

New and Advanced Open SAN Supported Solutions



March, 2002

Rev. 2/4/2002

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Introduction

Compaq Computer Corporation, along with 9 other companies – Brocade Communications Systems, Inc., EMC Corporation, Hitachi Data Systems, IBM Corporation (including the IBM-Tivoli software division), Legato Systems, Inc., McDATA Corporation, Quantum, Storage Technology Corporation (StorageTek), and VERITAS Software Corporation - are all members of the Supported Solutions Forum (SSF) of the Storage Networking Industry Association (SNIA). We have cooperated to successfully qualify six new open SAN solutions. These solutions incorporate products from each company, and are fully supported by each company.

The principal characteristics of these solutions are:

- Homogeneous fabric using cascaded switches from Brocade or McData
- Multivendor disk storage in separate data zones
- Multivendor tape storage in a single data zone
- Complete path failover and load balancing for all disk accesses.
- Choice of three competing backup/recovery software applications for performing LAN-free backup and dynamic drive sharing

This solution set is the result of follow-on activity from the original supported solutions announced in June of last year. The new features included in this solution set over those found in the original solution set are:

- 4 new participating companies:
 - Legato
 - Quantum
 - StorageTek
 - VERITAS
- 10 new participating products:
 - IBM 3583 Ultrium Scalable Tape Library
 - IBM 3584 UltraScalable Tape Library
 - StorageTek L700 Tape Library
 - Quantum ATL P7000 Tape Library
 - IBM Tivoli Storage Manager
 - VERITAS NetBackup™ DataCenter
 - Legato NetWorker
 - McDATA ED-6064 Director (replaced the ED-5000 from the original solution)
 - McDATA ES-1000 Switch
 - Brocade 3800 Switch (in addition to the Brocade 2800 Switch from the original solution)
- Backup/Restore Software Products from 3 competing vendors:
 - IBM Tivoli
 - Legato
 - VERITAS

The objective in creating and qualifying these solutions and registering them with the SNIA-SSF is to provide our customers with interoperable multivendor storage networking options that have high value and solve real world business problems. This effort results in greater flexibility for

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our customers when choosing vendors and also reduces the total cost of the solution by eliminating the need to have each unique SAN configured and tested by each customer. Ultimately, this flexibility enables the customer to match their specific requirements with the appropriate mix of vendors and products to maximize feature/function, cost, security, scalability and support for their mixed vendor environment.

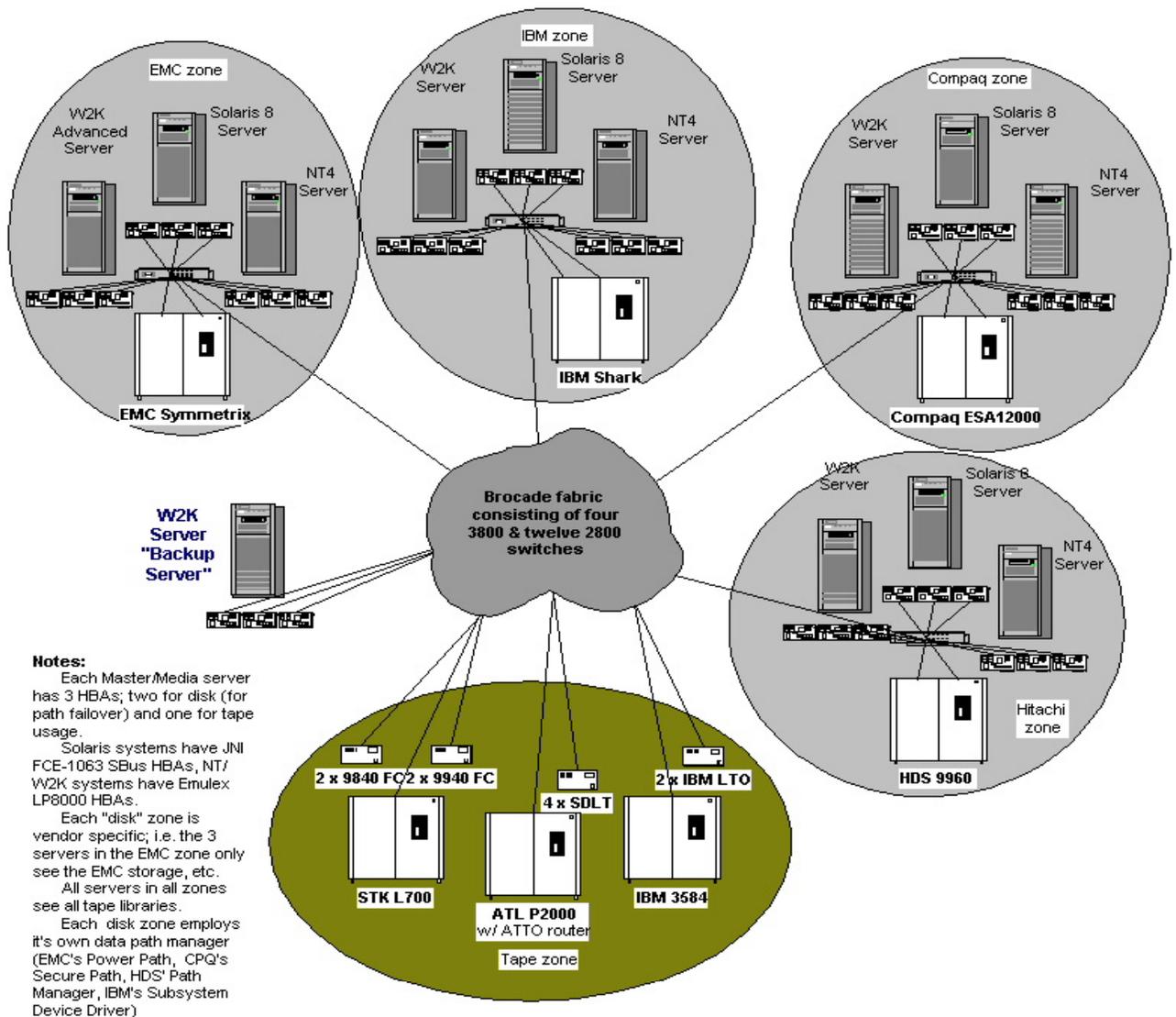
Solution Description

This solution set is composed of multivendor disk storage, multivendor tape storage, and multivendor backup/recovery software, all running on a Brocade fabric in one series of solutions and on a McDATA fabric in a second series of solutions.

The following graphic depicts the solutions on the Brocade fabric:

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Brocade SNIA-SSF test with backup application and 3rd party disk path manager



In this configuration there are four disk subsystems, one for each disk vendor: Compaq, EMC, HDS, and IBM. Each disk subsystem, along with its servers, is configured in its own separate data zone. All four data zones are isolated from each other so that neither the servers nor the storage in one data zone can communicate with any of the servers or storage in any of the other data zones. The disk subsystems used are:

- IBM Enterprise Storage Server 2105-F20
- EMC Symmetrix
- StorageWorks™ by Compaq Enterprise Storage Array 12000
- HDS Freedom Storage 9960

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For multipathing functionality, each disk vendor used its own multipathing software in its data zone. The multipathing software used by each vendor is as follows:

- IBM: ESS Subsystem Device Driver (SDD)
- EMC PowerPath
- SANworks™ by Compaq Secure Path
- HDS Path Manager

The servers that we picked for this solution - in each data zone - are (1) a Sun server running Solaris 8, (2) an Intel server running Windows NT 4.0 with Service Pack 6a, and (3) an Intel server running Windows 2000 Advanced Server with Service Pack 2. Each of these servers are configured with three HBAs: two are for disk attachment, the third is for tape attachment. The Solaris servers are configured with JNI FCE-1063 Sbus HBAs. The Windows servers are configured with Emulex LP8000 HBAs. In addition, we used another Intel server running Windows 2000 Advanced Server for our Backup/Restore Server.

There are three tape subsystems in this solution set, all located in the same data zone. These subsystems are:

- IBM 3584 UltraScalable Tape Library with LTO tape drives
- Quantum ATL P7000 with DLT tape drives
- StorageTek L700 Tape Library with 9840 and 9940 tape drives

The Brocade fabric is composed of four 3800 switches at its core, surrounded by twelve 2800 switches. The 3800 switches are 16-port switches capable of 2Gb/s on each port. The 2800 switches are 16-port switches capable of 1Gb/s on each port. A total of $16 \times 16 = 256$ switch ports exists in this fabric. 88 ports are used for Inter-Switch Links (ISLs), leaving 168 ports for host and device connections.

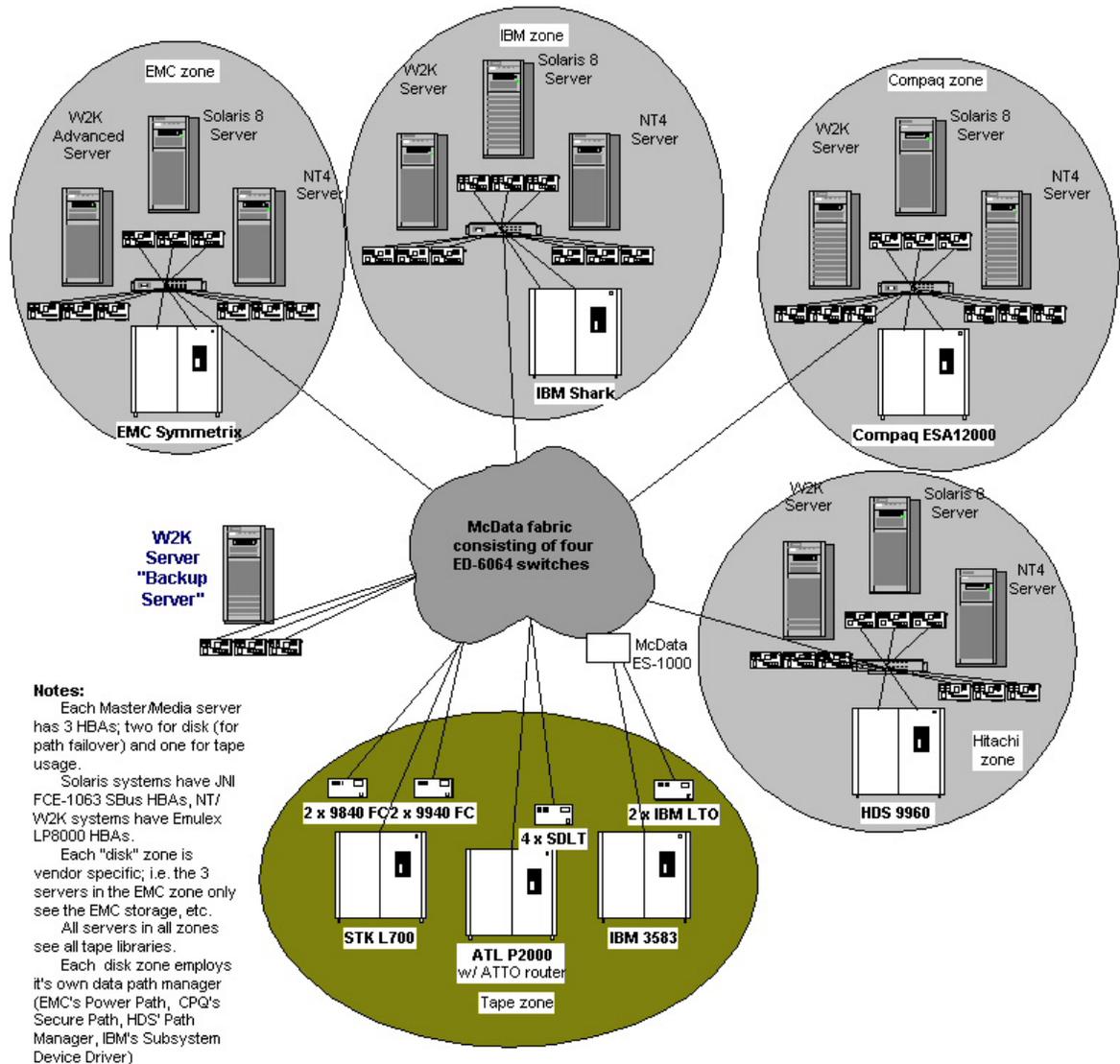
There are a total of three separate solutions on the Brocade fabric. They all use the same hardware as described above, but different backup/restore software. These three competing software applications did not run simultaneously, since doing so would provide no customer benefit. The three solutions are listed as follows:

- IBM Tivoli Storage Manager Backup/Restore on Brocade
- Legato NetWorker Backup/Restore on Brocade
- VERITAS NetBackup™ Data Center Backup/Restore on Brocade

The following graphic depicts the solutions on the McDATA fabric:

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McData SNIA-SSF test with backup application and 3rd party disk path manager



In this configuration the disk subsystems and the associated multipathing software, along with the servers and their HBAs, are all identical to that in the Brocade configuration. The differences in this configuration are the fabric (McDATA instead of Brocade), and in addition, the IBM tape subsystem (IBM 3583 instead of IBM 3584). Also, McDATA's EFCM is used to help manage the SAN.

The McDATA fabric is composed of four ED-6064 directors, all interconnected with ISLs, plus one ES-1000 switch. Each director supports 64 1Gb/s ports. The ES-1000 has 9 1Gb/s ports. There are a total of 265 ports in this configuration. The directors each use 12 ports for ISLs that cross connect them together. The ES-1000 switch provides the FC-Loop attachment required by the StorageTek tape subsystem, and uses 1 port as an ISL. All of the other tape subsystems, along with all the servers and all the disk subsystems, are attached directly to the ED-6064s.

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Since a total of $4 \times 12 + 1 = 49$ ISLs are used here, there are $265 - 49 = 216$ ports for host and device connections.

There are a total of three separate solutions on the McDATA fabric. They all use the same hardware as described above, but different backup/restore software. These three competing software applications did not run simultaneously, since doing so would provide no customer benefit. The three solutions are listed as follows:

- IBM Tivoli Storage Manager Backup/Restore on McDATA
- Legato NetWorker Backup/Restore on McDATA
- VERITAS NetBackup™ Data Center Backup/Restore on McDATA

Disk Storage Data Zones:

Each fabric contained four separate data zones on the SAN, one for each of the four disk storage vendors. Within each data zone are the disk storage and the servers that access the disk storage. None of the servers in one data zone can access disk storage in any of the other data zones.

Each server is configured with two HBAs for attachment to its disk storage. These HBAs provide the two paths that are used for the multipathing access to the disk.

Each data zone contains multiple switch, or fabric, zones. These switch zones are used to isolate the servers from one another. Therefore, since there are three servers in each data zone, there will be three switch zones in these data zones.

Tape Storage Data Zones:

The tape library data zone has access to all four disk data zones.

Each server has a single HBA that it uses to access each of the tape subsystems in the tape data zone, in addition to the two used for the disk data zone activity. As in the disk data zones, there are multiple switch zones in the tape data zone – one for each separate server. Therefore, there are $3 \times 4 = 12$ switch zones in this data zone.

Backup Application Summary

Legato NetWorker Backup Application

Legato NetWorker 6.1.1 Server for Windows 2000 packages were installed on the Windows 2000 backup server. Legato NetWorker Client and Storage Node packages for Solaris were installed on all the Sun Solaris 8 Clients. Legato NetWorker for Windows NT/Windows 2000 were installed on the Intel Windows NT and 2000 systems. NetWorker Client packages were installed on all twelve systems attached to the disk arrays because each of these systems owned data that was to be backed up. NetWorker Storage Node software was installed on all twelve

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systems because NetWorker was configured to use local tape device files for each of these clients.

The tape library and tape devices were configured by running “jbconfig” on the NetWorker Server. The robotic controls were controlled by the NetWorker Server, and the tape devices were configured as remote tape devices (rd=hostname:/tape/device/file) that were available on each of the NetWorker Clients/Storage Nodes. No vendor specific device drivers were installed. Legato NetWorker uses standard Operating System tape device files. Library sharing and Dynamic Drive Sharing configurations were used to allow greater flexibility among NetWorker Clients to use the same tape drives.

Backups were scheduled and initiated on the NetWorker Server that also maintained the media database. Backup data transfer remained locally to each of the clients. Backup data traveled from disk array to NetWorker Client and from NetWorker Client direct to tape. All backup data transfer was contained within the SAN and local to each client. Restores were performed in the same manner with data transferred over the SAN locally to the client.

The STK L700 library used two separate tape drive types. In Legato NetWorker we configured tape pools for each tape drive type. One pool was for the 9940 tape drives and the second tape pool was for the 9840 tape drives. This was necessary because the two types of tape drives are not compatible. Backup groups were configured to use specific tape drives and specific tape pools. This allowed us to actively share the library but not the media between the two drive types. No additional software was installed to perform this function.

IBM Tivoli Storage Manager Backup Application

Tivoli Storage Manager Server 4.2.1.7 was installed on the Windows 2000 backup servers. The Tivoli Storage Manager server is the central controlling component for the backups and restores. The Tivoli Storage Manager Server contains a database that keeps track of the information about the data being backed up (authorized clients, where their backup/archive data is stored, and configuration information about the tape storage devices). The database’s capabilities are one of the keys to Tivoli Storage Manager’s low cost of ownership. The Tivoli Storage Manager server also utilizes a recovery log that facilitates a two-phase commit for the transactions and online recovery of any interrupted transactions that may occur. Administration of the server environments was accomplished using both the Tivoli Storage Manager administrative command line and the web browser.

Each of the Windows servers and the SUN Solaris servers had a Tivoli Storage Agent, version 4.2.1.7, installed. The storage agents enable these servers to drive the backups and restores across the SAN rather than the LAN. This enables the LAN-free, client-directed data transfer direct to the tape drives shared with the Tivoli Storage Manager server for each environment.

Tivoli Storage Manager device drivers were used on the Tivoli Storage Manager servers and the client platforms to facilitate the I/O data movement from disk to non-IBM tape. The level of the driver used for the StorageTek tape devices on the Windows platforms was 4.2.1.14, and on

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Solaris, it was 4.2.6. The IBM LTO 3580 devices were supported with the IBMTAPE driver on Solaris (4.0.5.0) and on Windows (5.0.2.4). Library control for the StorageTek L700 at McDATA was supported by the StorageTek ACSLS to accommodate 9840 and 9940 drives coexisting in the library. At Brocade, each drive type was tested separately, 1st with the 9840 drives in a logical library for it and then with the 9940 drives both using the Tivoli Storage Manager server's device driver. The Quantum ATL Library and the IBM 358x Libraries were both controlled by the Tivoli Storage Manager device driver at 4.2.14.

Both the IBMTAPE device driver and the Tivoli Storage Manager device driver required the use of the latest JNI device driver for the JNI-1063. This is obtained by selecting the JNI device driver for the EMC Symmetrix, which is at level 2.5.21 at the JNI web site.

The Tivoli Storage Manager client software was installed on each of the platforms, including the backup server. The client facilitates the file system reads and writes needed for sending or receiving data to the Tivoli Storage Manager server, or in this case, the storage agents. Transactional meta data is sent to the Tivoli Storage Manager server over the IP network. The Tivoli Storage Manager clients come with a graphical user interface (GUI), a command line interface and a web browser client. The Tivoli Storage Manager's Servers Administrative Client was also installed as part of the Backup/Archive Client install. The level of the client utilized on all the platforms was 4.2.1.16-16.

The data sets stored on the storage subsystems ranged in size from approximately 300 MB up to a maximum of 10GB. The data set was usually comprised of 10 1GB files.

The ACSLS software at 6.0.1 from StorageTek served as the Media Manager for the mixed drive configuration in the StorageTek L700 Library. It was installed on one Sun Solaris machine and was used extensively in the testing to support concurrent utilization of the 9840 and 9940 devices.

Gresham Software's EDT-DistribuTAPE served as the interface between StorageTek's ACSLS software, the Tivoli Storage Manager server (via the External Library Manager) and the storage agents. It managed the library and mounting of the devices. The most recent level of the product, 6.3.0.0, was used on all the platforms.

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Software Summary for Tivoli Solution

Server/Device	Software	Version	
Win2K Backup Server Advanced Server Edition, SP 2	TSM Server	4.2.1.7	
	TSM Backup/Archive Client	4.2.1.16-16	
	Gresham EDT-DistribuTAPE	6.3.0.0	
	STK 9840 Tape	Tivoli Device Driver	4.2.1.14
	STK T9940A Tape	Tivoli Device Driver	4.2.1.14
	STK L700e Library	Tivoli Device Driver	4.2.1.14
	IBM 3580 Tape	IBMTAPE Device Driver	5.0.2.4
	IBM 358x Library	Tivoli Device Driver	4.2.1.14
	Quantum Super DLT Tape	Tivoli Device Driver	4.2.1.14
	Quantum ATL P2000 Library	Tivoli Device Driver	4.2.1.14
Sun Solaris Data Servers Solaris 8	TSM Storage Agent	4.2.1.7	
	TSM Backup/Archive Client	4.2.1.16-16	
	STK ACSLS (1 machine)	6.0.1	
	Gresham EDT-DistribuTAPE	6.3.0.0	
	STK 9840 Tape	Tivoli Device Driver	4.2.6
	STK T9940A Tape	Tivoli Device Driver	4.2.6
	IBM 3580 Tape	IBMTAPE Device Driver	4.0.5.0
	Quantum Super DLT Tape	Tivoli Device Driver	4.2.6
WinNT / Win2K Data Servers SP 6 on NT, SP2 on Win2K	TSM Storage Agent	4.2.1.7	
	TSM Backup/Archive Client	4.2.1.16-16	
	Gresham EDT-DistribuTAPE	6.3.0.0	
	STK 9840 Tape	Tivoli Device Driver	4.2.1.14
	STK T9940A Tape	Tivoli Device Driver	4.2.1.14
	IBM 3580 Tape	IBMTAPE Device Driver	5.0.2.4
	Quantum Super DLT Tape	Tivoli Device Driver	4.2.1.14

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VERITAS NetBackup™ DataCenter Backup Application

In this solution, components of NetBackup DataCenter's three-tier architecture, Master Server, Media Server and Client were deployed. These tiers provide scalable data protection services, so that a backup architecture can be uniquely tailored to the SAN and LAN requirements in any enterprise.

The NetBackup Master Server version 3.4 (with current patches) software was loaded on a Compaq system, running Microsoft Windows 2000. Master Servers provide the NetBackup storage domain key controlling functions:

- NetBackup configuration and policy management
- Backup scheduling and device resource allocation
- Indexing and storage of metadata
- Robotic and tape device control

Additionally, the Master Server houses the NetBackup Media Manager volume database, used for tracking the assignment of tapes to any Media Server storage units.

The NetBackup SAN Media Server version 3.4 (with current patches) software was installed on twelve additional heterogeneous data servers in this SAN. The twelve systems were comprised of Microsoft Windows 2000, Microsoft Windows NT 4.0, and Sun Solaris 8 operating systems. The NetBackup SAN Media Server component provides device and media management services, including robotic/device control and monitoring, so that NetBackup client can provide performance backup and recovery. NetBackup supports multiplexed, and multi-streaming data transfer.

NetBackup tape drive and robotic control functions can be distributed to any master or media server as needed. For this test, the library's robot was controlled from the NetBackup Master server. This capability provides significant flexibility in environments where all hosts can communicate. All libraries in this test were robotically controlled through the master server's Fibre Channel connection, and no API robotic control was used.

VERITAS engineers configured all of the heterogeneous data servers and tape libraries into a single storage domain backup configuration with all three libraries managed by NetBackup. Each media server was configured to backup its SAN local data to any shared tape drive in a library. The tape drives were dynamically managed with NetBackup Shared Storage Option, producing cost effective resource sharing.

File based backup data was read from the local NetBackup Client, from the storage array, and passed locally to the NetBackup Media Server component, over the SAN, disk to host. Next the host writes the data out to tape over the SAN. For this configuration, the Media Servers request and coordinate any required robotic tape mounts through the NetBackup TLD robotic control daemon, tldcd on the Master Server.

NetBackup Shared Storage Option was implemented to fully utilize and optimize the interoperable SAN infrastructure. NetBackup Shared Storage Option (SSO) virtualizes individual tape drives by dynamically sharing them between multiple VERITAS NetBackup Servers.

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Software Summary for VERITAS Solution

Server/Device	Software	Version
Microsoft Win2K Backup Server	NetBackup Master Server / SSO	3.4 (patch NB_34_2)
STK 9840FC tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
STK T9940A tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
Quantum SDLT tape	VERITAS 0dlttape.sys Driver	4.0 dated 9/05/2001
IBM LTO Ultrium tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
STK L700 library	VERITAS tldcd driver	See footnote ¹
ATL / Quantum P2000 library	VERITAS tldcd driver	See footnote
IBM 3583 library ²	VERITAS tldcd driver	See footnote
IBM 3584 library ³	VERITAS tldcd driver	See footnote
Sun Solaris8 Data Server (all)	NetBackup Media Server / SSO	3.4 (patch NB_34_2)
STK 9840FC tape	Sun “st” Driver	See footnote ⁴
STK T9940A tape	Sun “st” Driver	See footnote
Quantum SDLT tape	Sun “st” Driver	See footnote
IBM LTO Ultrium tape	Sun “st” Driver	See footnote
STK L700 library	VERITAS tldcd driver	See footnote
ATL / Quantum P2000 library	VERITAS tldcd driver	See footnote
IBM 3583 library	VERITAS tldcd driver	See footnote
IBM 3584 library	VERITAS tldcd driver	See footnote
Microsoft NT4 Data Server (all)	NetBackup Media Server / SSO	3.4 (patch NB_34_2)
STK 9840FC tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
STK T9940A tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
Quantum SDLT tape	VERITAS 0dlttape.sys Driver	4.0 dated 9/05/2001
IBM LTO Ultrium tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
STK L700 library	VERITAS tldcd driver	See footnote [•]
ATL / Quantum P2000 library	VERITAS tldcd driver	See footnote
IBM 3583 library	VERITAS tldcd driver	See footnote
IBM 3584 library	VERITAS tldcd driver	See footnote
Microsoft Win2K Data Server (all)	NetBackup Media Server / SSO	3.4 (patch NB_34_2)
STK 9840FC tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
STK T9940A tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
Quantum SDLT tape	VERITAS 0dlttape.sys Driver	4.0 dated 9/05/2001
IBM LTO Ultrium tape	VERITAS halfinch.sys Driver	4.0 dated 6/29/2001
STK L700 library	VERITAS tldcd driver	See footnote [•]
ATL / Quantum P2000 library	VERITAS tldcd driver	See footnote
IBM 3583 library	VERITAS tldcd driver	See footnote
IBM 3584 library	VERITAS tldcd driver	See footnote

¹ NetBackup 3.4 with patch NB_34_2 using TLD robotic control

² This library specific to the McData-based solution

³ This library specific to the Brocade-based solution

⁴ Solaris 8 Recommended Patch Cluster DATED Jan 2001

[•] NetBackup 3.4 with patch NB_34_2 using TLD robotic control

[•] NetBackup 3.4 with patch NB_34_2 using TLD robotic control

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Detailed Configurations

Brocade Configuration –

The following tables summarize the configuration and results at Brocade for the backup software applications.

Brocade Legato Test Site Information

Sever	Multipath Version	HBA	Firmware	Driver	ATL Drives Seen	STK Drives Seen	IBM Drives Seen	ATL Library Seen	STK Library Seen	IBM Library Seen
Compaq NT	v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
Compaq Win2K	v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
Compaq Solaris	v2.1c	JNI 1063 Sbus	13.3.7	2.5.2.1	Yes	Yes	Yes	Yes	Yes	Yes
EMC NT	v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes	Yes	Yes	Yes
EMC W2K	v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes	Yes	Yes	Yes
EMC Solaris	v2.1.0	JNI 1063 Sbus	13.3.7	2.5.21	Yes	Yes	Yes	Yes	Yes	Yes
IBM NT	v1.3.0.1	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes	Yes	Yes	Yes
IBM Win2K	v1.3.0.0	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes	Yes	Yes	Yes
IBM Solaris	v1.2.0.5	JNI 1063 Sbus	13.3.7	2.5.2.1	Yes	Yes	Yes	Yes	Yes	Yes
HDS NT	N/A	Emulex LP-8000	3.81a1	4.31 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
HDS Win2K	N/A	Emulex LP-8000	3.81a1	4.41a8 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
HDS Solaris	N/A	JNI 1063 Sbus	13.3.7	2.5.2.1	Yes	Yes	Yes	Yes	Yes	Yes
Backup Server (W2K)	N/A	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes	Yes	Yes	Yes

Vendor	Library firmware version	Drive firmware version	Library Driver	Tape Driver
ATL P2000 with Super DLT-I Drives	3.11	V35	6318050 (NT/W2K); Note-2	Note-1 and Note-2
IBM 3584 with LTO Drives	2150	v16E0 for four drives	2150 (NT/W2K); Note-2	Note-1 and Note-2
STK L700 with 9840/9940 Drives	2.36.00	1.30.109 & 1.30.209	0236 (NT/W2K); Note-2	Note-1 and Note-2

Updated: 01/29/02

Legato:
NetWorker 6.1.1 for Backup Server.
NetWorker 6.1.1 and DDS for Client Servers.

Note-1: Window NT and 2K Tape Driver:
IBM LTO v.5.0.2.4

Quantum SDLT v.1.2.0.0

STK 9840/9940A v.1.0.2.0

Note-2: Solaris OS Library and Device Driver as stated in </kernel/drv/st.conf>
IBM Ultrium
SDLT1
STK-9x40

Brocade Tivoli Test Site Information

Sever	Multipath Version	HBA	Firmware	Driver	ATL Drives Seen	STK Drives Seen	IBM Drives Seen	ATL Library Seen	STK Library Seen	IBM Library Seen
Compaq NT	v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes	na	na	na
Compaq Win2K	v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes	na	na	na
Compaq SUN	v2.1c	JNI 1063 Sbus	13.3.7	2.5.2.1	Yes	Yes	Yes	na	na	na
EMC NT	v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes	na	na	na
EMC Win2K	v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes	na	na	na
EMC SUN	v2.1.0	JNI 1063 Sbus	13.3.7	2.5.21	Yes	Yes	Yes	na	na	na
IBM NT	v1.3.0.1	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes	na	na	na
IBM Win2K	v1.3.0.0	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes	na	na	na
IBM SUN	v1.2.0.5	JNI 1063 Sbus	13.3.7	2.5.2.1	Yes	Yes	Yes	na	na	na
HDS NT	N/A	Emulex LP-8000	3.81a1	4.31 (minport)	Yes	Yes	Yes	na	na	na
HDS Win2K	N/A	Emulex LP-8000	3.81a1	4.41a8 (minport)	Yes	Yes	Yes	na	na	na
HDS SUN	N/A	JNI 1063 Sbus	13.3.7	2.5.2.1	Yes	Yes	Yes	na	na	na
Backup Server (Win2K)	N/A	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes	Yes	Yes	Yes
Vendor	Library firmware version	Drive firmware version	Library Driver (Win2K)	Tape Driver						
ATL P2000 with Super DLT-I Drives	3.11	V35	adsm SCSI 4.2.1.0	adsm SCSI 4.2.1.0						
IBM 3584 with LTO Drives	2150	v16E0 for four drives	adsm SCSI 4.2.1.0	5.0.2.4 (Window 2K); 4.0.5.0 (SUN Solaris)						
STK L700 with 9840/9940 Drives	2.36.00	1.30.109 & 1.30.209	Note-1	adsm SCSI 4.2.1.0						
				Note-1: All SUN server has acsls 6.0.1 installed for the SUN Solaris. Also, Gresham Edt Distributape driver is installed on HDS SUN.						
Updated: 01/22/02										
				Tivoli Storage Mgr. Backup Server: Storage Agents: 4.2.1.7 Backup Archive Clients: 4.2.1.16.16						

Brocade Veritas Test Site Information

Sever	Multipath Version	HBA	Firmware	Driver	ATL Drives Seen	STK Drives Seen	IBM Drives Seen	ATL Library Seen	STK Library Seen	IBM Library Seen
Compaq NT	v3.1 update 3	Emulex	3.81a1	4.52a8 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
Compaq Win2K	v3.1 update 3	Emulex	3.81a1	4.52a8 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
Compaq SUN	v2.1c	JNI 1063 Sbus	13.3.7	2.5.9	Yes	Yes	Yes	Yes	Yes	Yes
EMC NT	v2.1.0	Emulex	3.81a3	2.01x1	Yes	Yes	Yes	Yes	Yes	Yes
EMC Win2K	v2.1.0	Emulex	3.81a3	2.01x1	Yes	Yes	Yes	Yes	Yes	Yes
EMC SUN	v2.1.0	JNI 1063 Sbus	13.3.7	2.5.21	Yes	Yes	Yes	Yes	Yes	Yes
IBM NT	v1.3.0.1	Emulex	3.82a1	2.10a2	Yes	Yes	Yes	Yes	Yes	Yes
IBM Win2K	v1.3.0.0	Emulex	3.82a1	2.10a2	Yes	Yes	Yes	Yes	Yes	Yes
IBM SUN	v1.2.0.5	JNI 1063 Sbus	13.3.7	2.5.14	Yes	Yes	Yes	Yes	Yes	Yes
HDS NT	N/A	Emulex	3.81a1	4.31 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
HDS Win2K	N/A	Emulex	3.81a1	4.41a8 (minport)	Yes	Yes	Yes	Yes	Yes	Yes
HDS SUN	N/A	JNI 1063 Sbus	13.3.7	2.58.HIT.07	Yes	Yes	Yes	Yes	Yes	Yes
Backup Server (Win2K)	N/A	Emulex	3.82a1	2.10a2	Yes	Yes	Yes	Yes	Yes	Yes

Vendor	Library firmware version	Drive firmware version	Library Driver (Win2K)	Tape Driver
ATL P2000 with Super DLT-I Drives	3.11	V35	N/A	NT = v1.9 Win2K=v1.2.0.0
IBM 3583 with LTO Drives	2150	v16E0 for four drives	1.1.1.0	5.0.2.4
STK L700 with 9840/9940 Drives	2.36.00	1.30.109 & 1.30.209	N/A	9840=1.0.2.0; 9940=file version 5.00.2195.1620

Updaed: 12/07/01

Note-1: SDLT, 1a1a=v26. SDLT, 0dlttape.sys, 09/05/01. Both NT/W2K

Note-2: 9840/9940/LTO, halfinch.sys, 0f. Both NT & W2K.

New and Advanced Open SAN Supported Solutions – Compaq

McData Configurations

The following tables document the test site information for the backup and restore application supported solution at McData.

McDATA Legato Test Site Information

Storage Array	Sever	Multipath Version	HBA	Firmware	Driver	ATL Drives Supported	STK Drives Supported	IBM Drives Supported
Compaq StorageWorks ESA-12000 firmware=86	Windows NT SP6a	Securepath v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes
Compaq StorageWorks ESA-12000 firmware=86	Windows 2000 SP2	Securepath v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes
Compaq StorageWorks ESA-12000 firmware=86	Solaris v2.8	SecurePathv2.1c	JNI 1063 Sbus	13.3.7	2.5.9	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Windows NT SP6a	Powerpath v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Windows 2000 SP2	Powerpath v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Solaris v2.8	Powerpath v2.1.0	JNI 1063 Sbus	13.3.7	2.5.21	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Windows NT SP6a	SDD v1.3.0.1	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Windows 2000 SP2	SDD v1.3.0.0	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Solaris v2.8	SDD v1.2.0.5	JNI 1063 Sbus	13.3.7	2.5.14	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Windows NT SP6a	N/A	Emulex LP-8000	3.82a1	4.31 (minport)	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Windows 2000 SP2	N/A	Emulex LP-8000	3.82a1	4.41a8 (minport)	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Solaris v2.8	N/A	JNI 1063 Sbus	13.3.7	2.58.HIT.07	Yes	Yes	Yes
n/a	Backup Server (Win2K)	N/A	Emulex LP-8000	3.82a1	2.11a2	Yes	Yes	Yes

Tape & Library Vendor	Library firmware version	Drive firmware version	Library Driver (Win2K) backup server	Tape Driver	Legato Info
ATL P2000 with Quantum Super DLT Drives	63180502.30	2323	5.0.2195.2959	NT = v1.9, Win2K=v1.2.0.0, Solaris=native st driver	Networker v6.1.1
IBM 3583 with LTO SCSI Drives using IBM built-in gateway FC bridge.	2.62	v18N2	5.0.2.4	NT= 1.1.7.8, Win2K = 5.0.2.4 Solaris v2.8 = pkg IBMtape 4.0.5.0	Networker v6.1.1
STK L700 with 9840A/9940 Drives (loop).	2.36.00	9840A = 1.30.109 and 9940 = 1.30.210	1.1.1.0	NT & Win2K: 9840A=1.0.2.0, 9940=file version 5.00.2195.1620, Solaris = native st driver	Networker v6.1.1

Backup Software Vendor	Code Versions
Legato	Networker v6.1.1

New and Advanced Open SAN Supported Solutions – Compaq

McDATA Tivoli Test Site Information

Storage Array	Sever	Multipath Version	HBA	Firmware	Driver	ATL Drives Supported	STK Drives Supported	IBM Drives Supported
Compaq StorageWorks ESA-12000 firmware=86	Windows NT SP6a	Securepath v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes
Compaq StorageWorks ESA-12000 firmware=86	Windows 2000 SP2	Securepath v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes
Compaq StorageWorks ESA-12000 firmware=86	Solaris v2.8	SecurePathv2.1c	JNI 1063 Sbus	13.3.7	2.5.9	Yes	Yes	NO
EMC Symmetrix firmware=5567.36.20A	Windows NT SP6a	Powerpath v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Windows 2000 SP2	Powerpath v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Solaris v2.8	Powerpath v2.1.0	JNI 1063 Sbus	13.3.7	2.5.21	Yes	Yes	NO
IBM ESS Array firmware=1.4.1.6	Windows NT SP6a	SDD v1.3.0.1	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Windows 2000 SP2	SDD v1.3.0.0	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Solaris v2.8	SDD v1.2.0.5	JNI 1063 Sbus	13.3.7	2.5.14	Yes	Yes	NO
HDS model 9900 firmware=01-15-39-00/05	Windows NT SP6a	N/A	Emulex LP-8000	3.82a1	4.31 (minport)	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Windows 2000 SP2	N/A	Emulex LP-8000	3.82a1	4.41a8 (minport)	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Solaris v2.8	N/A	JNI 1063 Sbus	13.3.7	2.58.HIT.07	Yes	Yes	NO
n/a	Backup Server (Win2K)	N/A	Emulex LP-8000	3.82a1	2.11a2	Yes	Yes	Yes
n/a	Tivoli ACSLS (v6.0.1) SUN Server (Solaris v2.8) with client Gresham Distributape (v6.3.0.0) on all clients.	N/A	QLA2200F (PCI)	2.1.34	3.16	n/a	Yes	n/a

Tape & Library Vendor	Library firmware version	Drive firmware version	Library Driver (Win2K) backup server	Tape Driver	Tivoli Info
ATL P2000 with Quantum Super DLT Drives	63180502.30	2323	5.0.2195.2959	NT = v1.9, Win2K=v1.2.0.0, Solaris=native st driver	TSM driver v4.2.1.14
IBM 3583 with LTO SCSI Drives using IBM built-in gateway FC bridge.	2.62	v18N2	5.0.2.4	NT= 1.1.7.8, Win2K = 5.0.2.4, Solaris v2.8 = pkg IBMtape 4.0.5.0	TSM driver v4.2.1.14
STK L700 with 9840A/9940 Drives (loop).	2.36.00	9840A = 1.30.109 and 9940 = 1.30.210	1.1.1.0	NT & Win2K: 9840A=1.0.2.0; 9940=file version 5.00.2195.1620, Solaris = native st driver	TSM driver v4.2.1.14

Backup Software Vendor	Code Versions
Tivoli	TSM Backup Server v4.2.1.7 and storage agents (NT, Win2K, and Solaris). TSM Backup Archive v4.2.1.16 client for NT, Win2K, and Solaris

McDATA Veritas Test Site Information

Storage Array	Sever	Multipath Version	HBA	Firmware	Driver	ATL Drives Supported	STK Drives Supported	IBM Drives Supported
Compaq StorageWorks ESA-12000 firmware=86	Windows NT SP6a	Securepath v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes
Compaq StorageWorks ESA-12000 firmware=86	Windows 2000 SP2	Securepath v3.1 update 3	Emulex LP-8000	3.81a1	4.52a8 (minport)	Yes	Yes	Yes
Compaq StorageWorks ESA-12000 firmware=86	Solaris v2.8	SecurePathv2.1c	JNI 1063 Sbus	13.3.7	2.5.9	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Windows NT SP6a	Powerpath v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Windows 2000 SP2	Powerpath v2.1.0	Emulex LP-8000	3.81a3	2.01x1	Yes	Yes	Yes
EMC Symmetrix firmware=5567.36.20A	Solaris v2.8	Powerpath v2.1.0	JNI 1063 Sbus	13.3.7	2.5.21	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Windows NT SP6a	SDD v1.3.0.1	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Windows 2000 SP2	SDD v1.3.0.0	Emulex LP-8000	3.82a1	2.10a2	Yes	Yes	Yes
IBM ESS Array firmware=1.4.1.6	Solaris v2.8	SDD v1.2.0.5	JNI 1063 Sbus	13.3.7	2.5.14	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Windows NT SP6a	N/A	Emulex LP-8000	3.82a1	4.31 (minport)	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Windows 2000 SP2	N/A	Emulex LP-8000	3.82a1	4.41a8 (minport)	Yes	Yes	Yes
HDS model 9900 firmware=01-15-39-00/05	Solaris v2.8	N/A	JNI 1063 Sbus	13.3.7	2.58.HIT.07	Yes	Yes	Yes
n/a	Backup Server (Win2K)	N/A	Emulex LP-8000	3.82a1	2.11a2	Yes	Yes	Yes

Tape & Library Vendor	Library firmware version	Drive firmware version	Library Driver (Win2K) backup server	Tape Driver	Veritas Info
ATL P2000 with Quantum Super DLT Drives	63180502.30	2323	Pass-thru drivers via Veritas Netbackup v3.4.2	NT & Win2K = Veritas Tape Driver Installer v4.0 (driver package 240009), Solaris= native st driver	Veritas Netbackup v3.4 (patch 3.4.2)
IBM 3583 with LTO SCSI Drives using IBM built-in gateway FC bridge.	2.62	v18N2	Pass-thru drivers via Veritas Netbackup v3.4.2	NT & Win2K = Veritas Tape Driver Installer v4.0 (driver package 240009), Solaris= native st driver	Veritas Netbackup v3.4 (patch 3.4.2)
STK L700 with 9840A/9940 Drives (loop).	2.36.00	9840A = 1.30.109 and 9940 = 1.30.210	Pass-thru drivers via Veritas Netbackup v3.4.2	NT & Win2K = Veritas Tape Driver Installer v4.0 (driver package 240009), Solaris= native st driver	Veritas Netbackup v3.4 (patch 3.4.2)

Backup Software Vendor	Code Versions
Veritas	Netback v3.4 (patch 3.4.2)

Test plan and results

Basic Interoperability Tests

Scope of Testing for Disk Storage Interoperability

During the first Multivendor Open San Supported Solutions testing, each disk storage vendor performed their respective data zone testing, in addition to monitoring the results observed at both Brocade and McData. The testing validated that the activities occurring in one data zone, whether normal or abnormal, did not affect the operation of the other data zones. It was assumed that the devices tested were already fully qualified by each vendor.

Testing Methodology for Disk Storage Interoperability

Each data zone was integrated into the fabric environment independently to verify proper functionality. After each data zone was independently verified, all of the data zones were integrated. Disk Storage Interoperability testing to validate proper coexistence was then initiated to ensure that a disruption in one data zone did not affect the stability of a device in another data zone. The fabric was subjected to rigorous testing to ensure interoperability and fabric robustness. The testing was categorized into two areas: interoperability testing and failure and fault testing. Interoperability testing sought to ensure minimal fabric disruption during device link activities and fabric build/change actions. Specifically the areas tested were device login, fabric build functions, and fabric change functions. In addition, failure and fault testing sought to ensure minimal fabric disruption during forced link failures and forced component failures within the switches/directors.

Common Backup/Restore testing results.

The major upgrade to this phase of the Open SAN interoperability tests were twofold - the fabric was updated to reflect current configuration support from each vendor, and the backup and restore solutions were added to the fabric.

All three backup and restore software vendors provided input into the testing and test plans, with review and approval by the disk and fabric vendors. Each software test was performed on identical SAN multivendor environments, under the supervision of the switch manufacturer (Brocade and McData) hosting the event. Upon successful conclusion of the tests, both the switch vendor and software vendor signed and approved the completed test plan. Compaq, along with the other data zone manufacturers, reviewed and approved the results. The revisions of drivers, HBAs, software and firmware were updated as testing results warranted.

New and Advanced Open SAN Supported Solutions – Compaq

Support Agreements

To satisfy the SSF's "proof of support" criteria, all previously announced solutions have relied on signing formal bilateral Cooperative Support Agreements (CSAs) with each other. However, with this solution, each of the companies participating in this solution have signed the same agreement with the Technical Support Alliance Network (TSANet) to form a group relationship focused on working together to overcome problems a customer may have with complex multivendor solutions. Through this relationship, each company has identified a core set of contacts and escalation process for other service providers to use in their engagement of services. This information is available via the internet to enable a vendor to access the information from anywhere that internet access is available. Having this common agreement and all contact information in one convenient place provides even faster engagement of services from one company to another, and reduces the time needed to resolve customer problems.

Summary

This solution set is further evidence that the storage networking vendors are serious about cooperating with each other to make their products interoperate. As an incremental follow-on to the original supported solutions announced last June, we have provided the backup and restore function to the solutions already announced. We intend to continue building upon these solutions with additional products, additional vendors and additional function.

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