HP StorageWorks NAS Data Center: A solution for network attached storage (NAS) satellite sites utilizing a central site and HP OpenView Storage Mirroring

Executive summary

HP has configured, tested, and demonstrated to customers the HP StorageWorks NAS Data Center solution, an affordable, easily managed solution for data consolidation that provides complete data protection for multiple satellite sites. The NAS Data Center solution achieves business continuity within the Microsoft® Windows® environment by combining the replication software HP OpenView Storage Mirroring (SM), HP ProLiant Storage Servers, and other HP StorageWorks components. This paper describes the configuration and testing of this solution. By deploying the NAS Data Center solution, businesses can reliably safeguard their data while realizing cost and efficiency improvements in their storage management and provisioning.

Overview

Enterprise storage systems are vitally important to businesses today because loss of data causes loss of productivity and revenue and can even lead to business failure. As companies continue to grow, and store more data, data protection is increasingly important. To reduce the threat of data loss, companies might want to use one central location for data collection, so that satellite locations are not responsible for housing expensive, cumbersome storage systems. This type of data solution is much easier and more affordable than having a full complement of storage resources at multiple satellite locations.

The NAS Data Center solution consists of **satellite sites,** a **central site,** and a **disaster recovery site.** The NAS servers at the satellite site provide local storage to local clients. The storage capacity at the satellite sites is scalable to address business growth. The central site provides a centralized repository of data replicated from satellite sites. It also provides data protection, high availability, disaster tolerance, and centralized management and expertise for a cost-effective solution. Data replication from satellite sites to the central site is managed by HP OpenView SM software. HP OpenView SM is a powerful tool that is used to create and maintain a continuously updated and immediately accessible copy of the satellite site client data at the central site. This copy of the data is used as the source for tape backups, eliminating the time-of-day limitation on when backups can take place (the "backup window").

Bringing new satellite offices online is easy and affordable because it requires only a low-cost NAS server and HP OpenView SM, with no need for on-site storage management.

The solution is designed for additional data protection and disaster recovery for the primary HP StorageWorks Enterprise Virtual Array 5000 (EVA5000) at the central site by utilizing a secondary EVA5000 at the disaster recovery site.

Solution configuration

Each satellite site is equipped with an HP StorageWorks NAS 1000s, HP ProLiant DL100 Storage Server, or HP ProLiant DL380 G4 Storage Server, while the central site houses HP ProLiant DL580 G2 Storage Servers. HP OpenView SM is deployed on network attached storage (NAS) servers at both the central and satellite sites. The satellite sites send their data to the central site, using HP OpenView SM. The central site stores this data on an EVA5000. The data stored at the central site is backed up to tape by means of an HP StorageWorks MSL6060 tape library and tape backup software, either HP OpenView Storage Data Protector 5.1 or a third-party application such as Veritas Backup Exec 9.1. Data from the central site is also replicated to an EVA5000 at the disaster recovery site, using HP StorageWorks Continuous Access EVA for additional data protection and disaster recovery.

Figure 1 shows the configuration that HP tested, and Table 1 lists the hardware and software used in the configuration.
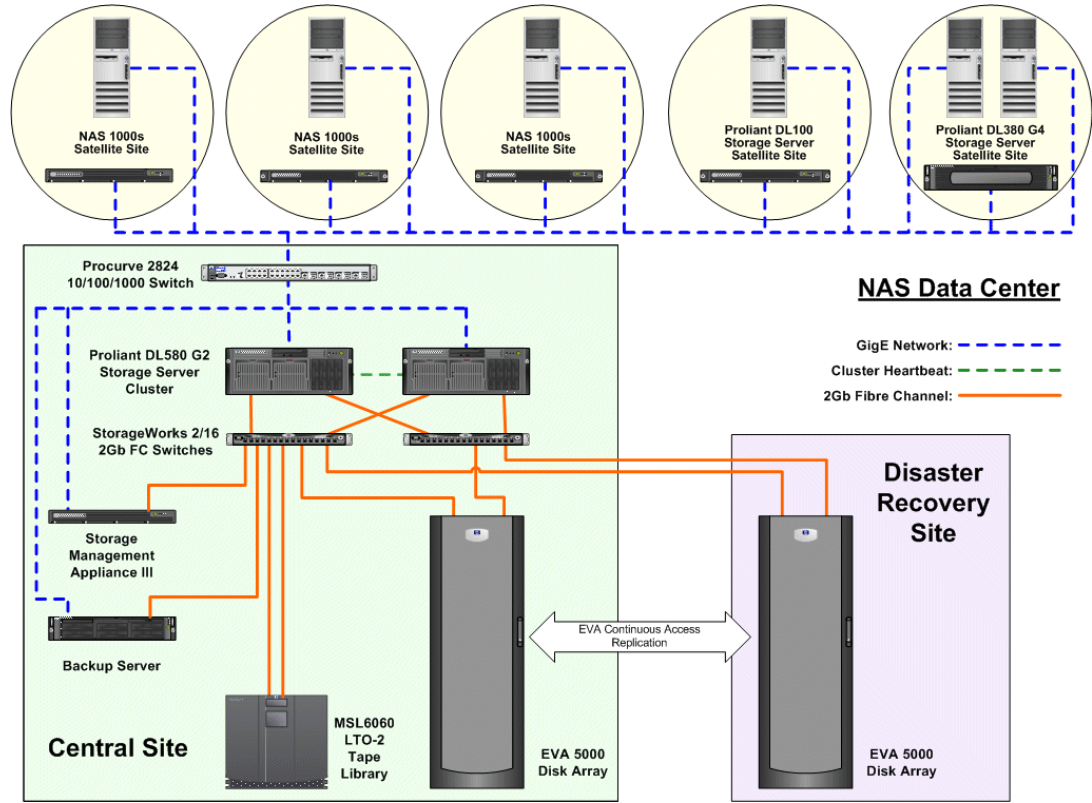
Figure 1.

Table 1.Tested configuration (bill of materials)

NAS servers

| Qty	Part number	Description	Comments
3	305016-B21	HP StorageWorks NAS 1000s (320 GB)	Branch office HP ProLiant Storage Server
1	349037-B21	DL100 Storage Server (320 GB Model)	Branch office HP ProLiant Storage Server
1	345646-001	DL380 G4 Storage Server	Branch office HP ProLiant Storage Server
2	348937-B21	DL580 G2 Storage Server	2 HP ProLiant Storage Servers for cluster
2	331474-B21	NAS Cluster Kit (for DL580 G2 Storage Server)	HP NAS cluster kit
3	344954-B21	HP OpenView SM for 1000s	Software licenses
1	344954-B21	HP OpenView SM for DL100 Storage Server	Software licenses
1	336243-B21	HP OpenView SM for DL380 G4 Storage Server	Software licenses
2	336247-B21	HP OpenView SM for DL580 G2 Storage Server	Software licenses

NAS servers

Qty	Part number	Description	Comments
5	DG767#ABA	D530C/P2. 66/40BC/512	NAS clients, Windows XP

Storage array systems

Qty	Part number	Description	Comments
2	309620-B23	Enterprise Virtual Array (EVA) 2C2D-C 60Hz Graphite	EVA storage units with 2.0 TB raw storage per EVA/site
56	293568-B23	FC HDD INT CTO 72G 15K Fact	To accomplish HP StorageWorks Continuous Access configurations
2	250203-B27	VCS HSV110 Media Kit 3.0b	

Management appliance and SAN components

Qty	Part number	Description	Comments
1	189715-003	HP OpenView Storage Management Appliance III	To manage EVA5000 (includes needed software)
2	344181-B21	Fibre Channel Switch,2/16 EL All	SAN switches to connect storage and DL580 G2 Storage Server
5	305573-B21	2-GB, 64-bit PCIx FC HBA	Required for DL580 G2 Storage Server connectivity

Tape storage

Qty	Part number	Description	Comments
1	331196-B22	MSL6060 4-drive Ultrium 460	2 router cards for fiber connectivity
1	333705-001	HP ProLiant DL380R03 X3.2-1MB/533, 1GB	Backup management server (hardware)
1	B6961AA	Storage Data Protector 5.1 (base configuration)	HP backup software
1	B6953AA	LTU for drive extension	(Required option)
1	B6957BA	LTU for 61-251 slots tape library	(Additional option)
2	B6965BA	Online backup extensions for Windows server	(Additional option)
2	BA1533AA	Open file backup Windows NT/2000/2003 server	(Additional option)
1	3rd party	Veritas Backup Exec 9.1	Third-party backup software

LAN

Qty	Part number	Description	Comments
1	J4903A	ProCurve 2824 (10/100/1000)	LAN switch

Replication software for EVA

Qty	Part number	Description	Comments
2	331268-B22	Continuous Access EVA LTU/CD 1.1	
2	331270-B21	Continuous Access EVA 5k 2 TB LTU 1.0 ALL	

HP OpenView Storage Mirroring overview

HP OpenView Storage Mirroring (SM) is an integral component in this solution, providing the ability to replicate data, whether in real time or scheduled, from the satellite sites to a central site data center. This functionality enables the business to host multiple remote offices without the need for significant hardware or IT expertise, while providing for data consolidation and disaster tolerance. In addition to providing a greater level of high availability in the event of physical or logical data failure, the replicated copy of the data at the central site is used as the source for tape backups, eliminating the backup window. For some customers, the online copy of the data can even serve as a replacement for daily tape backups.

The centralized operations of data replication are managed by the HP OpenView SM console. With its easy-to-use graphical user interface (GUI) (see Figure 2), you can configure the required operations of data replication.

Figure 2. HP OpenView SM console GUI
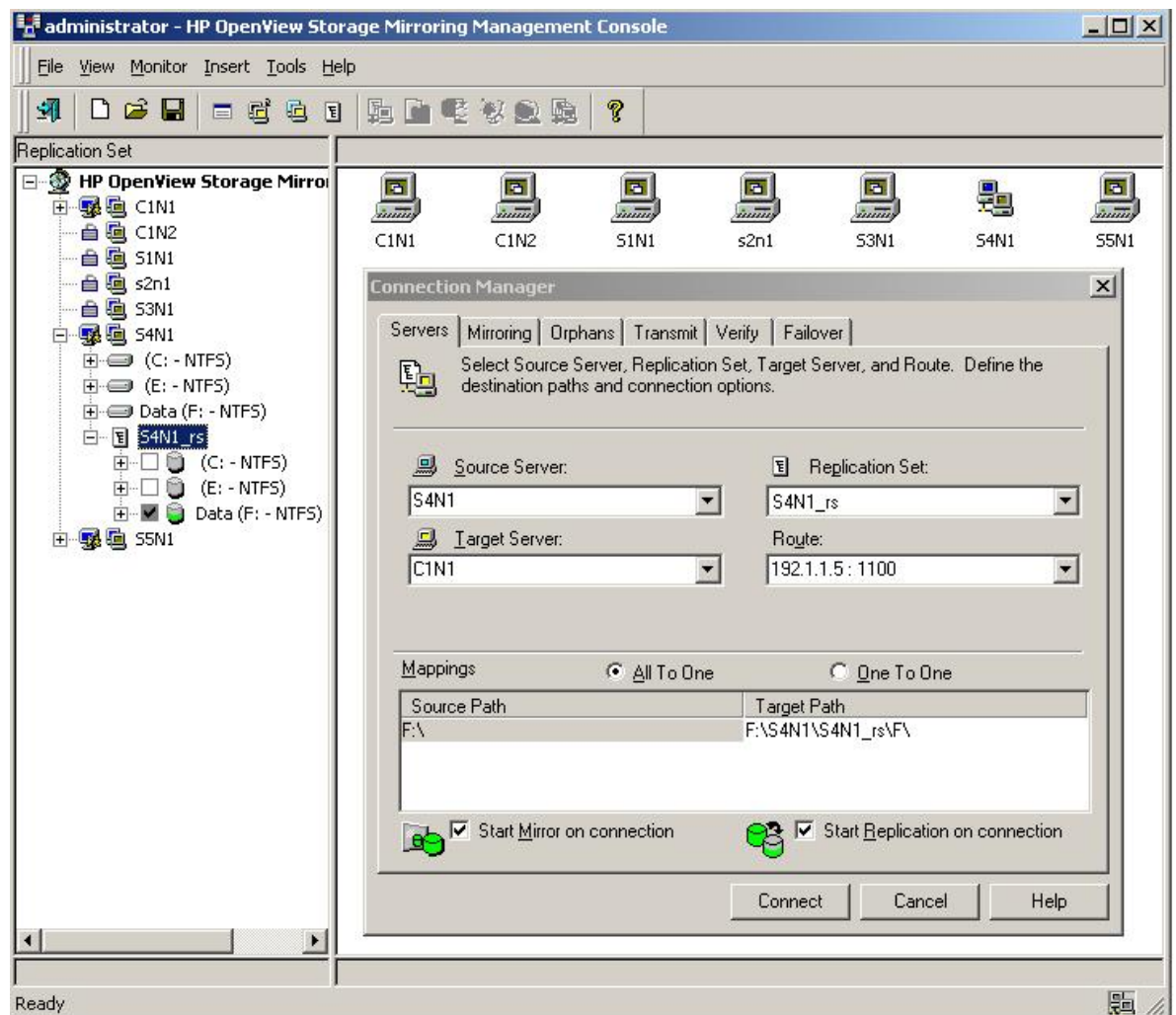
Key concepts

This paper uses some key terms to refer to the implementation and functionality of HP OpenView SM as it is used in the HP StorageWorks NAS Data Center solution.

Source and target

When describing how HP OpenView SM creates and maintains a copy of the data, HP refers to the *source,* or original data, and the target, or copy of the original data. When replication is implemented by way of HP OpenView SM, the source data can be individual files, subdirectories, or both on a file share or an entire disk. For most HP OpenView SM implementations, there is considerable flexibility in the choice of the target location. For example, a source disk may be replicated to an equivalent disk on the target or to a subdirectory on a target disk. HP OpenView SM must be installed on both the source and target NAS servers. HP OpenView SM is fully interoperable with HP ProLiant Storage Servers selected as source or target.

Mirroring and replicating

HP OpenView SM uses **mirroring** and **replication** as two main mechanisms to create and maintain copies of data. **Mirroring** is the byte-by-byte copying of data from the source location to the target location. **Replication** is the transmission of modifications of the source data to the target location. When a source and target have been defined to HP OpenView SM, typically the first operation that occurs is a mirroring of the data from the source to the target. After the initial mirroring operation is complete, HP OpenView SM uses replication to maintain the target data. In case the rate and amount of data change on the source exceed the throughput available for replication, the changes not replicated are stored in a queue file. When throughput increases or the rate of change at the source decreases, the queue file is read and changes are replicated to the target.

HP OpenView SM also possesses a third mechanism—**difference mirroring**—that examines the data blocks on the source and target and copies only the changed data from source to target. This mechanism can be used when the rate of change at the source has exceeded the bandwidth available to such an extent that the queue file has been completely filled. When the queue file is full, no further changes can be stored in it. To prevent any data inconsistencies between the source and target copies of the data, HP OpenView SM automatically undertakes a difference mirror of the source data.

Replication target

The replication target (the central site) must have available space equivalent to that at the replication sources (the satellite sites). In some cases, the target can require more available space than exists on the source. A main reason for this is "orphan" behavior, which refers to the replication rule that governs the handling of file deletion on the replication source. Controlling orphan behavior is more significant in file share environments, where accidental file deletions occur more frequently than in messaging or database environments. When HP OpenView SM is configured to allow orphans, deletion of a file on the source will not delete that file from the target. This configuration allows restoring deleted files from the online backup at the target rather than from tape.

Allowing orphans on the target means that the amount of space used on the target exceeds the amount of space used on the source because the space occupied by these files on the target is not in use on the source after the files have been deleted.

A benefit of having a replicated copy of production data is that files on the target are closed (that is, not opened by an application), so that the target files can be used for tape backup without having to shut down the application or use backup application-specific add-ins to allow the backup of open files. This means that the traditional backup window, the time that applications are unavailable while the data is copied to tape, is no longer a limiting factor.

Failover

Failover is a component of HP OpenView SM that allows a target to stand in for a failed source computer. The failover target assumes the network identity of the failed source. When the target assumes the identity of the source, user and application requests destined for the source system or its IP addresses are routed to the target.

HP OpenView SM failover monitors the status of a system by tracking network requests and responses exchanged between a monitored source computer and the failover target. The time between requests and the number of allowable responses that can be missed combine to create a time-out period. When the source system fails to respond before the time-out period has expired, HP OpenView SM determines that the source has failed. At this time, HP OpenView SM prompts you to initiate failover or, if so configured, it initiates failover automatically. In the event of failover, the target assumes or adds the identity of the failed source, including system name, IP address, and subnet mask.

Failover also sends updates to routers and other components to update the IP-to-media access control (MAC) address mapping. Network packets and applications destined for the failed IP address are routed to the target system.

Satellite site

An HP ProLiant Storage Server (DL100 Storage Server or DL380 G4 Storage Server) or an HP StorageWorks NAS 1000s at an individual satellite site provides storage file shares to local clients (see Figure 3). The NAS Data Center solution is scalable to support multiple satellite sites. The NAS servers at satellite sites are easily managed from any standard Web browser, and they offer additional remote options with terminal services to centralize the NAS server management. User and application data is saved on the mapped file shares from the local NAS servers.
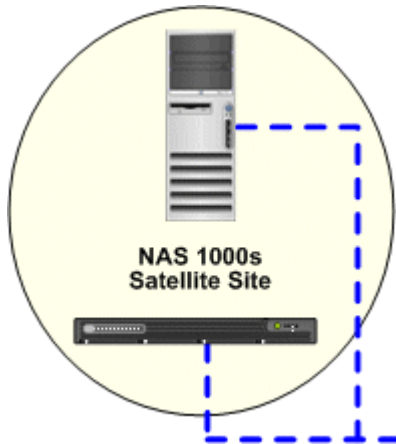
NAS file share replication

HP OpenView SM performs NAS file share replication from the satellite site to the central site. After the replication sets are defined, mirroring is the initial HP OpenView SM action for transferring data from a satellite site (source) to the central site (target), and replication is the on-going action between source and target to keep the target data current with the changes to data at the source.

The HP OpenView SM console provides centralized management for the installed base of HP OpenView SM (the satellite and central sites). HP OpenView SM reports the calculated size of selected source data in a defined replication set to ease the selection options for the data transfer window or network bandwidth utilization allocation to control the network load. The details of the data (files, directories, and bytes) transferred from source to target are logged in the log file (see Figure 4).

In tests of the NAS Data Center solution, mirroring and replication were successfully performed and confirmed for all satellite sites, both individually and concurrently. Though network bandwidth limitation was not a focus of this activity, an approximate maximum network utilization of 25 to 30% of theoretical (250 to 300 Mb/s for a 1000-BT connection) was observed. Further analysis of this observation was not performed.

Figure 4. Segment of HP OpenView SM report on mirror action test

07/13/2004	09:25:30.8470	Repset contains 1080721872 byte(s) to mirror	
07/13/2004	09:25:30.8470	Mirror Started <10>	
07/13/2004	09:26:14.3160	Mirror Ended <10>	
07/13/2004	09:26:14.3160	Directories Mirrored:	203
07/13/2004	09:26:14.3160	Files Mirrored:	804
07/13/2004	09:26:14.3160	Bytes Mirrored:	1080721872
07/13/2004	09:26:14.3160	Elapsed Time:	44.994530 seconds
07/13/2004	09:26:14.3160	Paused Time:	0 seconds
07/13/2004	09:26:14.3160	Total number of pauses:	0
07/13/2004	09:26:14.3160	Throughput:	1374 MB/min.

NAS file share restoration

NAS file share restoration is accomplished by using the Restoration Manager function of HP OpenView SM. This function provides an easy method for restore replicated data from the target (the central site) back to its original location on the source (the satellite site). Restoration can be used if the source data is lost due to a disk crash or when the most up-to-date data exists on the target following failover.

Recovering from the loss of a satellite site

The impact of NAS server failure at a satellite site is minimized by utilizing the failover function of HP OpenView SM partnered with the data replication capabilities of HP OpenView SM. As explained in the "Failover" section on page 8, the target (a NAS cluster) at the central site will take over to serve the clients supported by the failed source NAS server. The failover capability of HP OpenView SM reduces the downtime to seconds or minutes and provides automatic recovery of key business functions and data.

Adding a satellite site

Adding a new satellite site is straightforward and cost-effective. It requires only the selected HP ProLiant Storage Server model and HP OpenView SM. Installation and configuration are part of standard system administration procedures developed for previously installed satellite sites. The NAS Data Center solution is scalable to keep pace with business growth.

Central site

The central site provides a centralized repository of data replicated from satellite sites. It also provides data protection, high availability, disaster tolerance, and centralized management and expertise for a cost-effective solution. Replicating data to a central site allows for better utilization of IT resources, ease of management, and focused IT expertise.

High availability is provided by configuring HP ProLiant DL580 G2 Storage Servers as a clustered resource for satellite sites. NAS clustering functionality is provided by Microsoft Windows Storage Server 2003, which is part of the HP ProLiant Storage Server.

The central site is equipped with a storage area network (SAN) to connect an HP StorageWorks Enterprise Virtual Array 5000 (EVA5000), for a centralized repository of data replicated from satellite sites, to the DL580 G2 Storage Server clustered resource by means of HP OpenView SM.

Tape backup is provided by a tape library and a backup software application, as described in the next section, "Tape backup and recovery of data." A dedicated backup server (HP ProLiant DL380) is deployed to manage the tape library and backup application for a central database of backed-up data.

The central site configuration is illustrated in Figure 5.

Figure 5. Central site configuration
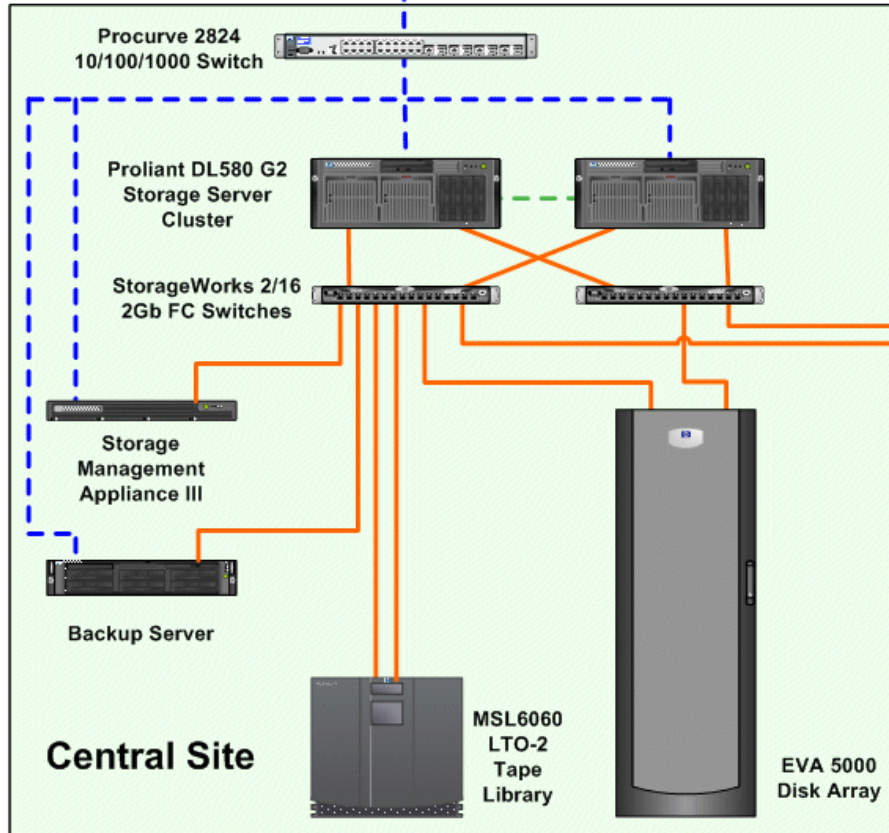
Tape backup and recovery of data

Data from the central site EVA5000 is backed up to the MSL6060 tape library. The NAS Data Center solution was successfully tested with both Storage Data Protector 5.1 and Veritas Backup Exec 9.1.

The HP StorageWorks MSL6000 tape library family provides performance and investment protection. Designed to maximize the performance of the HP StorageWorks Ultrium 460 tape drive, the MSL6000 tape libraries also provide unparalleled flexibility. The MSL6000 series tape library can be scaled with other MSL libraries using a pass-through mechanism for up to 16 drives and 240 slots, allowing a single library to grow and change with capacity and technology needs

The Storage Data Protector software provides enterprise data protection and disaster recovery, ensuring recovery from any disruption. Storage Data Protector integrates a variety of techniques to eliminate backup and recovery windows. The capabilities to eliminate planned downtime range from online backup and backup of open files to zero-downtime, zero-impact backup. The software provides industry-leading instant recovery as well as several disaster recovery alternatives to eliminate unplanned downtime, allowing recovery of entire data centers in minutes.

Backup statistics (see Figure 6) from the Storage Data Protector report captured during solution testing list the amount of data backed up and the time taken to transfer it to tape. This report clearly demonstrates the throughput advantage for backup and recovery of data from tape storage provided by SAN connectivity between tape storage array systems and tape storage at the central site.

Figure 6. Segment of Storage Data Protector report on backup testing

```
[Normal] From: BMA@c1n1.ndc.com "HP:Ultrium 2-SCSI_1_c1n1"  Time: 7/13/2004 9:30:32 AM
         STARTING Media Agent "HP:Ultrium 2-SCSI_1_c1n1"

[Normal] From: BMA@c1n1.ndc.com "HP:Ultrium 2-SCSI_1_c1n1"  Time: 7/13/2004 9:30:34 AM
         Loading medium from slot 13 to device Tape0:1:0:2C

[Normal] From: VBDA@c1n1.ndc.com "F:"  Time: 7/13/2004 9:31:49 AM
         STARTING Disk Agent for c1clstr.ndc.com:/F "F:".

[Normal] From: VBDA@c1n1.ndc.com "F:"  Time: 7/13/2004 9:32:08 AM
         COMPLETED Disk Agent for c1clstr.ndc.com:/F "F:".

[Normal] From: BMA@c1n1.ndc.com "HP:Ultrium 2-SCSI_1_c1n1"  Time: 7/13/2004 9:32:57 AM
         Tape0:1:0:2C
         Medium header verification completed, 0 errors found

[Normal] From: BMA@c1n1.ndc.com "HP:Ultrium 2-SCSI_1_c1n1"  Time: 7/13/2004 9:33:17 AM
         Unloading medium to slot 13 from device Tape0:1:0:2C

[Normal] From: BMA@c1n1.ndc.com "HP:Ultrium 2-SCSI_1_c1n1"  Time: 7/13/2004 9:33:30 AM
         COMPLETED Media Agent "HP:Ultrium 2-SCSI_1_c1n1"

[Normal] From: BSM@cftndc "C1N1FS1"  Time: 7/13/2004 9:33:30 AM

         Backup Statistics:

                 Session Queuing Time (hours)     0.00
                 ---------------------------------------
                 Completed Disk Agents ........    1
                 Failed Disk Agents ...........    0
                 Aborted Disk Agents ..........    0
                 ---------------------------------------
                 Disk Agents Total  ...........    1
                 =======================================
                 Completed Media Agents .......    1
                 Failed Media Agents ..........    0
                 Aborted Media Agents .........    0
                 ---------------------------------------
                 Media Agents Total  ..........    1
                 =======================================
                 Mbytes Total ................. 1037 MB
                 Used Media Total .............    1
                 Disk Agent Errors Total ......    0
```

# NAS cluster recovery from a NAS cluster node failure

Clustering is offered in the HP ProLiant DL380 G4 Storage Server and HP ProLiant DL580 G2 Storage Server in configurations of up to eight nodes. Clustering provides high availability for the clustering-aware applications, such as HP OpenView SM, Storage Data Protector, and Veritas Backup Exec, used in this solution. The NAS cluster configuration also presents storage file shares as clustered resources for satellite sites. In the event of a NAS cluster node failure or planned shutdown, clustered resources automatically move from the failing node to a surviving node. This configuration not only provides high availability for applications and storage, but it also makes it possible to perform system maintenance and upgrades during normal business hours.

Disaster recovery site

The disaster recovery site provides additional data protection for the centralized data repository at the central site by deploying a secondary EVA5000, as outlined in the "Solution configuration" on page 3 and illustrated in Figure 7. Continuous Access EVA provides data replication between the EVA5000s at the central site and the one at the disaster recovery site.

Continuous Access EVA is a storage-based SAN application that performs remote replication between EVA5000s. The application is enhanced to perform remote replication and deliver high data availability and performance to users on Fibre Channel-based campus, metro, or continental SANs. Continuous Access EVA features the highest level of storage data protection capabilities to meet business continuity goals.

Figure 7. Disaster recovery site configuration
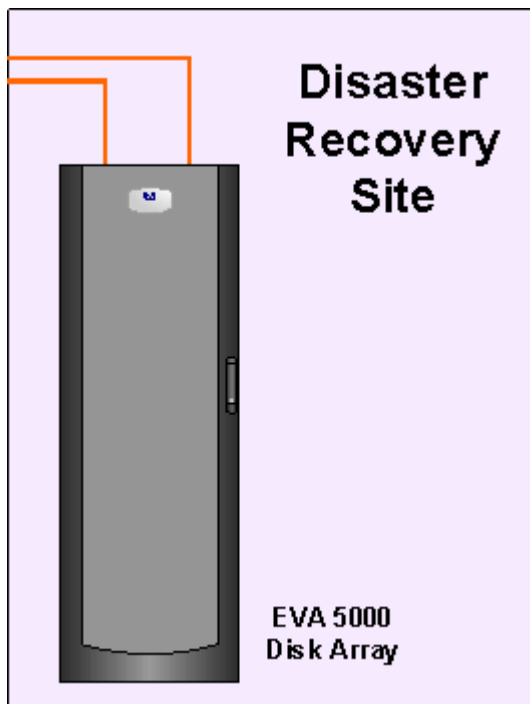

Online data replication

Continuous Access EVA uses the remote copy function of an HP StorageWorks HSV controller running HP StorageWorks Virtual Controller Software (VCS) 3 or later to achieve host-independent data replication. The remote-copy feature is the major feature of Continuous Access EVA. Storage system management is provided by an application residing on the HP OpenView Storage Management Appliance. The Continuous Access EVA console (see Figure 8) provides the operational overview of managed storage for the NAS Data Center solution. Data replication between the central site and the disaster recovery site is managed by defining copy sets, data replication (DR) groups, and managed sets (collections of DR groups).

Data replication has selectable write modes: asynchronous or synchronous. In synchronous mode, the disaster recovery site is constantly kept 100% consistent with the central site data. In asynchronous

mode, the write operation is reported to the host as complete before the data is written to the remote copy set at the disaster recovery site. Asynchronous mode can reduce the response time (write completion back to the host) on the high latency links, but it puts each of the outstanding writes at risk if the central site source storage system is lost.

Figure 8. Continuous Access EVA console GUI
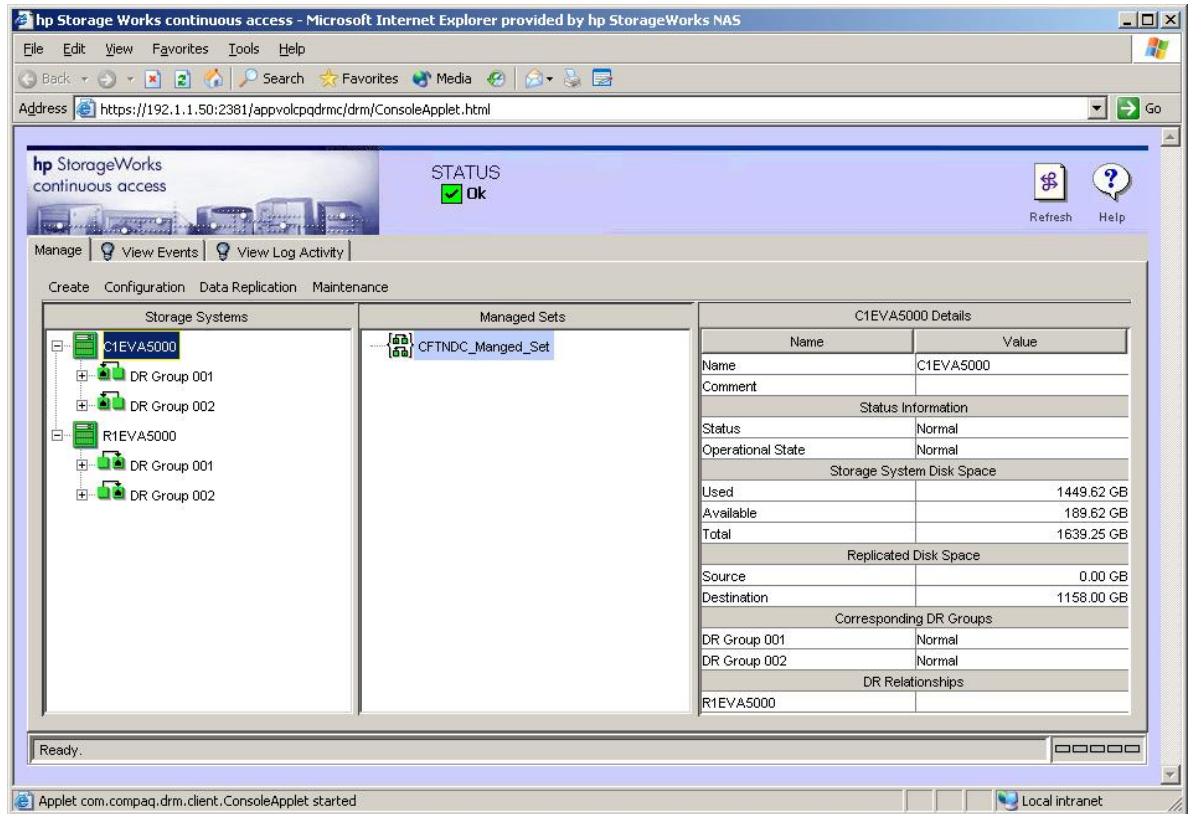
Data recovery from central site failure

The NAS Data Center solution takes advantage of the failover feature of Continuous Access EVA to provide quick recovery in the event of a planned or unplanned outage at the central site. The recovery process whereby one DR group, managed set, fabric (SAN), or controller switches over to its backup is called failover. Planned failover is administered from the maintenance link on the Continuous Access EVA console (see Figure 8). Data recovery from central site failure is quick and efficient because data is online at the disaster recovery site.

Important
System restart or hardware rescan might be required after a planned or unplanned failover.

The disaster recovery site can be configured to provide recovery from the failure of NAS servers at the central site by adding standby NAS servers at the disaster recovery site.

HP StorageWorks NAS Data Center solution

The NAS Data Center solution for protected storage combines low acquisition and maintenance cost with fine-grained replication that can be controlled to avoid placing excess load on production systems or networks. The combination of HP ProLiant Storage Server and HP OpenView Storage Mirroring (SM) in the NAS Data Center solution provides:

- **Low cost**—This centralized solution requires less equipment at satellite sites, thereby saving on cost, space, and maintenance. HP OpenView SM replicates data from HP ProLiant Storage Servers at satellite sites to those at the central site, offering better scalability than traditional storage solutions.
- **Flexible replication**—HP OpenView SM replicates only the bytes actually changed by each write, not the entire block or file. When compared with block-mode replication solutions, this approach offers lower load on production servers, faster updates, and the ability to send replication updates across wide area networks. Because HP OpenView SM allows replication updates to be controlled, administrators can tailor replication resource usage for their specific environments.
- **A standards-based solution**—HP ProLiant Storage Server is based on industry-standard components, such as Microsoft Windows Storage Server 2003, HP ProLiant servers, and HP StorageWorks disk array systems. Because Windows Storage Server 2003 operates as a member of a Windows domain, HP ProLiant Storage Server seamlessly integrates with an existing Windows infrastructure.

Summary

Storage protection strategies fall into four general areas: high availability, enhanced backup and restore, disaster recovery, and migration. Each of these areas is important. Most organizations focus on high availability and disaster recovery for only the systems they perceive as most critical, based on the belief that protecting file and print servers costs too much. Likewise, enhancements for backup/restore and migration are often dismissed for cost reasons. The combination of HP OpenView SM replication software and the HP ProLiant Storage Server platform enables cost-effective, easy-to-manage protection for file, print, and application servers.

HP tests have demonstrated that the NAS Data Center solution is a reliable, flexible, and scalable solution for protecting data at satellite sites. This centralized solution requires less equipment, thereby saving on cost, space, and maintenance. For satellite sites, the NAS Data Center is a cost-efficient, easily managed solution for data consolidation and protection.

Appendix—HP ProLiant Storage Server

Core NAS features

The following three features power all HP ProLiant Storage Server solutions:

- **Operating system**

  A crucial element of any NAS system, the operating system can directly affect the speed and ease of deployment. All HP ProLiant Storage Server solutions run on Microsoft Windows Storage Server 2003 and are optimized for maximum file sharing performance, straight out the box.

- **Management**

  Following successful deployment comes efficient management. HP ProLiant Storage Server solutions are easily managed from any standard Web browser, and they offer additional remote options with terminal services and Integrated Lights-Out.

- **Universal connectivity**

  Pre-installed file protocols enable access from Windows, NetWare, Linux, UNIX®, and Apple clients, plus native support for HTTP and FTP. No hidden software licenses are required.

Value-added NAS features

HP ProLiant Storage Server solutions offer a variety of ways to extend the level of protection and security for data:

- **Server clustering**

  If your availability requirements are higher than only redundant components built into a NAS device, such as network interface cards (NICs), disk drives, or even power supplies, you might want to configure your solution to have multiple NAS devices acting as a single unit (called clustering) to ensure availability in the event of an individual NAS device failure. Clustering is offered in the HP ProLiant DL380 G4 Storage Server and the HP ProLiant DL580 G2 Storage Server in configurations of up to eight nodes.

- **Data replication**

  This technology creates a complete mirror image of the data from one NAS device to another, leaving the original data intact and fully operational. After the initial replication has occurred, changes to that data only are synchronized between the two NAS devices, ensuring maximum performance. HP OpenView SM is an ideal data replication solution for protecting data that must be immediately available in the event of data loss or corruption on the primary system.

- **Data snapshots**

  Data snapshotting, a standard feature of Windows Storage Server 2003, enables administrators to take a copy of all data at any time (referred to as a "point-in-time" copy). This copy can then be duplicated and stored on another NAS device or tape media using any supported tape backup application, without affecting the original data. In addition, snapshots allow a simple and quick restore from disk, especially for client users running on Windows 2000 or XP, where accidentally deleted files can be restored from their individual PCs without involving the IT department.

- **Backup and recovery**

  HP ProLiant Storage Server solutions are supported by most of the leading tape backup software vendors and can easily be incorporated into any existing LAN- or SAN-based data protection environment or even attached directly to a tape drive. Optimum integration is achieved with Storage Data Protector and HP StorageWorks tapes and tape libraries.

- **Antivirus**

  HP ProLiant Storage Server solutions are also supported by the industry's leading antivirus software vendors and can be incorporated easily into any antivirus procedure or policy, without adding additional antivirus tools to the IT environment.

For more information

HP Storage

Access http://www.hp.com/country/us/eng/prodserv/storage.html for the latest information on this solution. From this website, select the appropriate product or solution.

The following links provide information about this solution and its components:

- HP OpenView Storage Mirroring
  http://h18006.www1.hp.com/products/storage/software/sm/index.html
- HP StorageWorks Continuous Access EVA
  http://h18006.www1.hp.com/products/storage/software/conaccesseva/index.html
- HP NAS configurations
  http://h18006.www1.hp.com/storage/networkattached.html
- HP StorageWorks Enterprise Virtual Array 5000
  http://h18006.www1.hp.com/products/storageworks/enterprise/index.html

Demo

A recorded demo of the NAS Data Center Solution is available on CD. Ask your sales person or reseller for a copy.

HP authorized reseller

For the name of your nearest HP authorized reseller:

- In the United States, call 1-800-345-1518
- In Canada, call 1-800-263-5868
- Elsewhere, see the HP website for locations and telephone numbers at http://www.hp.com.

HP technical support

Telephone numbers for worldwide technical support are listed at http://www.hp.com/support/. From this website, select the country of origin.

Note: For continuous quality improvement, calls may be recorded or monitored.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions