deduplication, job rate, and elapsed time statistics. As a comparison point, we also created an additional backup job, using a backup-to-disk destination instead with no deduplication. For more details on this process, see [Appendix D](#).

## File server backup scenario

In our file server backup scenario, we used a file server running Microsoft Windows Server® 2008 R2 and a custom workload to simulate data change rates. To build the workload, we used AutoIT, an automation-scripting tool that you can customize to simulate different actions on Microsoft Office® documents, as well as other file formats. We wrote and executed scripts that performed the following actions:

- Changed 3 percent of Microsoft Excel® files in the following ways:
  - Modified a random number (between 1 and 20) of cells.
    - With cells containing numeric values, the script appended random values to the existing value.
    - With cells containing string values, the script appended a string retrieved from another file to the existing string.
    - With other cells, it filled the cell with a random numeric value.
  - On worksheets containing more than 20 columns, the script deleted a single column.
  - On worksheets containing more than 20 rows, the script deleted a single row.
  - On worksheets 1 to 5 of workbooks containing fewer than 10 columns and fewer than 200 rows, the script added a row of numeric values.
  - In workbooks containing three worksheets, the script added an additional worksheet with a random number of rows and columns, all containing random values.
  - After making the changes, the script saved and closed two-thirds of the changed files and saved the remaining files to a new filename in the same folder.
- Changed 3 percent of Microsoft Word files in the following ways:
  - Copied between 1 and 10 randomly chosen paragraphs from a source document into random places in the target document.
  - After making the changes, the script saved and closed two-thirds of the changed files and saved the remaining files to a new filename in the same folder.
- Changed 3 percent of Microsoft PowerPoint® files in the following ways:
  - Copied a randomly chosen slide from a source PowerPoint file containing more than 300 slides onto the end of the target PowerPoint file.
  - After making the changes, saved the file.
- Deleted 1 percent of all files.
- Moved 2 percent of all files.
- Copied between 160 and 200 files into random directories in the file share.

After writing the script, we compiled it into a self-contained executable that we executed from a command-line prompt. Our workstation executed this workload against the Dell PowerEdge R710 file server under test once per backup period, and we repeated this workload-plus-backup iteration 7 times to simulate 7 days of activity. We started with one copy of our 12GB data set on the file server, which the workload then manipulated over the course of the 7 simulated days.

To measure the deduplication ratio and elapsed time from Symantec Backup Exec 2010 R3, we created a backup job, targeted our folder containing 12 GB of files on the Dell PowerEdge R710, selected the deduplication storage folder

as the destination, and selected the option to allow the remote agent to have direct access to the media server. We then executed this same backup job between workload iterations to gather the deduplication, job rate, and elapsed time statistics. As a comparison point, we also created an additional backup job, using a backup-to-disk destination instead with no deduplication. For more details on this process, see [Appendix D](#).

## Mail server backup scenario

In our mail server backup scenario, we used a mail server running Microsoft Windows Server 2008 x64 and Microsoft Exchange Server 2007, along with a client running Microsoft Exchange Load Generator (LoadGen) to simulate data change rates. LoadGen is an industry-standard tool for benchmarking an Exchange 2007 mail server. We based the workload on the settings from LoadGen's average workload. Our workload consisted of 300 users, and we compressed the workday tasks into a 30-minute test run to simulate 1 day. During the tests, LoadGen performs tasks to simulate users generating Exchange mail activity.

After configuring the LoadGen workload, we exported the configuration file and used it as an execution parameter, calling the LoadGenCMD utility directly from the command line. Our workstation executed this workload against the Dell PowerEdge R710 mail server under test once per backup period, and we repeated this workload-plus-backup iteration 7 times to simulate 7 days of activity. We started with one copy of our mail storage group on the mail server, which the workload then manipulated over the course of the 7 simulated workdays.

For the purposes of this testing scenario, we analyzed the deduplication ratio and the elapsed time of each full backup source deduplication turned off, and then turned on.

To measure the deduplication ratio and elapsed time of our backup jobs in Symantec Backup Exec 2010 R3, we created a backup job, targeted our Exchange storage group on the Dell PowerEdge R710, selected the deduplication storage folder as the destination, and selected the option to allow the remote agent to have direct access to the media server. We then executed this same backup job between workload iterations to gather the deduplication ratio, job rate, and elapsed time statistics. As a comparison point, we also created an additional backup job, using a backup-to-disk destination instead with no deduplication. For more details on this process, see [Appendix D](#).

## APPENDIX B – DETAILED SYSTEM SPECS

Figure 5 presents detailed information for the hardware we used in this report.

Servers	Dell PowerEdge R710	Dell PowerVault DL Appliance
<b>General dimension information</b>		
Height (inches)	3.5	3.5
Width (inches)	17.5	17.5
Depth (inches)	27.0	27.0
U size in server rack (U)	2	2
<b>General processor setup</b>		
Number of processor packages	2	2
Number of cores per processor package	4	4
Number of hardware threads per core	2	2
<b>CPU</b>		
Vendor	Intel®	Intel
Name	Xeon® E5570	Xeon E5620
Stepping	D0	B1
Socket type	LGA1366	LGA1366
Core frequency (GHz)	2.93	2.40
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 (MB)	8	12
<b>Platform</b>		
Vendor and model number	Dell PowerEdge R710	Dell PowerVault DL Appliance
Motherboard model number	OYDJK3	ODPRKF
Motherboard revision number	A02	A02
BIOS name and version	Dell 3.0.0	Dell 1.5.3
<b>Memory modules</b>		
Total RAM in system (GB)	24	24
Vendor and model number	Micron MT36JSZF51272PY-1G4D1AB	Samsung M393B1K70BH1-CF8
Type	PC3-10600 DDR3	PC3-8500 DDR3
Speed (MHz)	1,333	1,067
Speed in the system currently running @ (MHz)	1,067	1,067
Timing/latency (tCL-tRCD-iRP-tRASmin)	7-7-7-20	7-7-7-20
Size (GB)	24	24
Number of RAM modules	6 x 4 GB	6 x 4 GB
Chip organization	Double-sided	Double-sided
<b>Hard disk</b>		
Vendor and model number	Seagate ST973451SS	Dell ST3500414SS
Number of disks in system	8	8
Size (GB)	73	500

<b>Servers</b>	<b>Dell PowerEdge R710</b>	<b>Dell PowerVault DL Appliance</b>
Buffer size (MB)	16	8
RPM	15,000	7,200
Type	SAS	SAS
Controller	Dell PERC 6/i Integrated RAID Controller	Dell PERC H700 Integrated RAID Controller
Driver version	LSI 4.5.0.64 (02/06/2009)	Dell 4.31.1.64 (08/09/2010)
<b>Operating system</b>		
Name	Windows Server 2008 R2 Enterprise	Windows Server 2008 Standard
Build number	7601	7600
File system	NTFS	NTFS
Language	English	English
<b>Network card/subsystem</b>		
Vendor and model number	Broadcom® BCM5709C NetXtreme® II	Broadcom BCM5709C NetXtreme II
Type	Integrated	Integrated
Driver version	Broadcom 5.2.14.0 (12/17/2009)	Broadcom 6.0.29.0 (9/2/2010)
<b>Optical drive</b>		
Vendor and model number	TEAC DV28SV DVD-ROM	N/A
<b>USB ports</b>		
Number	4	4
Type	2.0	2.0

Figure 5: Detailed system configuration information for the test hardware.

## APPENDIX C – DETAILED TESTBED CONFIGURATION

In this appendix, we present our testbed configuration.

### Networking switch

- Dell PowerConnect™ 5448

### Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3

- Dell PowerVault DL Appliance with 2 x Intel Xeon Processor E5620s and 24GB RAM
- 4 x Broadcom BCM5709C Network Interface Cards
- One volume containing 2 x 500GB disks in RAID 1 configuration
- One volume containing 4 x 500GB disks in RAID 5 configuration

### File server

- Dell PowerEdge R710
- 2 x Intel Xeon processor E5570s
- 4 x Broadcom BCM5709C Network Interface Cards
- 8 x 15K SAS 2.5" drives; 1 x 2-disk RAID 1 and 1 x 6-disk RAID 5
- Windows Server 2008 R2
- File Server role enabled

### Active Directory server

- Dell PowerEdge 2650
- 2 x Intel Xeon processor 2.80 GHz
- 2 x Broadcom NetXtreme Gigabit Ethernet NICs
- One volume containing 2 x 36GB SCSI disks in a RAID 1 configuration

### File server load-generating clients

- One workstation-class machines
  - Windows Vista® Ultimate
  - AutoIT3 compiled workload driver

### WAN emulator

- Dell PowerEdge R610
  - FreeBSD 8.5
  - Compiled with ipfw and dummynet
  - Use the following command line settings to restrict the bandwidth and add delay:  

```
ipfw add 1000 pipe 1 ip from any to any  
ipfw pipe 1 config delay 3ms bw 45813Kbit
```

Note: ipfw 3ms delay results in 15ms actual round-trip latency.

Figure 6 illustrates our Dell PowerVault DL Appliance WAN test bed.

Dell PowerVault DL Appliance (media server)



Dell PowerEdge R710 (test server)



Dell PowerConnect 5448



Dell PowerEdge R610 (WAN emulator)



Dell PowerEdge 2650 (Active Directory server)



Client machine

Figure 6: Our Dell PowerVault DL Appliance WAN test bed.

## APPENDIX D – DETAILED TEST METHODOLOGY

In this appendix, we present the detailed steps we used to set up each test scenario. We first present those steps common to each scenario, and then present those steps unique to each scenario. Note that we reconfigured the Dell PowerEdge R710 between each test scenario.

### Setting up and configuring the Active Directory server

We used a separate Active Directory server for our test bed.

#### Setting up the operating system

1. Boot the server, and insert the Windows Server 2003 R2 installation CD in the CD drive.
2. At the Welcome to Set up screen, press Enter to begin the installation.
3. At the Windows Licensing Agreement screen, press F8 to agree to the terms.
4. Press Enter to install in the default location.
5. Select Format the partition using the NTFS file system (Quick), and press Enter to continue.
6. At the Regional and Language Options screen, click Next.
7. Enter Name and Organization, and click Next. Note: Organization is an optional field, while username is required.
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, type `Password1` as the new password in both fields, 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, the installer will prompt you to insert the second installation CD. Insert the appropriate CD, 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. When the installer prompts you, click Finish to end the installation.

#### Promoting the active directory server using dcpromo

1. Click Start, click Run, type `cmd` in the prompt, and press Enter.
2. Type `dcpromo`, and press Enter.
3. Click Next.
4. Click Next.
5. Click Next.
6. Select Create a new domain in a new forest, and click Next.
7. Type `domainname.local` as the FQDN (Fully Qualified Domain Name), where `domainname` is the name of your domain, and click Next.
8. Set the forest functional level to Windows Server 2003, and click Next.
9. Set the domain functional level to Windows Server 2003, and click Next.
10. Leave defaults on the Additional Domain Controller Options screen, and click Next.
11. If a warning window appears asking about dynamically assigned IP addresses, click Yes.
12. Click Yes to continue.
13. Leave defaults at the Location for Database, Log Files, and SYSVOL screen, and click Next.
14. At the Directory Services Restore Mode Administrator Password screen, type `Password1`
15. At the summary screen, click Next.
16. Click Finish.

17. Click Restart now.

## Setting up and configuring the Hyper-V host server

### Installing the operating system

1. Boot the Dell PowerEdge R710 server.
2. When prompted by the boot to enter the storage configuration, press Ctrl+R.
3. Highlight Controller 0 and press F2, and choose Clear Config.
4. Accept the warning of loss of data.
5. Highlight Controller 0 and press F2, and choose Create New VD.
6. Choose RAID 1, select the first two disks, leave other options at the default values, and press OK.
7. Accept the warning regarding initialization.
8. Highlight the Virtual Disk, and press F2, Initialization, Start Init.
9. Highlight Controller 0, press F2, and choose Create New VD.
10. Choose RAID 5, select the remaining six disks, leave other options at the default values, and press OK.
11. Accept the warning regarding initialization.
12. Highlight the new Virtual Disk and press F2, Initialization, Start Init.
13. After initialization completes, press Esc to reboot the machine.
14. Insert the installation DVD for Windows Server 2008 R2 Enterprise x64 into the DVD drive.
15. Choose the language, time and currency, and keyboard input. Click Next.
16. Click Install Now.
17. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
18. Accept the license terms, and click Next.
19. Click Custom.
20. Click the disk, and click Drive options (advanced).
21. Click New, Apply, Format, and click Next.
22. Let the installation process continue. The server will reboot several times.
23. After the installation completes, click OK to set the Administrator password.
24. Enter the administrator password twice, and click OK.
25. Click Start, Control Panel, and double-click System.
26. Click Change Settings.
27. Click Change.
28. Enter the new computer name, and click OK.
29. Click OK to restart, click Close, and click Restart Now.

### Installing Windows updates on the server

1. Click Start, type `update`
2. Click View Advanced Options.
3. Click Never Check for Updates.
4. Click OK.
5. Click Check for Updates.
6. When the application prompts you to install an update for Windows Update, click Install Now.
7. Click View available updates to ensure you install the necessary updates.
8. Click Install.
9. Agree to the license terms, and click Finish.
10. When the application requests you do so, reboot the machine.
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, close the updates window.

## Joining the domain

1. Click Start, right-click Network, and choose Properties.
2. Click Change adapter settings.
3. Right-click the relevant network adapter, and choose Properties.
4. Click Internet Protocol Version 4 (TCP/IPv4).
5. Click Properties.
6. Click Use the following IP address.
7. Enter a valid IP address, Subnet mask.
8. Click Use the following DNS server addresses.
9. Enter the IP address of the Active Directory Server.
10. Click OK.
11. Click Close.
12. Click Start, right-click Computer, and choose Properties.
13. Click change settings.
14. Click change.
15. Choose Domain, and enter the domain name.
16. Enter valid credentials, and click OK.
17. When prompted by Windows to restart, restart the machine.

## 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 volume meant for server data, and choose New Simple Volume. Click Next.
6. Accept the default volume size. Click Next.
7. Choose E: from the drop-down menu for the drive letter. Click Next.
8. Type `data` for the volume name. Click Next.
9. Choose NTFS, 64K allocation unit size, and check the Perform a quick format checkbox. Click Next.
10. Click Finish.

## Enabling the Hyper-V role

Allow around 10 minutes for enabling the Hyper-V role in Windows Server 2008 R2 SP1.

1. Click Start.
2. Expand Administrative Tools, and click Server Manager.
3. Right-click Roles, and select Add Roles.
4. On the Before You Begin page, click Next.
5. On the Select Server Roles page, select Hyper-V, and click Next.
6. On the Hyper-V page, click Next.
7. On the Create Virtual Networks page, select the appropriate Local Area Connection, and click Next. (In our Dell PowerEdge R710, we had four NICs in the system. We used the first as a NIC specifically assigned to the SCVMM VM, and one NIC per VM after the P2V process.)
8. On the Confirm Installation Selections page, click Install.
9. On the Installation results screen, click Close.
10. When Windows prompts you to reboot the server, click Yes. The server will reboot twice.
11. When you see the Installation Results page, click Close.

## Creating a virtual machine

Follow the steps below to create a VM on the server that will host the Lync Server 2010 components.

1. Click Start.
2. Expand Administrative Tools, and click Hyper-V Manager.
3. From the Action menu, select New→Virtual Hard Disk.
4. Choose Fixed Size, assign 100GB for size, and place the VHD in the appropriate folder on the server.
5. From the Action menu, select New→Virtual Machine.
6. On the Before You Begin page, click Next.
7. On the Specify Name and Location page, enter the name for your new VM, and click Next.
8. On the Assign Memory page, enter 8,000 MB of RAM.
9. On the Configure Networking, choose the network assigned to internal traffic, and click Next.
10. Choose to add a virtual hard disk later.
11. On the Installation Options page, accept the default of Install an operating system later, and click Next.
12. On the Completing the New Virtual Machine Wizard page, click Finish.
13. Right-click the VM, and choose Settings.
14. Click Processors, and choose 2 virtual processors.
15. Click the virtual IDE controller 0.
16. Click Add, and click Hard Drive.
17. Browse to the VHD you created in Step 4, and choose that VHD for the guest OS VHD.
18. Click Apply.

### Installing the guest operating system:

Note that these steps are common to the database and file server scenarios.

1. Insert the installation DVD for Windows Server 2008 R2 into the physical DVD drive.
2. In Hyper-V Manager, right-click the VM, and choose Connect.
3. On the media menu, choose DVD Drive→Capture D:
4. On the Action menu, choose Start.
5. Double-click the VM to connect to the console.
6. During the boot of the VM, a Windows is loading files message appears, followed by a Windows booting loading bar.
7. At the Install Windows Server 2008 R2 screen, accept the defaults of English language, English time and currency format, and US keyboard or input method by clicking Next.
8. Click Install now.
9. At the Select the edition of Windows that you purchased screen, click the appropriate edition, and click Next.
10. At the Please read the license terms screen, check the I accept the license terms checkbox, and click Next.
11. At the Which type of installation do you want? screen, for Type of install, click Custom (Advanced).
12. In the Where do you want to install Windows? screen, click Drive options (Advanced).
13. Delete any existing partitions, recreate a partition, and format it. Highlight the partition, and click Next to start the installation.
14. When the system indicates that you must change the user's password before you log on for the first time, click OK.
15. Enter a strong password in both the New password and Confirm password fields, and click the arrow.
16. At the Your password has been changed prompt, click OK. Windows then prepares the desktop.
17. Set the time zone.
18. Set the IP address, subnet mask, and domain information as per the steps in the above section.
19. Install Windows updates if applicable, including Windows Server 2008 R2 SP1. (Download times will vary based on number and size of updates.)
20. Reboot the VM after any updates install.

Note: Use these steps for installing the operating system for the mail server only.

1. Boot the Dell PowerEdge R710 server.
2. When prompted by the boot to enter the storage configuration, press Ctrl+R.
3. Highlight Controller 0 and press F2, and choose Clear Config.
4. Accept the warning of loss of data.
5. Highlight Controller 0 and press F2, and choose Create New VD.
6. Choose RAID 1, select the first two disks, leave other options at the default values, and press OK.
7. Accept the warning regarding initialization.
8. Highlight the Virtual Disk, and press F2, Initialization, Start Init.
9. Highlight Controller 0, press F2, and choose Create New VD.
10. Choose RAID 5, select the remaining six disks, leave other options at the default values, and press OK.
11. Accept the warning regarding initialization.
12. Highlight the new Virtual Disk and press F2, Initialization, Start Init.
13. After initialization completes, press Esc to reboot the machine.
14. Insert the installation DVD for Windows Server 2008 Enterprise x64 into the DVD drive.
15. Choose the language, time and currency, and keyboard input. Click Next.
16. Click Install Now.
17. Choose Windows Server 2008 Enterprise (Full Installation), and click Next.
18. Accept the license terms, and click Next.
19. Click Custom.
20. Click the disk, and click Drive options (advanced).
21. Click New, Apply, Format, and click Next.
22. Let the installation process continue. The server will reboot several times.
23. After the installation completes, click OK to set the Administrator password.
24. Enter the administrator password twice, and click OK.
25. Click Start, Control Panel, and double-click System.
26. Click Change Settings.
27. Click Change.
28. Enter the new computer name, and click OK.
29. Click OK to restart, click Close, and click Restart Now.

## Setting up and configuring the Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3

### Setting up the operating system

1. Power on the Dell PowerVault DL Appliance.
2. At the License agreement screen, accept license agreements, and click Next.
3. At the Set up Windows screen, click Start.
4. At the Password must be changed screen, click OK.
5. Enter password and confirm password, and click OK.
6. At the Welcome screen, click Next.
7. At the Locate Symantec licenses screen, click Next.
8. At the Storage connections screen, click Next.
9. Select the network interface you wish to configure, and click Next.
10. Enter network configuration information, and click Next.
11. Enter a new hostname. Join the domain if your configuration requires you to do so, and click Next.
12. At the SNMP settings screen, click Next.
13. At the Disk configuration policy screen, choose Automatic with confirmation (default), and click Next.
14. Under the deduplication scenario, choose Internal storage controller (default), and click Next.

15. Click Finish. After the configuration completes, click Reboot. The system will reboot.
16. After reboot, press Ctrl+Alt+Delete to login.
17. Click Switch User, and click Other User.
18. Log in as a domain user with administrative credentials.
19. Wait a few minutes for the Configuration Wizard to continue.
20. At the Symantec Backup Exec 2010 welcome screen, click Next.
21. Accept license agreements, and click Next.
22. At the license key screen, enter license keys, and click Next.
23. On the components screen, choose desired components, and click Next.
24. On the user credentials screen, enter the password, and click Next.
25. On account rights message, click OK.
26. On the summary screen, click Install.
27. After installation completes, click Finish.
28. After configuration of the appliance completes, click Exit. Do not shut down the appliance until automatic disk provisioning is complete. You can check the status of this operation on the Appliance Console.
29. On the PowerVault DL Backup To Disk Appliance Console, click Launch Symantec Backup Exec.
30. Click Yes when the application prompts you regarding the disk configuration changes.
31. On the Device Warning screen, click OK when the application informs you of the configuration of the deduplication folder.
32. Open Backup Exec 2010, click Tools, Backup Exec Services, and click Restart All Services.
33. Click OK upon completion of the services being restarted, and click Close.
34. Click Tools, Options, and click Device and Media.
35. Select the Deduplication Storage Folder 1 storage device as the default storage location, and click OK.
36. Open Backup Exec 2010, and click Tools, LiveUpdate to download the latest updates for the Backup Exec 2010.

### Installing the Symantec Remote Agent on the host server and virtual machine

1. Log into the Hyper-V host server.
2. Map a drive to the C:\ root share of the Dell PowerVault DL Appliance. Use command line text as follows:  

```
net use x: \\DLAppliancehostname\c$
```
3. While in the context of the mapped drive, navigate to X:\Program Files\Symantec\Backup Exec\Agents\RAWXS64 using the following command line text:  

```
cd X:\Program Files\Symantec\Backup Exec\Agents\RAWXS64
```
4. Execute the setupaax64.cmd file to install the remote agent.
5. Repeat steps 2 to 4 on the virtual machine.

### Setting up the Remote Agent Direct Access

1. Open Symantec Backup Exec 2010.
2. Click the Devices tab.
3. Click the Configure devices assistant in the right-hand pane if the screen does not appear automatically.
4. Click Remote Agent with Direct Deduplication.
5. Provide the fully qualified server name of the server running the agent you wish to provide direct access to. (Note: You must enter in the name exactly as it appears in the backup selection screen when you create the new backup job.)
6. Click OK.
7. On the Restart Services message box, click Restart Now.

### Setting up the Backup to Disk folder (only when using the backup-to-disk scenario)

Configure the Dell PowerVault DL Appliance as above, choosing not to auto-provision storage and choosing not to create deduplication folders.

1. Open Symantec Backup Exec 2010.
2. Click the Devices tab.
3. Click the Configure devices assistant.
4. Click Backup to Disk folder.
5. If the application asks about configuring additional storage devices, click Yes.
6. Click Next.
7. Name the backup to disk folder.
8. Provide the path to the folder, and click OK.
9. Click Next.
10. On the Maximum Size screen, choose No, and click Next.
11. Type 200 for the maximum size (GB) for the backup-to-disk file. This is adjustable.
12. Click Next.
13. Type 250 for the maximum number of backup sets per backup-to-disk file and click Next.
14. On the concurrent jobs screen, click Next.
15. On the low disk space threshold screen, enter the low space threshold for your environment, and click Next.
16. Click Next on the Backup-to-Disk folder Summary screen to finish the configuration.
17. Click Finish to close wizard.

## Setting up the database server virtual machine

The following steps in this section are specific to the database server scenario.

### Installing SQL Server 2008

1. Insert the DVD into the DVD drive.
2. Click Run SETUP.EXE on the AutoPlay menu.
3. If the application prompts you to install the .NET Framework, click OK.
4. Select the Accept radio button, and click Install.
5. When the installation finishes, click Exit.
6. If any warnings appear about compatibility, accept them as installing SP1 in the next section should solve them.
7. If the application prompts you, click OK to install a hotfix for Windows (KB942288).
8. Click Restart now to restart the server upon completion.
9. After rebooting, log into the server.
10. Click Start, and click Computer.
11. Double-click the CD/DVD drive.
12. Click Installation.
13. Click New SQL Server stand-alone installation.
14. On the Setup support rules screen, click OK.
15. Specify the Enterprise Evaluation free edition. Click Next.
16. Click the checkbox to accept the license terms. Click Next.
17. Click Install to install the setup support files.
18. You may see a Windows Firewall warning. For now, ignore this, and click Next.
19. On the Feature Selection screen, select Database Engine Services, Full-Text Search, Client Tools Connectivity, Client Tools Backward Compatibility, Management Tools –Basic, and Management Tools – Complete. Click Next.
20. On the Instance configuration screen, leave the default selection of default instance, and click Next.
21. On the Disk space requirements screen, click Next.
22. On the Server configuration screen, the domain credentials for the SQL Server Agent, and enter the domain credentials for the SQL Server Database Engine. Click Next.
23. On the Database Engine Configuration screen, select Mixed Mode.
24. Enter a password for the system administrator (sa) account.
25. Click Add Current user. This may take several seconds.

26. Click Next.
27. On the Error and usage-reporting screen, click Next.
28. On the Installation rules screen, click Next.
29. On the Ready to Install screen, click Next.
30. After installation completes, click Start, All Programs, Microsoft SQL Server 2008, Configuration Tools, SQL Server Configuration Manager.
31. Expand the Network Configuration node, and select the relevant instance.
32. In the right pane, right-click TCP/IP, and choose Enable.
33. In the left pane, click SQL Server Services.
34. In the right pane, right-click the SQL Server service, and select Restart.
35. Create a SQL Server login for the ds2user (see the DVD Store setup section below for the specific script to use).
36. 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 SQL Server 2008 SP1

Service Pack 1 is available for download from

<http://www.microsoft.com/downloads/details.aspx?FamilyID=66ab3dbb-bf3e-4f46-9559-ccc6a4f9dc19&displaylang=en>.

1. Run SQLServer2008SP1-KB968369-x64-ENU.exe.
2. On the Welcome screen, click Next
3. On the License terms screen, accept the license terms, and click Next.
4. On the Features screen, select available features, and click Next.
5. On the Check files in use screen, click Next.
6. On the Update screen, click Next.
7. When the update completes, click Next, and click Close.

### Setting up and configuring the load-generating client

For the DVD Store scripts, we used a workstation client machine to simulate a number of users putting a load on the server. For our client, we installed the .NET 3.5 framework on the client, as the DVD Store test executable requires this. We created a performance counter log on the client machine to track the number of orders per minute (OPM) the database server returned. We followed this process for the installation:

1. Install Microsoft Windows Server 2003 R2 Enterprise x86 Edition Service Pack 2 on the client.
2. Assign a computer name of `Client1` for the database client.
3. For the licensing mode, use the default setting of five concurrent connections.
4. Enter a password for the administrator log on.
5. Select Eastern Time Zone.
6. Use typical settings for the Network installation.
7. Type `Workgroup` for the workgroup.
8. Install Windows Updates, .NET 3.5 framework, and copy the DVD Store client executable onto the machine.

### Setting up 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 1 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 1GB 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 W for the 1GB 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 1GB 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 W for the 1GB 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 1GB 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 1GB 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 1GB 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 1GB database:

```
ds2_create_orders_1gb.sh  
ds2_create_inv_1gb.sh  
ds2_create_prod_1gb.sh  
ds2_create_cust_1gb.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 a master copy of the 1GB database. We used that master backup file to initiate our Symantec Backup Exec backup simulations. We stored the backup file on the C: drive of the database server for quick access. Subsequent backups via Symantec Backup Exec 2010 were stored on the Dell PowerVault DL Appliance.

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 1GB 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 each 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.

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 logical processor. We used eight files per filegroup on the test server.
- 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 2008.
- We added the FORCESEEK hint in the BROWSE\_BY\_ACTOR stored procedure 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 created a SQL Server login we called ds2user and mapped a database user to this login. We made this 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.

### ***Editing the workload script - ds2xdriver.cs module***

To use the 1GB database we created earlier, we had to change the following constants:

- In the routine Controller(), we changed the string sizes. We added the W option for the 1GB database size. DS2 uses the sizes string to interpret the db\_size\_str option.
- In the class Controller, we changed the arrays MAX\_CUSTOMER and MAX\_PRODUCT. To each, we added values specifying the bounds for the customer and product IDs. The Controller() routine uses these arrays.
- We added a command line parameter for the database name:

-database\_name

### **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.

Execute the following command:

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

### **Performing the test**

To perform the test, we created a backup job in the Symantec Backup Exec 2010 console, then used a combination of batch files, the psexec utility, and the bemcmd.exe utility to execute our workload and backup jobs from our client machine.

The testing procedure consisted of the following general steps:

1. In SQL Server Management Studio, restore the initial backup of the SQL Server DVD Store database.
2. Create a backup job in Symantec Backup 2010 console, choosing the deduplication storage folder as the destination, and also selecting the option to allow the remote agent to have direct access to the Dell PowerVault DL Appliance.
3. Run the backup job to initially backup the database to the media server.
4. Execute the DVD Store workload to simulate one business day of activity, using 5 threads, 0.1 think time, and run for 5 minutes.
5. Rerun the backup job in Symantec Backup Exec 2010.
6. Execute the DVD Store workload to simulate one business day of activity, using 5 threads, 0.1 think time, and run for 5 minutes.
7. Repeat steps 5 and 6 through the end of testing.
8. Export the job details results data.

For the backup to disk scenario, we performed similar tasks as above, but targeted the backup destination to the backup to disk device, as opposed to the deduplication storage folder device.

### **Setting up and configuring the Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3**

Note that configuring the backup job requires steps specific to the database server scenario, and that you must complete them after the [Setting up the Backup to Disk folder](#) section.

#### **Configuring the backup job**

1. Open Symantec Backup Exec 2010.
2. Click the Job Setup tab.
3. Click New Job under Backup Tasks in left pane.
4. Browse Domains→Active Directory Domains→Domainname→Servername→Microsoft Hyper-V, and select Virtual Machines.
5. Select the desired virtual machine.
6. Under Destination, click Device and Media.
7. When running a deduplication scenario, select Deduplication Storage Folder. When running a backup to disk scenario, select the Backup To Disk device.
8. When running a deduplication scenario, select Use Client-side deduplication. This enables source deduplication.
9. Under Settings, click General.
10. Uncheck the Verify after backup completes checkbox.
11. Under Settings, click Microsoft Hyper-V.
12. GRT should be checked and enabled by default. Verify before proceeding to next step.
13. Click Run Now.

### **Setting up the file server**

The following steps are specific to the file server scenario. Note that Enabling the file server role follows the [Joining the domain](#) procedure.

#### **Enabling the file server role**

1. Click the Server Manager icon.
2. Click Roles.
3. Click Add Roles.
4. Click Next.
5. Click File Services, and click Next.
6. At the Introduction to File Services screen, click Next.
7. At the Role Services screen, click Next.
8. At the Confirm Installation Selections screen, click Install.
9. After the installation completes, click Close.

### **Setting up and configuring the Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3**

Note that configuring the backup job requires steps specific to the file server scenario, and that you must complete them after the [Setting up the Backup to Disk folder](#) section.

#### **Configuring the backup job**

1. Open Symantec Backup Exec 2010.
2. Click the Job Setup tab.
3. Click New Job under Backup Tasks in left pane.

4. Browse Domains→Active Directory Domains→Domainname→Servername→Microsoft Hyper-V, and select Virtual Machines.
5. Select the desired virtual machine.
6. Under Destination, click Device and Media.
7. When running a deduplication scenario, select Deduplication Storage Folder. When running a backup to disk scenario, select the Backup To Disk device.
8. When running a deduplication scenario, select Use Client-side deduplication. This enables source deduplication.
9. Under Settings, click General.
10. Uncheck the Verify after backup completes checkbox.
11. Under Settings, click Microsoft Hyper-V.
12. GRT should be checked and enabled by default. Verify before proceeding to next step.
13. Click Run Now.

### Setting up and configuring the load-generating client

For the file manipulation scripts, we used a workstation client machine to simulate a number of users putting a load on the server. For our client, we installed Microsoft Windows Vista Ultimate and Microsoft Office 2007 Professional, as the AutoIT test executable requires these components. We accepted all defaults as part of the Windows Vista and Microsoft Office installation process.

### Performing the test

To perform the test, we created a backup job in the Symantec Backup Exec 2010 console, then used a combination of batch files and the bemcmd.exe utility to execute our workload and backup jobs from our client machine.

The testing procedure consisted of the following general steps:

1. Copy the initial 12GB data set to our file server.
2. Create a backup job in Symantec Backup 2010 console, choosing the deduplication storage folder as the destination, and also selecting the option to allow the remote agent to have direct access to the Dell PowerVault DL Appliance.
3. Run the backup job to initially backup the file share to the media server.
4. Execute the custom AutoIT workload to simulate one business day of activity, modifying approximately 3 percent of Microsoft Office files, and copying, deleting, and moving other files.
5. Rerun the backup job in Symantec Backup Exec 2010.
6. Repeat steps 4 and 5 through the end of testing.
7. Export the job details results data.

For the backup to disk scenario, we performed similar tasks as above, but targeted the backup destination to the backup to disk device, as opposed to the deduplication storage folder device.

### Setting up the mail server

The following steps are specific to the mail server scenario. Note that the following three Exchange Server sections follow the [Configuring additional drives in Disk Management](#) section.

### Installing prerequisites for Microsoft Exchange Server 2007

1. Click the Server Manager icon.
2. Click features, and click add features.
3. Select Windows Powershell.
4. Click Next.

5. Click Install.
6. After the installation of Windows Powershell completes, in Server Manager, click Roles, and click Add Roles.
7. Select Web Server (IIS).
8. At the Add required features screen, click Yes.
9. At the introduction to IIS screen, click Next.
10. Proceed through the IIS installation.
11. At a command prompt, type `ServerManagerCmd -i RSAT-ADDS` to install Active Directory Management tools.

### Installing Microsoft Exchange Server 2007

1. Insert the Microsoft Exchange Server 2007 CD.
2. In the pop-up AutoPlay window, click Run Setup.EXE.
3. The installer should consider Steps 1, 2, and 3 complete, and gray them out.
4. Click the link to Step 4: Install Microsoft Exchange Server 2007 SP2.
5. Click Next to go past the introduction screen.
6. Accept the license agreement, and click Next.
7. Select No for error reporting, and click Next.
8. Select Typical Exchange Server Installation, and click Next.
9. Leave the organization name at default (First Organization), and click Next.
10. At the question about client computers running Outlook 2003 and earlier, select No, and click Next.
11. If an error about the Active Directory domain is in mixed mode appears, raise the domain function level using the following steps on the Active Directory Server:
12. Click Start→All Programs→Administrative Tools→Active Directory Domains and Trusts.
13. Right-click domain.com, and choose Raise Domain Functional Level.
14. Choose Windows 2000 native in the drop-down menu, and click Raise.
15. At the warning popup window, click OK.
16. When the application raises the level successfully, click OK.
17. Close the Active Directory Domains and Trusts window.
18. At the Exchange 2007 setup window, click Retry on the Readiness Checks screen.
19. If a warning about a lack of SMTP appears after the check finishes, ignore it.
20. Click Install to start the installation process.
21. Once installation is complete, click Finish.
22. When the application prompts you to reboot, click OK.
23. Reboot the server.
24. Download and install the Microsoft Messaging API and Collaboration Data Objects 1.2.1 with all defaults on the Exchange 2007 server as this is required by Symantec Backup Exec 2010.

### Configuring Microsoft Exchange Server 2007 and Active Directory for LoadGen

1. On the Exchange mail server, select Start→All Programs→Microsoft Exchange Server 2007→Exchange Management Console.
2. In the left pane, expand Organization Configuration, and select Hub Transport.
3. In the action pane on the far right, select New Send Connector.
4. Name the send connector SMTP, select the intended use as Internet, and click Next.
5. In the Address space window, click Add.
6. In the SMTP Address Space window, type \* as the address, ensure that the installer has checked Include all subdomains, and click OK.
7. Click Next.
8. Accept defaults for the next two pages by clicking Next.
9. At the New Connector page, click New to create the connector.

10. Click Finish to close the New SMTP Send Connector wizard.
11. On the Active Directory server, select Start→All Programs→Administrative Tools→Active Directory Users and Computers.
12. In the Active Directory Users and Computers window, select the domain in the left pane, and open Users in the right pane.
13. Right-click a blank area in the Users folder, and select New→User.
14. 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.
15. Enter a secure password (we used Password1), and check Password never expires.
16. In the pop-up information window, click Accept.
17. Select Finish to close the New Object – User window.
18. Double-click the new user to bring up the Properties window.
19. Under the Member Of tab, click Add.
20. In the Enter the object names to select dialog box, type Domain Admins; Exchange Organization Administrators select Check Names to verify, and click OK.
21. Click OK to close the User Properties window and close the Active Directory Users and Computers window.
22. On the Exchange server, select Start→All Programs→Microsoft Exchange Server 2007→Exchange Management Console.
23. In the left pane of the Exchange Management Console window, select Recipient Configuration; in the right pane, select New Mailbox.
24. In the New Mailbox window, select User Mailbox, and click Next.
25. In the User Type page, select Existing users, and click Add.
26. Select the new account you created earlier, and click OK to add it to selection box.
27. Click Next.
28. In the Mailbox Settings page, leave the Alias textbox with default settings, and select Browse in the Mailbox database selection spot.
29. In the Select Mailbox database window, select Mailbox Database, and click OK.
30. Click through the next screens to create the new mailbox, and close when you have done so.
31. In the left windowpane, expand Server Configuration and Mailbox so the First Storage Group is visible.
32. Right-click First Storage Group, and select Properties.
33. Check the Enable circular logging box (only used for initialization of database).
34. Click OK.
35. Right-click Mailbox Database, and select Move Database Path...
36. Click Browse, change the data files path location to D:\exchdata, and click Move.
37. When the pop-up message appears asking if you want to perform this task, click Yes.
38. Click Finish.
39. Right-click Mailbox Database under First Storage Group, and select Properties.
40. Check the box beside This database can be overwritten by a restore.
41. Click Customize next to Maintenance interval.
42. Remove all blue from the boxes so the system will not perform maintenance, and click OK.
43. At the Mailbox Store Properties window, click Apply.
44. If a warning message appears, click Yes.
45. Click OK to close the Mailbox Store Properties window.

Note that the following section follows the [Setting up the Backup-to-Disk folder](#) section.

## Installing additional Exchange Server 2007 components on the media server

To back up Exchange Server 2007 from Symantec Backup Exec 2010 R3, you must install the Exchange Management Console on the media server.

1. Extract the Exchange 2007 installation media and double-click setup.exe after extraction.
2. Click Step 5: Install Microsoft Exchange Server 2007 SP2.
3. To proceed past the introduction screen, click Next.
4. Accept the license agreements, and click Next.
5. Select No for error reporting, and click Next.
6. Select Custom Exchange server installation, and click Next.
7. Select Management Tools, and click Next.
8. Proceed through the installation.
9. Click Start→Run, type `regedit` and click OK.
10. Navigate to `HKLM\SOFTWARE\Symantec\Backup Exec for Windows\Backup Exec\Engine\Echange`
11. Right-click right pane, select NEW→String Value and name it `OnHostTemp`
12. Double-click `OnHostTemp`, type `c:\temp` for new value and click OK.
13. In Symantec Backup Exec console select Tools→Backup Exec Services... and click Restart All Services.

## Setting up and configuring the Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3

Note that configuring the backup job requires steps specific to the email server scenario, and that you must complete them after the [Setting up the Backup to Disk folder](#) section.

### Configuring the backup job

1. Open Symantec Backup Exec 2010.
2. Click the Job Setup tab.
3. Click New Job under Backup Tasks in left pane.
4. Browse Domains→Active Directory Domains→Domainname→Servername→Microsoft Hyper-V, and select Virtual Machines.
5. Select the desired virtual machine.
6. Under Destination, click Device and Media.
7. When running a deduplication scenario, select Deduplication Storage Folder. When running a backup to disk scenario, select the Backup To Disk device.
8. When running a deduplication scenario, select Use Client-side deduplication. This enables source deduplication.
9. Under Settings, click General.
10. Uncheck the Verify after backup completes checkbox.
11. Under Settings, click Microsoft Hyper-V.
12. GRT should be checked and enabled by default. Verify before proceeding to next step.
13. Click Run Now.

## APPENDIX E – DETAILED TEST RESULTS

Figures 7 through 12 present detailed results of our tests using source deduplication and our test using a backup-to-disk folder with no source deduplication.

<b>Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 with source deduplication</b>				
<b>Backup number</b>	<b>Job time (HH:MM:SS)</b>	<b>Job rate (MB/min)</b>	<b>Deduplication ratio</b>	<b>Total backup size (GB)</b>
1	4:51:06	221	4.8:1	58.46
2	3:12:05	336	545.1:1	58.63
3	3:14:16	335	179.8:1	59.03
4	3:14:47	334	414.6:1	59.12
5	3:13:19	337	410.1:1	59.19
6	3:14:51	335	405.5:1	59.26
7	3:14:33	336	373.2:1	59.34

Figure 7: Virtualized database server data backup metrics when using source deduplication.

<b>Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 without source deduplication</b>		
<b>Job time (HH:MM:SS)</b>	<b>Job rate (MB/min)</b>	<b>Total backup size (GB)</b>
6:41:05	150	58.46

Figure 8: Virtualized database server data backup metrics when using no source deduplication.

Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 with source deduplication				
Backup number	Job time (HH:MM:SS)	Job rate (MB/min)	Deduplication ratio	Total backup size (GB)
1	6:15:22	148	4.6:1	53.93
2	3:01:33	342	24.4:1	53.93
3	3:06:01	321	42.4:1	53.93
4	3:13:49	310	26.1:1	53.93
5	3:11:02	318	36.8:1	53.93
6	3:11:19	322	47.1:1	53.93
7	3:14:32	319	40.8:1	53.93

Figure 9: Virtualized file server data backup metrics when using source deduplication.

Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 without source deduplication		
Job time (HH:MM:SS)	Job rate (MB/min)	Total backup size (GB)
6:09:46	150	53.93

Figure 10: Virtualized file server data backup metrics when using no source deduplication.

Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 with source deduplication				
Backup number	Job time (HH:MM:SS)	Job rate (MB/min)	Deduplication ratio	Total backup size (GB)
1	7:01:57	138	1.7:1	53.93
2	3:04:02	326	177.4:1	53.93
3	3:02:36	329	223.1:1	53.93
4	3:03:07	328	222.1:1	53.93
5	3:02:17	330	369.1:1	53.93
6	3:02:48	328	252.0:1	53.93
7	3:02:20	329	382.9:1	53.93

Figure 11: Virtualized mail server data backup metrics when using source deduplication.

Dell PowerVault DL Appliance powered by Symantec Backup Exec 2010 R3 without source deduplication		
Job time (HH:MM:SS)	Job rate (MB/min)	Total backup size (GB)
6:06:46	150	53.93

Figure 12: Virtualized mail server data backup metrics when using no source deduplication.

## ABOUT PRINCIPLED TECHNOLOGIES



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1007 Slater Road, Suite 300  
Durham, NC, 27703  
[www.principledtechnologies.com](http://www.principledtechnologies.com)

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