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StorageWorks Virtualized Storage Management for Exchange 2000

A Virtualization and Recovery Solution for Microsoft Exchange 2000 Environments

Abstract

This Solution Guide provides tools and best practices to increase application availability, using the proven virtualization technology, *SANworks* Virtual Replicator by Compaq.

This guide is intended for use by experienced Microsoft Exchange 2000 administrators.

In this guide, administrators learn to use snapshot technology to recover an Exchange environment in far less time than with conventional tape restore methods.

Additionally, this guide describes how virtual storage pools can be centrally managed and expanded, without impacting users or application availability. The solution can be applied as part of a standard disaster recovery practice.



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Notice

Virtualized Storage Management for Exchange 2000, Edition 3.0
Solutions Guide prepared by Enterprise Storage Group

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Microsoft Exchange Server does not currently support true snapshot capability, which involves taking a "hot" snapshot of database information while users are active and connected to their mailboxes. The information described in this Solutions Guide details a technically sound approach to implementing snapshots within the boundaries imposed by Exchange. The approach has been thoroughly tested and is supported by Compaq and involves a temporary quiescence of the database and full committal of all outstanding transactions before the snapshot is taken. The solution follows the Microsoft published guidelines as documented in the Microsoft Knowledge Base Article, [Understanding Offline and Snapshot Backups, Q237767](#).

1.0 Management Summary

Successful businesses face similar challenges, including the continuous growth of critical data, shrinking backup windows, and time-crunched administrators. The Virtualized Storage Management solution for Exchange 2000 introduces new tools and strategies for administrators to use that enhance data availability and streamline storage management. This easy to deploy solution provides a cost-effective method for maximizing data availability through fast recovery and on-line volume growth.

Using snapshot technology, data protection is increased with a time effective recovery alternative to standard tape restores. Administrators maximize operational efficiencies by dynamically growing storage pools without affecting application availability.

SANworks Virtual Replicator enables administrators to manage a single storage infrastructure independent of the physical disk drives and associated disk arrays. *SANworks* Virtual Replicator uses virtual server storage technology consistent with the Compaq VersaStor™ initiative.

This solution provides an integrated infrastructure addressing the challenges of unpredictable growth and disk utilization efficiency to restore the integrity of a database for as little as the cost of the *SANworks* Virtual Replicator licenses.

Testing has shown the following advantages:

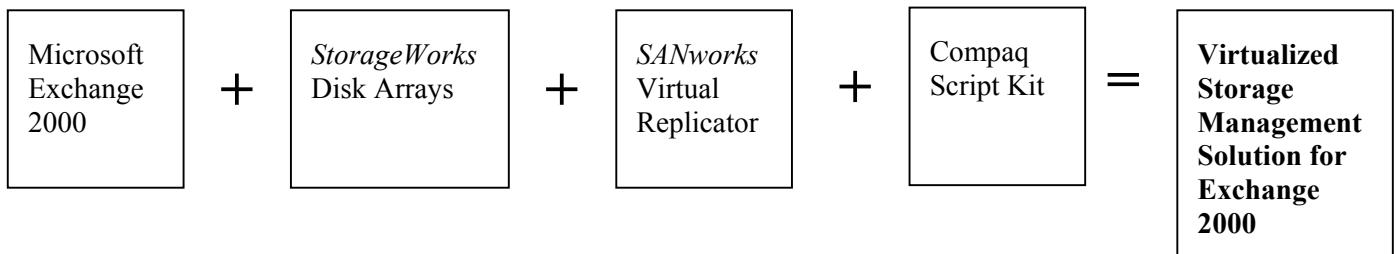
- Snapshot based restores reduce downtime as compared to tape-based restores. For example, snapshots with changes of 27% can be used to restore the Exchange environment in only 22 minutes – representing over a three-fold decrease in downtime as compared to a similar restore from tape. Exchange environments with less activity can represent even shorter recovery times.
- Dynamic online storage growth can be achieved without application downtime, as compared to **more than one hour of downtime using standard volume growth practices.**
- Administrators can increase virtual storage pools in **less than four minutes.** This is a significant time savings compared with typical volume expansion procedures, which could take hours.

"The requirement for continuous, 24x7 access to our data has added a new dimension to backup operations. We can't afford downtime or access interruptions to process data backup. With the snapshot capability of SANworks Virtual Replicator [the core component in the Virtualized Storage Management solution] we can quickly and easily take a space efficient, point in time replica of the data on our production volume..."

- Richard A Baldwin, President & CEO, Nth Generation

2.0 Solution Description

The Virtualized Storage Management for Exchange 2000 Solution is a fully integrated configuration of hardware and software that provides host-based virtualization for online capacity expansion and snapshot technology for rapid database and storage group restoration, providing minimal downtime for Microsoft Exchange 2000. To achieve these results, this solution for Exchange 2000 leverages the capabilities of Compaq *StorageWorks* RAID arrays, along with Compaq *SANworks* Virtual Replicator, and user customizable scripts as illustrated below.



This solutions guide is intended to give administrators the best practices, procedures, and tools needed to:

- Create snapshots of Exchange volumes
- Perform snapshot based recoveries
- Dynamically expand virtual storage pools
- Streamline the solution implementation
- Make informed management decisions using performance data

The solution is a tested configuration of hardware, software, and services. Procedures for installation, configuration, integration, and operation within a typical application environment are included, for a smooth and predictable deployment experience. Performance and operational guidelines, not usually found within individual product documentation, are also available.

This guide includes the following solution specific information:

- Step by step installation instructions
- Validated scripts for the creation of a snapshot of an Exchange 2000 environment
- Best practice information, cautions, and areas of consideration
- Performance, sizing, and characterization information for a typical customer environment
- Discussion relating to the integration of this solution with regular online backups
- A consolidated list of available tools and other white papers for reference

2.1 Solution Components

The Virtualized Storage Management solution for Exchange 2000 consists of four components:

Microsoft Exchange 2000

Exchange 2000 may be configured on any Windows 2000 server and may utilize a MSCS configuration for improved application availability. The Exchange servers own the storage groups and databases, which are stored on virtual disks, sharing available disk capacity across the SAN or network. Refer to Section 4.3, Partner Content.

SANworks Virtual Replicator 3.0

To provide the storage virtualization function and the ability to create snapshots of virtual disks, each Exchange server requires a *SANworks* Virtual Replicator license. In a clustered environment, each node also requires a *SANworks* Virtual Replicator license.

Disk Storage

Although the configuration tested used the *StorageWorks* MSA1000 fibre-based storage array, the solution is neither limited to this controller nor is it a prerequisite. The solution configuration can operate using direct attached storage and/or any other SAN-based fibre array controller. All disk storage devices on the network may be considered part of the available storage pool and may be used in the creation of virtual disks. The solution can operate with multiple storage devices, as long as they are available to the specific Exchange 2000 host. Existing disk storage may be utilized without any modifications.

Tape Backup

Consideration: Although this solution provides procedures for the use of a Virtual Replicator snapshot as a source for data restoration, a snapshot may only be used to recover from specific failure conditions. It is recommended that you continue to perform periodic tape backups, either directly from the application database or from the snapshot itself. A tape backup device and suitable backup software configuration is not required for this solution, but is highly recommended. It is assumed that the user already operates a suitable tape backup configuration and has a pre-existing backup policy and schedule. This solution easily integrates into any preexisting backup configuration.

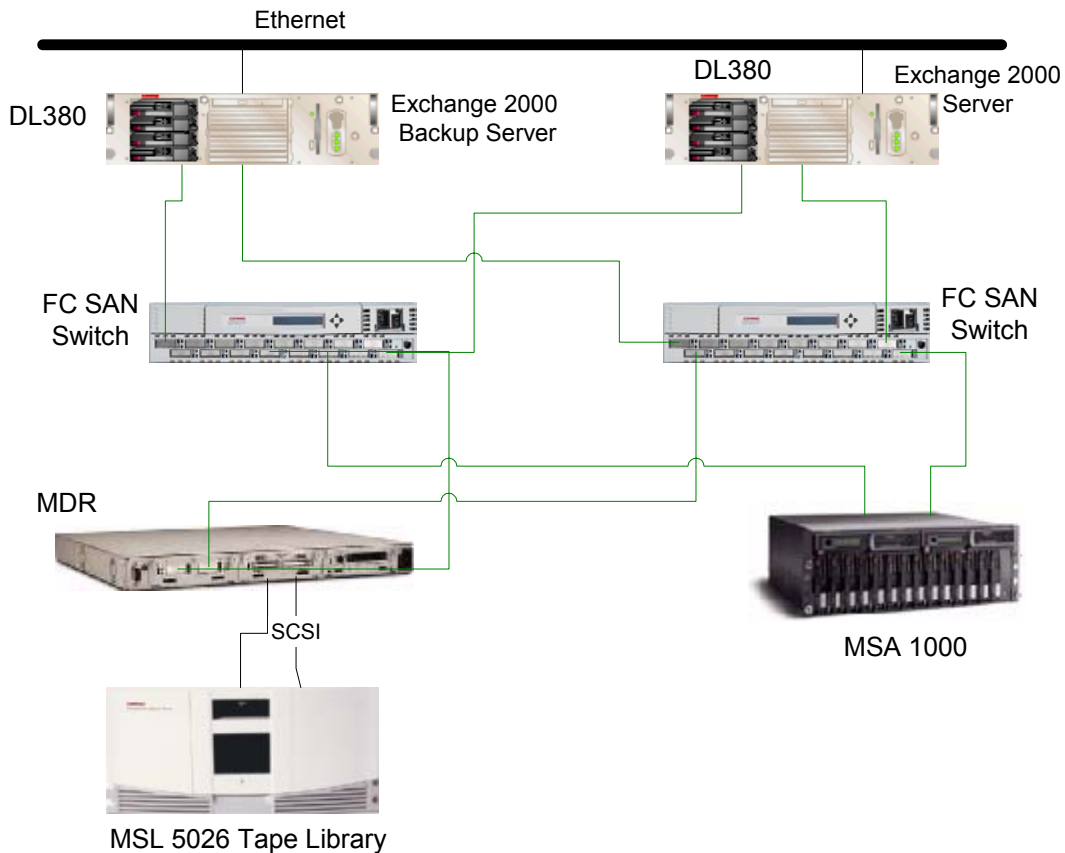
Solution Package

The specially developed tools provided by this solution are necessary to guarantee interoperability between the application, software, and hardware components.

Script Kit – automates operation for designated application servers and database

Solution Guide – Consolidates information to streamline implementation and operation

Figure 1 represents a typical solution configuration. The disk array configuration may be modified to meet specific customer requirements and is only shown as an example. The tape library / backup configuration may also be modified to meet your requirements. The Storage Area Network configuration, although recommended for improved I/O performance, is not a core requirement for successful operation of this solution. Additional information on suitable configuration guidelines is found in Section 4.0, Supported Configurations.

Figure 1 – Typical Solution Configuration

2.2 Features / Benefits

The Virtualized Storage Management for Exchange 2000 solution provides the following benefits to administrators:

- Simplifies management of data and storage with easy to use, automated tools to increase productivity of IT staff.
- Provides quick and efficient snapshots that are created in seconds, making use of storage capacity only when production data changes.
- Provides the ability to create tape or disk backups directly from the snapshot.
- Does not require significant investments in hardware or software and can be applied directly to existing environments in just a few hours.
- Can be applied as an integral part of a standard disaster recovery practice that provides timely restoration of corrupted database transactions. Using snapshots, administrators can recover the Exchange environment without using conventional tape restore methods.
- Allows virtual storage pools to be centrally managed and expanded effortlessly, without impact to online users or application availability.

- “Solution in a Box” – A complete solution – fully tested, integrated, and documented, providing a simple, predictable deployment.
- With do-it-yourself scripting, administrators can modify scripting to best fit their business requirements without the need for an onsite service call – Installation and Startup Services are also available from Compaq Global Services.
- Leverage Compaq’s depth of knowledge and experience with Microsoft deployments. There is “peace of mind” knowing that the solution is backed by the industry experts.
- Applicable across the entire range of *StorageWorks* arrays, in SAN and direct attached environments. Select the hardware and network configuration that meets your business need, and be prepared for future expansion.

2.3 Key Supporting Products

This solution requires *SANworks* Virtual Replicator 3.0.

See Section 4.0, Supported Configurations, for complete configuration information.

2.4 Business Value

Solution

All the necessary installation instructions, scripts, and operational best practices are provided at no cost to facilitate a quick, trouble free deployment without the need for in-house development of scripts or best practices. The solution requires no additional products and/or services beyond those required to deploy *SANworks* Virtual Replicator.

Most importantly, even though the solution is automated, you can customize the scripts without a mandatory and costly onsite service engagement. Open systems tools are leveraged whenever possible and Compaq specific tools are provided only where specific functionality is required.

Online volume growth

With online volume growth, you no longer have to over allocate disk storage capacity at the original deployment phase of an application. You can avoid inefficient capacity utilization by allocating only the required number of disks for the planning period and then dynamically grow the data volumes as the database grows. The online volume growth feature also allows you to respond quickly to unpredictable capacity growth without affecting database availability.

Snapshots

Administrators traditionally rely on tape restores for the recovery of files or databases. By integrating a snapshot recovery strategy into an existing tape backup policy, restoration times can be more than cut in half, directly improving application availability.

2.5 Customer Profile

You can implement the solution in any organization where Exchange 2000 is currently installed or planned. Although tested specifically on Compaq ProLiant servers and *StorageWorks* SAN

based storage hardware, the solution can be administered in any open systems environment where *SANworks* Virtual Replicator is supported.

The solution is specifically targeted towards medium size enterprises (Exchange environments with 2000 to 5000 seats) requiring improved access to data, simplified management for rapidly growing databases, and/or quick recovery from data corruption or frequently lost files. The solution offers the highest value to those companies implementing entry level or departmental level array based SANs. These companies acknowledge the business value of virtualized storage and want to start building a foundation for storage virtualization.

It is ideally suited for those customers considering the *StorageWorks* MSA 1000 as part of an entry-level SAN configuration.

2.6 Application Best Fits

This solution is best applied in situations that require:

- Quick restores or database restoration from database corruption, lost or deleted data, frequent user restore requests, or virus damage
- An additional data protection scheme to provide 24 hour database protection, where the time to perform more frequent tape backups is not available
- More efficient use of disk resources. By allowing up to 8 logical units in a storage pool, this solution can allow for a smaller initial disk investment and smaller planning increments, which leads to more efficient disk allocation.
- Strategies to respond to unplanned or frequent volume growth or to cover situations where disk utilization is consistently under-forecasted
- Snapshot capabilities that span multiple disk controllers
- A solution that provides both online volume growth and snapshots all within one single package

2.7 Cost / Value Analysis

An administrator can choose from several alternatives with regards to maintaining an Exchange storage environment. Each alternative introduces additional costs related to software, installation and configuration, and management. Each alternative also has an inherent value, which includes the following:

- Increase in application availability (limited disruption to the user)
- Ability to respond to failure events (quick database recovery)
- Ease of manageability (minimum daily attention required by the IT administrator)
- Increase in storage utilization efficiency (minimization of the number of unallocated disk drives supporting the application)

Table 1 – Cost / Value Summary

Implementation Scenario	Cost		Value	
	Initial Implementation	Continued Management	Initial Implementation	Continued Management
Standard	Inefficient use of storage resources during initial database deployment	Excessive application non-availability during restores Application non-availability during unplanned volume expansion activities	Easy deployment No additional hardware or software required	Fits into existing management practices
Microsoft Dynamic Disk	Ships with Windows 2000	Excessive application non-availability during restores	Easy deployment No additional hardware or software required	Ability to respond to unplanned storage growth Improved storage utilization efficiency
Controller-based Cloning	Cost of controller based cloning software licenses Requires allocation of 2x disk capacity	Heterogeneous environments may require multiple management interfaces		Ability to offload backup to non-application server Ability to develop additional restore strategies for improved application availability
SANworks Virtual Replicator	Cost of host based <i>SANworks</i> Virtual Replicator software licenses Cost of testing and developing database integrated scripts and policies	Minimal	Requires less disk capacity than clone implementations	Ability to respond to unplanned storage growth Improved storage utilization efficiency Ability to develop additional restore strategies for improved application availability
Virtualized Storage Management Solution	Solutions package is a free downloadable enhancement to <i>SANworks</i> Virtual Replicator	Minimal	All of the above , plus all installation instructions, scripts, and best practices are provided	All management and maintenance policies are provided

Standard Implementation

The Exchange administrator can rely on standard tape backup strategies to recover from system failure events. Regardless of the level of the failure, the only recovery strategy available to the administrator is to restore the Exchange environment from tape. Even an insignificant failure event can require a significant restoration period, over which time the application availability would be compromised.

The administrator can rely on typical storage capacity planning techniques, where mailbox quotas, document retention policies and deleted items cache sizes dictate the necessary capacity over a particular planning period. This technique requires the purchase of additional storage capacity at the beginning of the planning period, regardless of the forecasted number of mailboxes, which can result in over-allocation and under-utilization of storage.

Experience shows that about 30 percent of the allocated storage is actually utilized at the outset of the planning period. Although this margin provides room for forecasted growth and unforeseen usage patterns, it can be a bad investment practice, especially with the historical decrease in storage pricing over time.

There is always a trade off between over allocation of storage resources at the start of a planning period and the impact of downtime for unplanned volume expansion. In the event that the storage group grows beyond its allocated capacity, new and larger volumes have to be created. The storage group needs to be migrated to the larger volumes outside of the planned maintenance period. This practice directly impacts application availability during the data migration to the new volume.

Microsoft Dynamic Disk Implementation

The Microsoft Windows 2000 operating system offers the administrator the additional capability of storage virtualization through the use of Dynamic Disks. With Dynamic Disks, the administrator can create volumes that span multiple disks, increase the size of an existing volume, or add a mirrored volume without a reboot. This enables improved disk utilization by providing the administrator the ability to increase disk volume size as the need arises during the planning period. It also provides the administrator with a tool to respond to unforeseen or under-forecasted storage growth.

Consideration: Microsoft Windows 2000 Advanced Server and Datacenter do not provide support for Dynamic Disks in a server cluster (MSCS cluster) environment. Refer to Microsoft Tech Note: [Microsoft Cluster Service Installation Resources \(Q259267\)](#).

Consideration: Dynamic Disks must be originally configured as such (1 MB of configuration data must be stored during initial configuration at the end of each dynamic disk). Existing disks, not already configured as dynamic disks, cannot be imported into an existing dynamic disk pool.

The Microsoft Dynamic Disk implementation does not address the previously described issue associated with relying on tape for database restoration.

Controller-based Clone Implementation

Administrators also use array controller-based cloning software to create business continuance volumes (BCVs). This technique provides a controller-based option for both database backup and database restores. When integrated with existing tape-based backup and restore policies, a clone-based backup can improve application availability by off loading the backup function to a non-application server. Clones may also be used for quick restoration for certain database failures, improving application downtime as compared to typical restoration from tape.

Cloning software packages are typically controller specific and therefore are not supported across multiple storage configurations or manufacturers' products. Cloning technology is also not 'disk efficient', because it requires allocating storage capacity equal to twice the database capacity, as compared to potentially lower levels for snapshots.

Clone implementation does not address the previously described issue associated with the inability to dynamically grow data volumes. Clone based solutions do not offer storage virtualization capabilities, such as those features found in Microsoft Dynamic Disk or *SANworks* Virtual Replicator.

Caution: Compatibility between cloning software and the Dynamic Disk function should be thoroughly investigated and tested. Support for the cloning of volumes configured as Dynamic Disks should be verified.

Implementation of *SANworks* Virtual Replicator

With *SANworks* Virtual Replicator, the administrator can dynamically allocate additional disk capacity and can also restore directly from snapshots of production volumes, all in one package. Operating as a host based application, this solution can span multiple storage configurations and can be implemented across multiple storage manufacturers' products.

Online Volume Growth - With the ability to dynamically allocate storage capacity, the administrator no longer has to over allocate capacity. More importantly, situations that require the allocation of additional capacity between planned maintenance periods do not have to result in downtime. The unplanned growth of existing Exchange volumes normally requires the application to be unavailable for up to one hour, whereas using the online volume growth capability of *SANworks* Virtual Replicator, application downtime is reduced to zero.

Snapshots – Snapshots are used to augment conventional disaster recovery plans that rely on restoration from local or remote tape backups. Snapshots are easy to create and discard as necessary. Since snapshots take only minutes to create, they can be recreated frequently providing a current base from which to restore. Snapshot volumes typically utilize less capacity than clone volumes, offering lower disk utilization costs.

Restoration from snapshot volumes can reduce recovery times, which directly affects application availability. Snapshots can be functionally equivalent to conventional differential backups and can form an integral part of a backup and recovery strategy to provide highly available databases environments. *SANworks* Virtual Replicator supports incremental backup to maximize efficient backup operations with industry standard backup utilities.

Virtualized Storage Management Solution Implementation

Beyond the cost of purchasing software licenses, the implementation of any software solution also requires the cost of installation, testing, integration, and deployment into the production database environment. In order to implement any software-based solution, the administrator must find the time and resources to develop and debug the required tools and scripts for integration with the application.

This solution does not require additional or specialized hardware, software, or services, making for a very cost-effective implementation. This Solutions Guide provides the administrator with all the necessary installation instructions, scripts, and best practices required for a quick and successful implementation of the *SANworks* Virtual Replicator software within an Exchange 2000 environment. Using this document, the time needed to create, test, and deploy the solution is significantly reduced, by as much as 50%.

2.8 Positioning with other Compaq Products or Solutions

If you require the most rapid restore capabilities possible in the industry, Compaq also offers the *Rapid Restore for Exchange2000 Solution*. This solution, based on *SANworks* Enterprise Volume Manager by Compaq, provides extremely rapid recovery through cloning technology. Instead of the virtual copies that a snapshot provides, a clone is an entire physical replica or a third mirror of your database. Testing for this solution has shown that the environment, in certain cases, can be restored in a matter of just minutes. This solution works with the entire family of *StorageWorks* RAID arrays as supported by *SANworks* Enterprise Volume Manager. For more information, or to obtain the solutions guide, see:

<http://www.compaq.com/products/storageworks/solutions/mseub/index.html>

3.0 Performance

A test configuration was developed to characterize the key features of *SANworks* Virtual Replicator within an Exchange 2000 environment. The impact to Exchange, during the creation of multiple virtual disks and the on-line dynamic growth of an Exchange volume, was measured. The performance impact of using a *SANworks* Virtual Replicator created snapshot for recoveries was also determined. Baseline performance results were also captured, allowing you the ability to compare these results to other potential configurations.

3.1 Test Description

The following configurations were tested:

- Baseline configuration without *SANworks* Virtual Replicator
- *SANworks* Virtual Replicator virtual disk baseline without a snapshot
- *SANworks* Virtual Replicator virtual disk with a snapshot
- *SANworks* Virtual Replicator Snapback (restore of the storage group's databases from a snapshot)
- *SANworks* Virtual Replicator online volume growth
- *SANworks* Virtual Replicator online volume growth vs. traditional LUN growth
- *SANworks* Virtual Replicator snapshot tape backup/restore vs. traditional tape restore

Two Microsoft Exchange 2000 Servers were configured as domain members, one represented the primary Exchange server, the other was used as the Exchange backup and restore server. A MMB2 user profile, using Microsoft LoadSim was used as the load generator. Three thousand Outlook clients were configured to use Exchange 2000 on one Compaq ProLiant DL380 server.

The main tool used to generate the workload was the Microsoft Exchange Server Load Simulation utility called "Load Simulator" (LoadSim). LoadSim simulates an Outlook client load on an Exchange 2000 Server. The purpose of LoadSim is to enable multiple machines, called "LoadSim clients," to simulate thousands of Microsoft Exchange client users.

For each test, the Microsoft LoadSim heavy Outlook MMB2 (MAPI Messaging Bench) canonical profile was chosen. This profile reflects the task workload of a corporate email user, including common daily mail tasks, such as send and receive attachments, browse, read, and forward, as well as scheduling tasks and distribution list usage. The Response Time score represents a 95th-percentile score of the measured test run. The score is expressed in milliseconds (ms).

Multiple Intel-based LoadSim client systems were used to drive the system under test to saturation levels. Up to 450 users were simulated on each client system. The tests were run for eight hours to verify that the response times and all measured events and counters were within acceptable limits.

Caution: Loadsim is a load generation tool that is useful to use for comparison between test configurations. The results obtained should not be used as a projection or sizing tool for production workloads.

For detailed information on the workload used for testing, refer to the *Microsoft Exchange Server* White Paper, available from the Microsoft Website at <http://www.microsoft.com/Exchange>.

3.2 Test Configuration

Domain setup

The server network was setup within a single domain (LAB4.com). The domain server (not shown below) also had the active directory (DS) and Global Catalog Services elements. Three servers and seven clients were connected on the 1Gigabit LAB4 Ethernet domain.

SAN setup

The SAN test configuration had two Microsoft Windows 2000 Advanced Servers, one *StorageWorks* SAN switch, *StorageWorks* MSA1000 EL array and *StorageWorks* MSL5026SL tape library. The tape library was attached behind a *StorageWorks* Modular Data Router. Fault tolerant failover was not tested in this configuration.

Server configuration

Two DL380 Compaq ProLiant servers.

Table 2 – Microsoft Exchange 2000 Configuration

PROLIANT DL380 TEST CONFIGURATION	SKU
ProLiant DL380 servers	193707-001
Two (2) Pentium III 1GHz Processors – 512-KB level 2 ECC cache per processor, Fast Ethernet NIC (embedded)	187602-B21 210818-B21
Memory 4GB RAM	128280-B21
(2) Internal Ultra2 SCSI 18.2GB SCSI Drive – RAID 1	128418-B22
Compaq NC6134 PCI 1000SX FC Ethernet NIC	174818-B21
Compaq KGPSA, LP952, 2 GB FC, V 5.4.52a7	245299-B21
Software	
Windows 2000 Advanced Server (5.00.2195) Pre-SP3, Mixed mode	Order from Microsoft
Microsoft Exchange Server 2000 V6.0 (build 4712.7: SP1)	Order from Microsoft
Compaq SANworks Virtual Replicator Version 3, 5 user license	261775-B21
StorageWorks MSA1000 EL Array	
StorageWorks MSA 1000 EL Storage Array, 64KB Cache 1.14 Firmware, 4 SCSI channels	201723-B21
StorageWorks MSA 1000 Controller 64KB Cache	281231-B21
StorageWorks MSA Fibre Channel I/O Module	218960-B21
(2) StorageWorks Enclosure Model 4214R	190209-B31
(14) 18.2GB, 15KRPM, Ultra 3 SCSI	188122-B22
(28) 36.4GB, 10K RPM, Ultra 3 SCSI	176496-B22
Exchange Advanced Server 2000	
Exchange Log Files x2: (6) 18.2GB Disk, RAID 1+0.	N/A
Exchange Storage Groups: Two SG's with two databases per SG, RAID 1+0 per DB, mailbox size 50MB. (14) 36.4GB Disk	

Consideration: This solution was tested on a specific configuration as documented in this section, using a typical Exchange 2000 environment with typical database sizes and user loads. The best practices, considerations, and performance information may be applied to similar environments, but results may differ from those published.

In order to meet the MMB2 test requirements, the Exchange server was configured with two Storage Groups (SG) with two Databases (DB) within each Storage Group. The Databases and logs were dismounted/mounted during certain tests using scripts.

Below is the Microsoft Exchange 2000 drive mapping assignment.

F:SG1, **G:** SG2, **H:**SG1log, **I:**SG2log

SANworks Virtual Replicator Snapshots were used to back up the *.EDB, *.STM, and *.Log. *SANworks* Virtual Replicator virtual disk snapshots were created and mapped Microsoft Windows 2000.

N:SG1, **O:**SG1log, **P:**SG2, **Q:**SG2log

Table 3 - SAN Configuration

COMPAQ STORAGEWORKS MSL5026SL LIBRARY	SKU
StorageWorks MSL5026SL, 2 Super DLT 110/220, LVD, RM	231892-B22
StorageWorks Modular Data Router (MDR) Fibre to SCSI bridge	163083-B21
SAN & Ethernet Hardware	
Compaq StorageWorks SAN Switch 16	158223-B21
3COM 9300 12 port switch, 1GB Ethernet	Order from 3COM
(4) FC short wave GBIC	380561-B21
(3) Multi mode FC short wave 2 meter LC/SC Cables (1GB/s to 2GB/s)	221691-B21
(11) Multi mode FC Short Wave 2-Meter Cable	234457-B21

Server and Client Software Configuration

The following software was loaded on the Compaq ProLiant servers before testing started. LoadSim was loaded on separate Compaq ProLiant DL380 (7) to simulate users.

- Microsoft Windows 2000 Advanced Server with Pre-SP3
- Microsoft Windows 2000 Advanced Server with Pre-SP3 (Clients)
- Microsoft Exchange 2000 Server V6.0 (build 4712.7: SP1)
- Compaq's *SANworks* Virtual Replicator version 3.0
- Compaq ACU 2.80 and ACU XE 2.80
- Customizable scripts to dismount/mount Exchange 2000 EDB, STM and logs for snapshots
- Microsoft LoadSim (MAPI Messaging Benchmark) build 4612, with MMB2 user MAPI profiles.

Backup Software

VERITAS Backup Exec v 8.6 backup application software and associated Exchange agents were loaded on the Exchange 2000 backup server.

3.3 Performance Results

The results from the tested configurations are described. To establish valid test results, the Microsoft Exchange 2000 UPS Policy Guideline was used to capture important data that reflects changes in the O/S, Exchange and Disk I/O performances. System counters in the Windows 2000 System Monitor were also used in each test. The only variance in which counters were used was their relevance to a particular test.

Characterization Test Results

Baseline

The **Baseline** test was configured without *SANworks* Virtual Replicator. This configuration established a baseline using Compaq ProLiant DL380 Servers and the *StorageWorks* Modular SAN Array MSA1000. The purpose of the baseline test was to determine if the Exchange solution configuration passed the Microsoft Exchange 2000 UPS Policy Guidelines for conducting a benchmark user per server (UPS) test.

Results: Test 1 passed the criteria listed above and the test results are listed in Table 7.

Baseline with *SANworks* Virtual Replicator

The Virtual Replicator baseline test created virtual pools and virtual disks on the *StorageWorks* MSA1000 array. The purpose of this test was to identify any *SANworks* Virtual Replicator related resource issues.

Results: There was an insignificant (~2%) increase of CPU utilization once virtual disks were configured. Test 2 passed the UPS criteria listed above and the test results are listed in Table 7.

Conclusion: No performance impact is shown for the utilization of *SANworks* Virtual Replicator.

Snapshot while under a 3000-user load

A snapshot is a virtual disk in a pool that is created by making a virtual copy of another disk, called the parent disk. This test used scripting to mount and dismount all databases (see Appendix A). While running a user load, a snapshot was created to store images of all databases and logs on an Exchange 2000 server. To test the integrity of the snapshot, the ESEFILE and ESEUTIL commands were used within the script. ESEFILE is a Microsoft Exchange tool that verifies the page level integrity of the database and compares the checksum of the database file to see if it matches with the page. All *SANworks* Virtual Replicator snapshot databases passed the checksum and consistency test. The snapshot process, when used in the script, ran for 90 seconds per Storage Group. The actual process time is broken down in Table 4.

Table 4 - Snapshot Process mean time

Process	Time (sec)
Delete old snap (x2)	80
Snapshot (x2)	80
Map snapshot (x2)	20
Snapshot process Time	180
Storage Group 1 dismount time	80
Storage Group 2 dismount time	33
Storage Group Dismount Time Total	113
Consistency Test	82
Checksum Test	828
Total Check Time	910
Total Script Duration (min)	20.05

Before a *SANworks* Virtual Replicator snapshot can be created, the Exchange databases need to be in a consistent state (see Appendix A). This is achieved by executing a database dismount command using the scripts provided with this solution. In Exchange 2000, it is not necessary to dismount all the databases at the same time, unless a snapshot of the transaction log volume is required.

Best Practice: All of the databases in a Storage Group should be dismounted at one time so that the transaction logs remain consistent. All of the transaction logs for the databases in a single Storage Group are interleaved.

With this process, other users with mounted databases can continue to process transactions while other snapshots are created. When the Exchange process submits a transaction to a dismounted database, one of two actions will occur. The transaction is submitted and sent to the transaction queue (waiting for the database to mount) or an error message displayed notifying the user of the reason (temporary condition that is corrected when database is remounted). The databases that are unavailable will only remain in that state for a short time (less than 2 minutes).

Using a custom script (refer to Appendix A), the process deletes old *SANworks* Virtual Replicator snapshots and dismounts all the databases within a Storage Group. The scripts then create and map a snapshot before remounting the databases. This process is repeated twice within the same script. The Storage Groups (Table 4) were unavailable for 80 seconds (SG1) and 33 seconds (SG2). The snapshot process took a total of three minutes. The integrity checking took 15.1 minutes. Test 3 meets the performance criteria set in the MMB2 established guidelines (see Table 7).

Screen Shot 1 below shows the actual stop/start of the databases in Storage Group 1. Event 9539 indicates when the database was stopped, and event 9523 indicates when the database was started. Event 103 indicates the ESE engine stopped for SG1. The time of 3:21:39 shows when the scripts requested the dismount of 1PRIV1 and subsequent dismounts. At 3:22:22 the last

database in SG1 was remounted. The overall time for mounting and dismounting the storage group was just over 40 seconds. Even though the overall time of dismounting/ and mounting took only 40 seconds to complete, the process of user activity was continuing. The time it took for all users to log back in varies depending on user activity levels.

The impact on the Exchange users relates to the amount of time the Exchange Storage Groups were offline. Users that are members of the Storage Group to be snapped are affected. On average, the offline time was 60 seconds per Storage Group. Although the integrity check is a necessary process and was used in the scripts, it is only included as an example. The ESEFILE process takes about 12% of CPU resources and discretion should be used when running this command due to the increase in CPU utilization.

Results: Overall time for mounting/dismounting storage group was just over 40 seconds. The average offline time was 60 seconds per storage group

Conclusion: Snapshot procedure occurs quickly and efficiently with little to no noticeable impact to the user community.

Screen Shot 1

Type	Date	Time	Source	Category	Event	User	Computer
Information	1/22/2002	3:22:22 PM	MSEExchangeIs Public S...	General	9523	N/A	EXCHSERV
Information	1/22/2002	3:22:22 PM	MSEExchangeIs Public S...	Replicati...	3000	N/A	EXCHSERV
Information	1/22/2002	3:22:22 PM	MSEExchangeIs Public S...	General	1133	N/A	EXCHSERV
Information	1/22/2002	3:22:22 PM	MSEExchangeIs Public S...	General	1000	N/A	EXCHSERV
Information	1/22/2002	3:22:22 PM	MSEExchangeIs Public S...	General	1217	N/A	EXCHSERV
Information	1/22/2002	3:22:21 PM	MSEExchangeIs Mailbox...	General	9523	N/A	EXCHSERV
Information	1/22/2002	3:22:20 PM	MSEExchangeIs Mailbox...	General	1133	N/A	EXCHSERV
Information	1/22/2002	3:22:20 PM	MSEExchangeIs Mailbox...	General	1000	N/A	EXCHSERV
Information	1/22/2002	3:22:20 PM	MSEExchangeIs Mailbox...	General	1217	N/A	EXCHSERV
Information	1/22/2002	3:22:19 PM	MSEExchangeIs Mailbox...	General	9523	N/A	EXCHSERV
Information	1/22/2002	3:22:17 PM	MSEExchangeIs Mailbox...	General	1133	N/A	EXCHSERV
Information	1/22/2002	3:22:17 PM	MSEExchangeIs Mailbox...	General	1000	N/A	EXCHSERV
Information	1/22/2002	3:22:17 PM	MSEExchangeIs Mailbox...	General	1217	N/A	EXCHSERV
Information	1/22/2002	3:22:17 PM	ESE98	General	102	N/A	EXCHSERV
Information	1/22/2002	3:22:05 PM	ESE98	General	103	N/A	EXCHSERV
Information	1/22/2002	3:22:03 PM	MSEExchangeIs Public S...	General	9539	N/A	EXCHSERV
Information	1/22/2002	3:21:56 PM	MSEExchangeIs Mailbox...	General	9539	N/A	EXCHSERV
Information	1/22/2002	3:21:39 PM	MSEExchangeIs Mailbox...	General	9539	N/A	EXCHSERV

Restore from Snapshot using Snapback

The time to restore the databases using the *SANworks* Virtual Replicator Snapback feature, while operating the other Storage Group under a user load, was measured. The Snapback performance (restore time) varies based on the amount of copy-outs performed while the snapshot is open (see Table 5). During a copy-out, old data from the parent disk is copied to the snapshot disk during database writes. The longer a snapshot is recording, the longer it takes to restore the parent disk to its original state. Table 5 summarizes the various times required to restore from a snapshot using the Snapback feature. The database may not show a visible change in size, however any transactions will change some data during any given period,

causing an increase in copy-outs. Once data is changed or deleted on the parent or snapshot disk, a copy-out occurs.

Best Practice: The more snapshots existing for a virtual volume, the longer the reboot and restore times. On a periodic basis, the administrator should refresh the snapshot by creating new snapshots and deleting the unneeded old ones.

Consideration: High levels of database activity, coupled with long periods after snapshot creation, will cause the snapshot volume to increase significantly and consequently consume more virtual pool space. It is important to monitor the snapshot growth to determine the best period between snapshots for your specific environment.

Best Practice: If the snapshot is to be used for restoration purposes, it is suggested that a snap period be established that produces a snapshot size, as a percentage of the virtual volume, that is less than (50%) fifty percent. This is recommended in order to take advantage of the benefits of snapshots for restoration. You may wish to perform your own snapshot and tape restore tests to determine a snapshot volume limit for your own specific environment.

To monitor the snapshot percentage of the virtual volume, check the “delspace” value for the virtual disk. The “delspace” is displayed in the Snap Manager interface and represents the actual data space that the associated snapshot uses in the virtual pool. If the snapshot percentage continually exceeds the 25 percent suggested limit within the period between snapshots, the following alternatives are suggested:

1. Reduce the time between snapshots
 2. Consider an alternative rapid recovery method (Rapid Restore Solution for Exchange 2000)
 3. Rely on tape based restores
-

Best Practice: Clone based recovery methods require a considerably larger amount of disk capacity and are therefore considered a more expensive alternative. Tape should always be used as a final restore option and as the most suitable option for catastrophic failures.

Table 5 - Data Rate Copies

Backup Type	% of Database Change	Backup Time (min)	Backup Rate (GB/hr)	Restore Time (min)	Restore Rate (GB/hr)	% of Tape Restore Time	Data Size	Del Space
VERITAS Tape Full Backup/Restore (f:\SG1)	N/A	65	37	75	32	baseline	40GB	N/A
WIN2K Drag/Drop copy from a snap disk	28%	N/A	N/A	31	20	41%	38GB	10417mb
Snapshot Creation (f:\SG1)	N/A	0.25	5472	N/A	N/A	N/A	38GB	N/A
Snapback after 1 hour run (f:\SG1)	27%	N/A	N/A	22	28	29%	38GB	10117mb
Snapback after 2hr run (f:\SG1)	48%	N/A	N/A	37	29	49%	38GB	18095mb
Snapback after 4.5hr run (f:\SG1)	57%	N/A	N/A	52	25	69%	38GB	22367mb

NOTE: SG1 used 16 spindles, RAID 1+0; SG1LOG used 8 spindles, RAID 1+0

Results: The times observed for snapshot restores range from 22 to 52 minutes based on percentage snapshot changes ranging from 27% to 57% of the database volume. The snapshot restore time directly affects the amount of time that the Exchange Storage Groups are unavailable. Users, who are members of the Storage Groups, are affected, as the Exchange database needs to be suspended while the snapback occurs.

Conclusion: High levels of database activity, coupled with long periods between snapshots, will cause the snapshot volume to increase significantly and consequently consume more virtual pool space. It is therefore important to monitor the snapshot growth in order to determine the best snapshot period for your specific environment.

Snapshot based recoveries can reduce downtime by as much a third when compared to conventional tape restore.

Online Volume Growth vs. Traditional LUN Growth

A virtual disk was grown in size while the Exchange server was under the MMB2 user load. This result was compared to a tradition LUN expansion where a new LUN was created from a separate disk and a copy of the Exchange database was written to that LUN.

Result: The entire *SANworks* Virtual Replicator online volume growth process took four minutes to complete as compared to 60 minutes for the traditional LUN expansion technique. During this online volume growth operation, there was no impact on the Exchange application.

Conclusion: SANworks Virtual Replicator online volume growth occurs within minutes and is transparent to the Exchange user. The storage groups are not taken offline, no transactions are lost, and system performance is not affected. Dynamic on-line storage growth can be achieved with less than 4 minutes of administrative time, enabling additional capacity to on-line database volumes in less than 7% of the time that it typically takes without the solution.

Table 6 - Compare Disk Growth Time*

Process	Traditional	SANworks Virtual Replicator
Preparing Disk Hardware		
Add disks to Chassis	20	20
Configure RAID Array	30	30
Create Logical Drive	10	10
Total Time for Preparation	60 minutes	60 minutes
Volume Expansion		
Present Logical Drive to O/S	1	1
Partition and Format disk	5	N/A
Add disk to Virtual Pool	N/A	1
Grow Virtual Disk	N/A	2
Shut down databases. No user access.	2	N/A
Copy databases and Logs to new LUN. (I/O is 20MB/s, 60GB of data)	50	N/A
Start databases	2	N/A
Total Time for Volume Growth	60 minutes	4 minutes

* NOTE: All components were already in place to run this test (no logistical issues). The level of administrator experience can affect the results.

Backup Snapshot to tape

The *StorageWorks* MSL5026SL Library and SDLT drives were used for this test. VERITAS Backup Exec was loaded on an Exchange 2000 backup server. Microsoft Exchange Server agents were loaded on both Exchange servers. The backup rate using the MSL5026SL with SDLT tape drives was 37 GB/hr. The restore rate was 34.5 GB/hr.

Table 7 - System Monitor Performance Counters

	(1)Baseline without SANworks Virtual Replicator	(2)Baseline with SANworks Virtual Replicator	(3)Snapshot	(5) Online volume growth one Storage group
Users	3000	3000	3000	3000
Benchmark Profile	MMB2	MMB2	MMB2	MMB2
Protocol	MAPI	MAPI	MAPI	MAPI
Length of Test	8 hours	8 hours	8 hours	8 hours
# Log Disk	(6) 18.2GB, RAID 1+0	(6) 18.2GB, RAID 1+0	(6) 18.2GB, RAID 1+0	(8) 18.2GB, RAID 1+0
# DB disk	(12) RAID 1+0	(12) RAID 1+0	(12) RAID 1+0	(16) RAID 1+0
Response Time (milliseconds)	198	182	149	178
Average Local Delivery Time	0	0	0	0

Transaction Load (hourly)				
Messages Submitted	19575	19754	19131	19307
Message Recipients Delivered	71541	72349	69478	70726
Messages Sent	19555	19754	19126	19303
Transaction Load (per second)				
Message Opens/Sec	29	30	28	29
Folder Opens/Sec	13	14	13	13
RPC Read Bytes/Sec	70371	68603	65159	68331
RPC Write Bytes/Sec	561913	575590	468192	518057
Transaction Queues				
IS Send Queue Average Length	13	12	10	10
Processor Utilization				
System Processor Utilization (%)	50	52	48	54
System Processor Queue Length	2.71	2.7	2.5	3.7
System Context Switches/Sec	3726	4001	4074	4325
Process % CPU Time – Store	84	86	78	91
Memory Utilization				
Available Bytes	2.5GB	2.6GB	2.42GB	2.5GB
Pages/Sec	1.5	0.37	0.53	0.2
Process Working Set Bytes – Store	1GB	1GB	1.1GB	1GB
Process Virtual Bytes – Store	1.9GB	1.9GB	1.9GB	1.8GB
Logical Drive Utilization				
IS Database Disk Reads/Sec	181	184	266	253
IS Database Disk Writes/Sec	134	139	142	144
IS Database Average Disk Queue Length	4	3.9	4.3	3.8
IS Log Disk Writes/Sec	149	153	287	
IS Log Average Disk Queue Length	0.14	0.13	0.13	0.126
I/O Reads Bytes/sec Store	3MB	3MB	3MB	3MB
I/O Writes Bytes/sec Store	4MB	4MB	3MB	4MB

The counters on the above table are critical to understanding the performance of Exchange on any given hardware and software installation. Counter definitions are located within System Monitor Properties on the Windows 2000 Advanced server.

Processor: % Total Processor Time

Expected: % Processor Time is the percentage of time that the processor is executing non-idle threads. When the system load reaches 100 percent, the processor has become the bottleneck and further rate increases are not possible.

Results: During testing, the CPU reached 100 percent utilization while 3000 users were logging on at the same time to the Exchange 2000 server. Thereafter the system CPU utilization averaged 50%. The CPU was not a bottleneck for any of the tests performed.

Disks

Virtual Disk - IS Database Average Disk Queue Length

Expected: The average should be less than the number of spindles in the physical device.

Results: There were 14 disks (RAID 1+0) used for the Exchange databases. The rule of using one spindle for every 100 users was not explicitly followed (performance was not the prime criteria for testing) and therefore the average queue length was higher than it would have been if the rule were applied. A queue length of four indicates little performance degradation. The logs do not use this rule and therefore were not impacted.

To view the disk counters, the “diskperf -y” command was used in testing scripts to enable the counters.

Outlook Clients

Expected: Response Time should be 1000 ms or less for e-mail users utilizing Exchange 2000 server’s MAPI protocol. The weighted average is calculated by using the 95th percentile.

Results: All tests showed Response Times less than 200 ms. This indicates that 95 times out of 100, the resolve name command takes less than 200 ms to complete. This counter indicates that there were no issues with our test load.

4.0 Supported Configurations

Note: In order to continually provide improved features and functions, the hardware and software products used in this solution are subject to change. Although it is our objective that all newly released products be compatible with previously released solutions, Compaq makes no warranty of compatibility of any kind. As always, it remains the responsibility of the user to refer to the specific component documentation when applying component versions that do not match those stated in this guide.

4.1 Configuration Information

Minimum Requirements

The configuration must include

- at least one Windows 2000 host operating an Exchange 2000 database
- one instance of *SANworks* Virtual Replicator 3.0
- VBScripter
- mount.vbs script file (Appendix A)
- batch file (Appendix A)
- a scheduler (optional)
- a storage volume equal to at least 1.3 times the database volume, viewable by the application server

Minimum application host requirements:

- Pentium class processor
- 128 MB memory
- 40 MB available disk space for full installation

Consideration: Use a storage volume size of 1.3 times the database size only as a guideline. Carefully consider the actual volume size after analysis of the number of snaps, the size of the database changes, and the period between snapshots. Although not recommended or likely, the snapshot volume can consume up to the same size as the virtual disk. Virtual Replicator provides the user with a warning when there is only 5 percent of the volume left for snapshot writes.

Maximum Requirements

The virtual storage pool viewable to the Windows 2000 server is limited to two TBs per virtual disk. Refer to *SANworks* Virtual Replicator Quick Spec for more details.

4.2 Sizing

The Virtualized Storage Management for Exchange 2000 solution does not require any special sizing for installation, provided all minimum configuration requirements are met.

Snapshot Planner

The *SANworks* Virtual Replicator application includes a tool that can be used for planning snapshot allocations, called Snapshot Planner. This tool can be used prior to loading and configuring *SANworks* Virtual Replicator to help predict the cost (overhead) of snapshots in terms of disk space and disk I/O. Snapshot Planner tracks actual reads and writes to existing drives and determines how much disk space a snapshot of each drive would require. It also projects any additional disk I/O that the snapshot may generate. For more information on how to use Snapshot Planner refer to the *SANworks* Virtual Replicator 3.0 System Administrators Guide.

The virtual storage pool size depends on the size of the virtual disk that is required for the database volume. You should plan to configure a pool with enough capacity to allow space for creating a primary virtual disk for the data volume, space for copy out activity associated with two snapshots, and space for overhead.

Best Practice: Snapshot Planner should be run prior to installing and setting up the *SANworks* Virtual Replicator environment. After running Snapshot Planner, the tool should be uninstalled prior to installation of *SANworks* Virtual Replicator.

Related sizing information may be obtained from the following locations:

[Compaq ProLiant Sizer for Microsoft Exchange 2000](#)

Based on characterization testing performed in Compaq solutions engineering labs, this tool provides server configuration recommendations for deploying Microsoft Exchange 2000 Server on Compaq ProLiant servers.

[Exchange 2000 Storage Planning Calculator](#)

Addresses one of the most critical areas of Exchange 2000 server sizing; I/O and storage capacity planning for the storage subsystem.

[Exchange 2000 Sizing Tool and Users Guide](#)

Provides server configuration guidelines for deploying a single Exchange 2000 mail server on a variety of ProLiant platforms and *StorageWorks* solutions.

4.3 Partner Content

The following third party products are required for the successful implementation of this solution:

- Microsoft Windows 2000 Server or Advanced Server
- Microsoft Exchange 2000 Standard Edition or Enterprise Edition where clusters and multiple storage groups are required. For more information, refer to [Microsoft Tech Note Q296614](#).
- Microsoft Internet Explorer
- Microsoft Task Scheduler or related product (optional)
- Tape backup application (optional)
- VBScripter (Visual Basic 6.0 as part of Microsoft 2000)
Information at <http://msdn.microsoft.com/vbasic/>

Consideration: Compaq and Microsoft are long-standing partners. With their combined strengths, they offer comprehensive support, integrated services, recognized expertise, and complete solutions. More information on this partnership can be found on the Compaq/Microsoft Global Alliance <http://www.compaq.com/partners/microsoft/index.html> web site.

Consideration: During implementation, you can back up the snapshot using the Compaq SAN based Enterprise Backup Solution (EBS). Check this link for a list of EBS Software Partners, who have developed a tightly integrated and tested data protection solution that combines the partner backup application with Compaq *StorageWorks* hardware and *SANworks* software.
<http://www.compaq.com/products/storageworks/ebs/partners.html>

4.4 Compatibility

This solution operates with SAN array controllers and with direct attached storage configurations viewed as physical devices by a Windows 2000 Server or Advanced Server operating system. It is supported behind MSCS configurations and operation in a redundant failover configuration. The solution has been tested using the *StorageWorks* MSA 1000 array controller, but can be applied across any of the *StorageWorks* arrays.

Consideration: Note that the configurations demonstrated in this guide do not represent a complete qualification and are only a demonstration of performance or functionality for the “as tested” condition.

Consideration: Any Windows 2000 server platform used in this solution must comply with the hardware & software prerequisites stated in the *SANworks* Virtual Replicator Quick Spec:
<http://www.compaq.com/products/sanworks/vr/index.html>

All other solution hardware components are supported as described in their associated published Quick Specs.

If integrating with a SAN based backup configuration, please refer to the existing Enterprise Backup Solution Compatibility table:

<http://www.compaq.com/products/storageworks/ebs/EBScompatmatrix.html>

4.5 Solution Specific Installation / Setup Instructions

To implement the solution, you need to perform the following steps. Note that the procedures presented assume the use of a *StorageWorks* MSA1000 array.

Caution: Many of the procedures described require administrator privileges and can be disruptive to database operation if used incorrectly. If you are not familiar with these commands and functions, consult your Exchange documentation before proceeding. As with any change to your database configuration or backup plan, it is important that you test these changes thoroughly before implementing them in a production environment.

This document assumes that the installer has experience with Microsoft Windows 2000 Advanced Server, Microsoft Exchange 2000 Server, SAN technology, tape backup technology, RAID and driver installs.

Setting up the Exchange Server

1. Establish the domain, if not already performed.
2. Install the Microsoft Windows 2000 system on an internal disk. Do not install the operating system on a Virtual Replicator virtual disk since it is not supported.
3. Install Compaq *StorageWorks* Host Bus Adapter (HBA) and HBA drivers.
4. Install all applications including *SANworks* Virtual Replicator and the Array Configuration Utility XE (ACU XE).
5. Attach the external disk array.

Setting up the disks

1. Launch the ACU XE browser utility.
2. Create the arrays and initialize the LUNs on the *StorageWorks* MSA1000. See Screen Shot 2.
3. Choose the selective presentation option in the ACU XE browser to activate the access rights for the newly created LUN.
4. Refresh the Device Manager in Windows 2000 if you need to recognize the new drives.
5. Assign a disk signature to the new disk. Make sure the disks are configured as basic disks and do not partition the disk that will be assigned to *SANworks* Virtual Replicator. Dynamic Disks are not supported in *SANworks* Virtual Replicator.

6. Be sure the *SANworks* Storage License Manager (Screen Shot 3) is installed on the network. Retrieve the *SANworks* Virtual Replicator license key from the Compaq Web site by following the instructions on the License Key Retrieval sheet that accompanied your license kit. <http://www.compaq.com/products/software/softwarekeys/index.html>

Screen Shot 2

The screenshot displays the Compaq Array Configuration Utility XE (Version 1.30.4.0) interface. The top left features the Compaq logo and a 'Controllers' sidebar with options for 'Integrated Smart Array Controller in Embedded Slot' and 'MSA1000 Controller in P3442XBH9M3383'. The main area lists 18 unassigned drives with their capacities and bay locations (e.g., '18.2 GB Unassigned Drive at Box 1 : Bay 11'). Below this, four arrays (A, B, C, D) are shown with their respective logical drives and RAID configurations (e.g., 'Logical Drive 1 (104195 MB, RAID 1+0)'). The right sidebar contains a 'Select a task for: MSA1000 Controller in P3442XBH9M3383' section with links for 'Controller Settings', 'Logical Drive Array Accelerator', 'Create Array', 'Selective Storage Presentation', 'More Information', and 'Clear Configuration'. A 'Refresh' button and a 'Main Menu' link are also present.



Screen Shot 3

EXCHSERV - Compaq WBEM Device Home - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites History Print

Address <http://127.0.0.1:2301/> Go Link

 **Compaq Web-Based Management** 

Login Account: administrator EXCHSERV
10.77.77.50
01/14/2002 13:35:26

[Refresh](#) [Options](#) [Devices](#) [Logout](#)

Device Home Page

Compaq SANworks Storage License Manager Compaq SANworks Storage License Manager.

Compaq Survey Utility Compaq Survey Utility captures the hardware and software configuration history. It generates reports, the configuration changes between captured sessions.

Compaq Array Configuration Utility XE Compaq Array Configuration Utility XE provides configuration facilities for Compaq Smart Array and RAID controllers.

[Compaq on the Internet](#)

Design the virtual pool structure

Before you create a virtual disk for Exchange, you need to create a virtual pool using Snapshot Manager. Determine the required disk space and how to organize the data.

Best Practice: For best I/O performance, a good strategy is to keep multiple Storage Groups on separate volumes.

In Exchange 2000, it is not necessary to bring down all of the Exchange databases if you need to service a single database. In addition, in situations where logging needs to be stopped, it will affect all databases within that Storage Group (SG). Keeping all databases within a single SG on the same volume allows for better maintenance.

When a virtual disk is created, it spans multiple physical disks in the associated virtual storage pool. Users cannot choose the disk that makes up the virtual disk.

Best Practice: The best practice for designing virtual pools is to use the same RAID configuration throughout the pool and make sure the disk sizes are the same.

Screen Shot 4 is a best practice design example of virtual pools and disks. If you follow this technique, you will be able to easily manage storage groups and logs. Volume growth management will be more straightforward as it allows the user the ability to increase volume space in targeted storage groups or log volumes.

4.6 Service

The following optional service is available to help the user in the design, installation, configuration, and operation of this solution:

***SANworks* Virtual Replicator Installation and Startup Service**

Part Number: 269991-002 (QR-SMSVR-IS)

Compaq CarePac Part Numbers: 236027-002 (FP-CSTAR-09)

Service Description Summary

The *SANworks* Virtual Replicator Installation and Startup Service provides the following:

- Assistance with the installation and startup of *SANworks* Virtual Replicator software.
- Optionally implements the Virtualized Storage Management Solution for Exchange 2000.
- Installs and configures the *SANworks* Virtual Replicator software for successful snapshot creation on the customer's existing storage environment.
- A sample restore procedure of the database from the snapshot.
- An orientation session provides an overview of the configuration and utilization of *SANworks* Virtual Replicator software as it applies to this solution.

5.0 Operational Guidelines

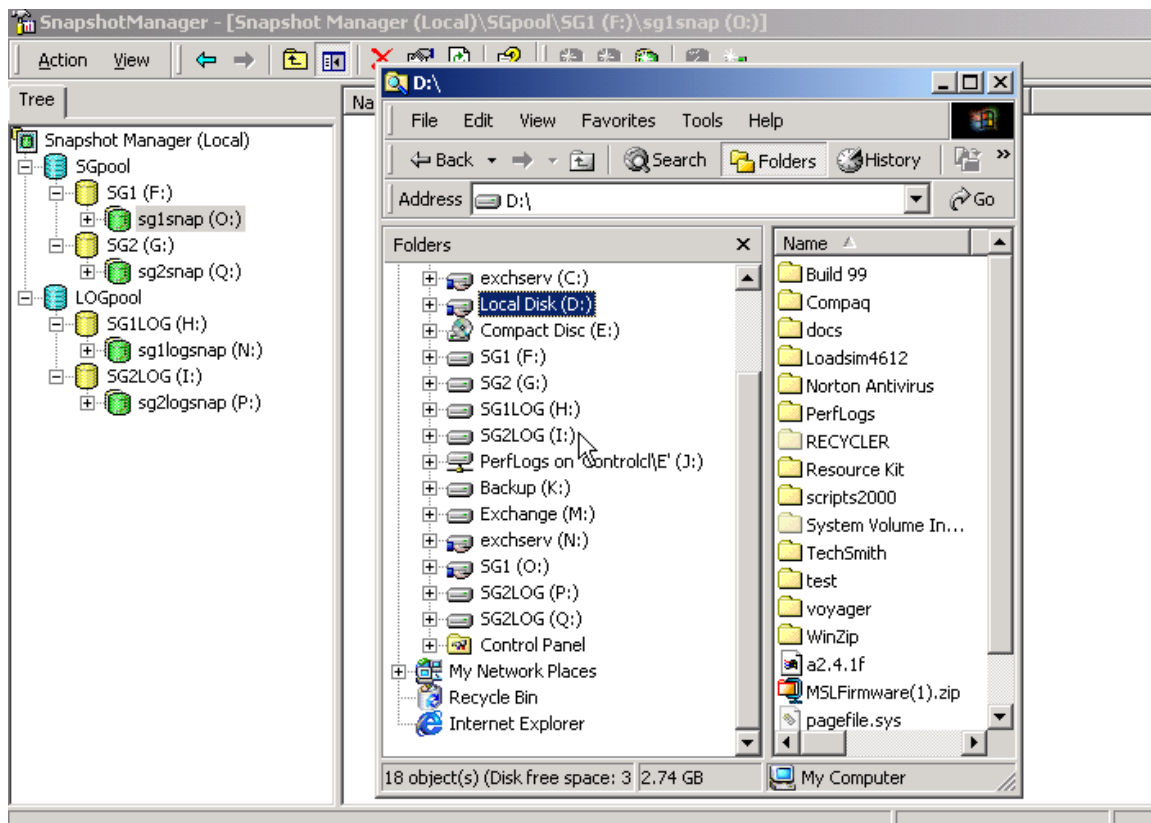
Operation of Solution

Volume Growth

Volume growth is a seamless operation that does not disrupt Exchange. A Snapshot Manager wizard guides the user through the volume growth process. Online volume growth cannot occur if there are snapshots associated to the virtual disk that need to be expanded. Before a snapshot is taken, make sure you have a recent backup. Before disks can be extended, be sure there is enough space in the storage pool to allow for expansion.

Caution: If there is not enough space for the creation of snapshots, then you need to increase the size of the virtual pool by creating additional LUNs using the ACU XE browser (Screen Shot 2). Snapshots consume free space in the pool. Once the free space reaches 30 percent (default parameter) of the free pool, you receive a notification. Free space in the virtual pool will be consumed at a greater rate than virtual disk space. In the event that the virtual pool free space is totally consumed, *SANworks* Virtual Replicator will fail to write to the virtual disk and present an associated I/O failure back to the application.

Screen Shot 4



Custom Scripts

The Exchange databases need to be in a constant state before a snapshot can take place (see Appendix A). You can use scripts to mount and dismount the databases before using the snapshot command. Custom scripts can be downloaded from the site listed below and are installed on the primary Exchange server. There are many script examples but the two that are needed are “SnapexchDB.cmd” and “mount.vbs”. Both these files need to be in the same directory. The CMD files execute the commands for exchange server and *SANworks* Virtual Replicator. The VBS file launches the VBScripter. The user needs to modify the .cmd file and change the parameter related to Exchange server. The scripts can be launched either by a system scheduler or manually.

Best Practice: The scripts provided in this guide delete the snapshot prior to creating another snapshot on the same volume. When this occurs, there is a brief period where the database is somewhat unprotected. This means there is no available snapshot volume. Although not covered in this guide, you can minimize this risk by creating at least two iterations of scripts, allowing for two rolling snapshots. As an example, you would create scripts for drive D: and alternate with scripts for drive E:. In this way, at least one snapshot is always available.

Script Download Web site for Virtualized Storage Management for Exchange 2000 Solution
<http://www.compaq.com/products/storageworks/solutions/vsm-e2000/scripts.html>

Snapshot

A snapshot has many uses regarding data protection. In an Exchange environment, you can schedule snapshots every few hours. It is best to avoid performing the snapshot during peak messaging demand where possible. You can also make a snapshot before doing a system upgrade. When you create and map a snapshot, you can observe the snapshot from Windows Explorer.

Consideration: Within Windows Explorer the snapshot appears the same as the parent disk. Windows Explorer will display the same physical size for the snapshot and the parent disk. Initially, the actual storage capacity used will be zero. The snapshot only starts to grow when the parent or snapshot is changed. The snapshot never grows bigger than the parent disk. The disk pool needs to have enough free space to allow for the snapshot to grow.

You can execute a snapshot using a series of pull down menus in Snapshot Manager or at a command line. You can optionally map a snapshot to a drive letter so Windows 2000 can see the snapshot. The name that is picked during the snapshot execution is viewable by the Snapshot Manager, but the name for the snapshot volume is identical to the parent virtual disk when map.

The right side of Screen Shot 4 shows the mapping of both the parent and snapshot. Drive mapping F, G, H and I show the parent virtual disk. Drive mappings N, O, P and Q are

snapshot disk. Drive mapping N shows a different disk label than its parent. The data in the snapshot is identical to parent disk F.

Caution: Windows 2000 does not *always* recognize the correct volume label and therefore will not map the drive letter correctly. If this occurs, the snapshot will not function as designed, so you will need to reboot the Exchange server to remedy the problem. Rebooting updates the current drive mappings in the Windows registry.

Best Practice: Microsoft recommends that the log files and data files be kept on separate volumes.

A variety of methods can be used to restore virtual disks from the snapshot. These snapshot based restoration alternatives are shown in order of recommendation.

Snapback

The Snapback function allows for an automated restore from a snapshot created within *SANworks* Virtual Replicator. For more information on how to use the Snapback function, refer to the *SANworks* Virtual Replicator User's Guide.

Many of the procedures required to restore from a snapshot are automated within the *SANworks* Virtual Replicator snapback function. There is no need to map and remap drives, copy files, or delete snapshots or virtual disks (Snapback performs all of these steps for you). Snapback also allows you to recover data without performing a file copy to an intermediate location, reducing the requirement for additional disk capacity.

Consideration: Although it is recommended to create a snapshot of the *.log files, special care should be taken with respect to log files during the Snapback process. During restores, log files need to be treated separately from data files and therefore should reside within separate snapshot volumes. A Snapback of the log file snapshot volume will replace the current log files, preventing all transactions that occurred after the log file snapshot was created from being applied. Therefore, a Snapback of the log files should only be used in instances where the administrator wishes to recover to the point in time of the snapshot.

Copy / Remount

The copy / remount procedure requires a higher level of administrator intervention. The procedure requires the administrator to perform the following steps:

1. Create a new virtual disk
2. Copy the associated files from the previously created snapshot to the new virtual disk
3. Verify that the copy is complete
4. Delete the old virtual disk and related snapshots
5. Remount the new virtual disk to the original database drive letter

Note that this method requires the pre-allocation of additional capacity within the storage pool to support two virtual disks.

Running off the Snapshot

This method uses the snapshot as the database volume. After performing this procedure your application will be operating solely off of the snapshot, leaving the virtual disk in a state of vulnerability. It is critical that, at the time of earliest convenience, a complete database recovery be performed in order to return to a standard operating condition. In order to operate off of the snapshot, the following steps are required:

1. Unmap the drive letter of the virtual disk
2. Map the same drive letter to the snapshot volume

Caution: Stop any processes that are using the target database before restoring from the snapshot.

5.1 Solution Management and Maintenance

Mandatory Update Requirement for SANworks Virtual Replicator for V3.0 installations:

This update addresses the registry growth issues that result from products utilizing Microsoft's plug and play architecture that report storage devices to the operating system. The SANworks Virtual Replicator V3.0A software update implements a Registry Cleanup Tool to eliminate unused SANworks Virtual Replicator entries that are created in the Windows Registry. This update kit also includes the functionality required to import an existing storage unit with production data into a storage pool created with SANworks Virtual Replicator in a Windows 2000 cluster.

This tool is available at: <http://www.compaq.com/products/sanworks/softwaredrivers/>

First time snapshot caution

When the provided scripts run for the first time, an error is generated by indicating a failure. The error states that a dismount command was issued against a snapshot that didn't exist. You can ignore this error. If the scripts are scheduled to run daily, the problem goes away after the first day. In the custom scripts, there is a redirect command issued to a log file. The log file output shows what a good script run looks like.

Naming issue when creating snap

The operating system labels virtual snap as "Local Disk" on Explorer. Reboot to correct the problem. Don't try to change or rename.

Maintenance of the storage pool

It is important to monitor the pool space available and delete all unnecessary snapshots. You can use the Snapshot Manager snap-in within Microsoft Management Console or the SnapMgr command line to display information about the existing pool. When free space is less than 30 percent of pool capacity, *SANworks* Virtual Replicator logs warnings every five minutes in the system event log. When the free space drops below 5 percent of pool capacity, *SANworks* Virtual Replicator logs critical events. If you run into a free space limitation situation, you should immediately add more storage to your virtual pool.

It is also important to monitor the size of your snapshots. Snapback time is directly related to the amount of copy-outs (Delspace) on your snapshots. When recovering a database from a

snapshot as described in the previous section, the amount of copy-outs to a snapshot also affects the time it takes for the database to bring the log files and the data files to a consistent state. An administrator should monitor the amount of database transactions during the initial implementation period in order to better plan the snapshot frequency.

Log Management

It is important to backup the log files apart from the database files. It is recommended that you perform frequent log backups throughout the day. Multiple snapshots attached to log files create a performance impact on the database. In general, attach one snapshot to a log file and frequently update the snapshot to maintain minimal growth.

5.2 On-Going Service and Support

Postsales telephone support, providing problem identification and resolution for *SANworks* Virtual Replicator related issues, is available by ordering part number: QT-66MAB-Z*. Refer to the *SANworks* Virtual Replicator Quick Spec for more information.

6.0 Related Information

6.1 Web / Documentation Links

Compaq ActiveAnswers

Messaging and Collaboration Portal

<http://activeanswers.compaq.com/ActiveAnswers/Render/1,1027,2366-6-100-225-1,00.html>

Exchange 2000 Whitepapers

<http://www.compaq.com/ActiveAnswers/Exchange>

Other

Microsoft: Understanding Offline and Snapshot Backups (Microsoft Tech Note: Q237767)

<http://support.microsoft.com/view/tn.asp?kb=237767>

This article provides information about snapshot backup solutions for Exchange, although it does not address any vendor's specific implementation. The article states that offline and snapshot backups can be performed safely and successfully. However, it is up to the backup solution vendor or Exchange administrator to ensure that all of the needed files are backed up and restored correctly, and that the integrity of all files is preserved at each stage of the process.

SANworks Virtual Replicator by Compaq

<http://www.compaq.com/products/sanworks/vr/index.html>

Q&A on *SANworks* Virtual Replicator

<http://www.compaq.com/products/sanworks/vr/qa.html>

StorageWorks MSA 1000 Array Controller

<http://www.compaq.com/products/storageworks/msa1000/index.html>

Compaq ENSA2 Vision

<http://www.compaq.com/storage/ensa2vision.html>

Compaq Microsoft Exchange 2000 Solutions

<http://www.compaq.com/messaging/>

Compaq Storage at Microsoft

Microsoft uses *StorageWorks* for their own internal Exchange 2000 deployment!

<http://www.compaq.com/storage/casestudies/Microsoft.html>

SANworks Secure Path by Compaq

<http://www.compaq.com/products/sanworks/secure-path/index.html>

6.2 Related Solution Offerings

For positioning details, please see Section 2.8, Positioning with Other Compaq Products or Solutions.

Rapid Restore for Exchange 2000

<http://www.compaq.com/products/storageworks/solutions/mseub/index.html>

6.3 Feedback

Forward comments, questions, and related feedback to Microsoft_Storage_Solutions@compaq.com.

Appendix A: Sample Scripts

Sample Scripts

Scripts are required to quiesce the Exchange databases (EDM, STM) and log files before you execute *SANworks* Virtual Replicator snap commands. You may also schedule the scripts to launch at the appropriate times using a Microsoft Windows 2000 Task Scheduler or equivalent. The sample scripts provided and associated VBScripter file were used in the operation of this solution. A description of each script is provided to give you enough knowledge to develop your own scripts or to customize these scripts. The downloaded scripts require modification prior to use to accommodate the local environment.

When executed, each script relies on the VBScripter to assimilate the variables found in the script files.

Below is a fragment of the script that demonstrates the variables that need to be updated. You may want to use this fragment in order to perform a manual test run to verify access to the Exchange server and any path irregularities, and whether you have the right naming conventions pertaining to your environment.

There are four Exchange server entries required after mount.vbs command. The variables include: Server, Storage Group, Database, and Dismount/Mount command.

The *cscript* command sends the server name <exchserv>, storage group <SG1>, and Database <1priv1> to the <mount.vbs> (VBScripter) file. Since the “**Dismount**” command has been issued, the databases are dismounted. To create a mount script, perform the opposite event sequence. Replace “**Dismount**” with “**Mount**”. The Exchange server variables must be entered as they appear in the Exchange System Manager. Note that these are case sensitive. If there are any spaces in the variable, encapsulate them within double quotes.

Dismount.CMD

```
cscript mount.vbs exchserv SG1 1priv1 Dismount
cscript mount.vbs exchserv SG1 1priv2 Dismount
cscript mount.vbs exchserv SG1 “Public Store (exchserv)” Dismount
```

The Snapexchdb.cmd file is used to dismount/mount all the databases in two Storage Groups and take a snapshot of all the .EDB, .STM, and log files in the tested Exchange solution. A redirect command is placed at the end of each line to post results in a temp file. The last two operations of the script run the Exchange ESE utility to test the integrity of the databases. It is not necessary to redirect the output or run the integrity check on the snapped databases. The administrator can download the appropriate script file from <http://www.compaq.com/products/storageworks/solutions/vsm-e2000/scripts.html>

This sample script does not contain the ESEFILE and ESEUTIL commands.

Consideration: If the integrity test is performed, the ESEFILE command takes CPU cycles. In this solution, the ESEFILE process used 15% of CPU resources.

SnapexchDB.CMD

```
date /t time /t >> c:\temp\snap.log
rem ***** Delete old Snapshot *****
Snapmgr exchserv snapshot sg1logsnap /unmap /delete >> c:\temp\snap.log
Snapmgr exchserv snapshot sg1snap /unmap /delete >> c:\temp\snap.log
rem ***** Dismount all Database in this Storage Group *****
cscript mount.vbs exchserv SG1 Ipriv1 Dismount >> c:\temp\snap.log
cscript mount.vbs exchserv SG1 Ipriv2 Dismount >> c:\temp\snap.log
cscript mount.vbs exchserv SG1 "Public Store" Dismount >> C:\temp\snap.log
rem ***** Create a Snapshot of Two Volumes *****
snapmgr exchserv snapshot sg1logsnap /parent:sglog1 >> c:\temp\snap.log
snapmgr exchserv snapshot sg1snap /parent:sg1 >> c:\temp\snap.log
rem ***** Map drive letter for Snapshots *****
snapmgr exchserv snapshot sg1logsnap /map:n >> c:\temp\snap.log
snapmgr exchserv snapshot sg1snap /map:o >> c:\temp\snap.log

Rem ***** Mount all Databases in SG1 *****
cscript mount.vbs exchserv SG1 Ipriv1 Mount >> c:\temp\snap.log
cscript mount.vbs exchserv SG1 Ipriv2 Mount >> c:\temp\snap.log
cscript mount.vbs exchserv SG1 "Public Store" Mount >> c:\temp\snap.log

rem ***** Delete old Snapshot *****
Snapmgr exchserv snapshot sg2logsnap /unmap /delete >> c:\temp\snap.log
Snapmgr exchserv snapshot sg2snap /unmap /delete >> c:\temp\snap.log

rem ***** Dismount all Database in this Storage Group *****
cscript mount.vbs exchserv SG2 2PRIV1 Dismount >> c:\temp\snap.log
cscript mount.vbs exchserv SG2 2PRIV2 Dismount >> c:\temp\snap.log

rem ***** Create a Snapshot of Two Volumes *****
snapmgr exchserv snapshot sg2logsnap /parent:sglog2 >> c:\temp\snap.log
snapmgr exchserv snapshot sg2snap /parent:sg2 >> c:\temp\snap.log

rem ***** Map drive letter for Snapshots *****
```

```
snapmgr exchsrv snapshot sg2logsnap /map:p >> c:\temp\snap.log
snapmgr exchsrv snapshot sg2snap /map:q >> c:\temp\snap.log

rem ***** Mount all Databases in SG2 *****
cscript mount.vbs exchsrv SG2 2PRIV1 Mount >> c:\temp\snap.log
cscript mount.vbs exchsrv SG2 2PRIV2 Mount >> c:\temp\snap.log

rem ***** Check the consistency of the Snaps. The output file will display
the *****
rem ***** state of each Database. The last two groups in the parenthesis
*****
rem ***** from the output file should match each pair of databases
*****

eseutil /mh o:\exchsrvr\mdbdata\1priv1\1priv1.edb | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh o:\exchsrvr\mdbdata\1priv1\1priv1.stm | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh o:\exchsrvr\mdbdata\1priv2\1priv2.edb | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh o:\exchsrvr\mdbdata\1priv2\1priv2.stm | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh o:\exchsrvr\mdbdata\public\pub1.edb | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh o:\exchsrvr\mdbdata\public\pub1.stm | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh q:\exchsrvr\mdbdata\2priv1\2priv1.edb | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh q:\exchsrvr\mdbdata\2priv1\2priv1.stm | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh q:\exchsrvr\mdbdata\2priv2\2priv2.edb | find /i "consistent" >>
c:\temp\snap.log
eseutil /mh q:\exchsrvr\mdbdata\2priv2\2priv2.stm | find /i "consistent" >>
c:\temp\snap.log

rem ***** Check the snapped databases using eseutil utility. If there are 0 bad
*****
rem ***** check sums/ 0 wrong page numbers then the database is good.
*****
eseutil /s o:\exchsrvr\mdbdata\1priv1\1priv1.edb >> c:\temp\snap.log
```

```

esefile /s o:\exchsrvr\mdbdata\1priv2\1priv2.edb >> c:\temp\snap.log
esefile /s o:\exchsrvr\mdbdata\public\pub1.edb >> c:\temp\snap.log
esefile /s q:\exchsrvr\mdbdata\2priv1\2priv1.edb >> c:\temp\snap.log
esefile /s q:\exchsrvr\mdbdata\2priv2\2priv2.edb >> c:\temp\snap.log
rem pause

```

Best Practice: Pause can be used, but user intervention is required. It is suggested that the pause command be used until the scripts are fully tested. After the testing is complete, remove or remark out the pause commands.

Visual Basic Scripter: Mount.vbs

The mount.vbs file is a VBScripter file that receives input from the scripts created for Exchange.

```

Set oServer = CreateObject("CDOEXM.ExchangeServer")
Set oFirstStorageGroup = CreateObject("CDOEXM.StorageGroup")
Set oMailboxStoreDB = CreateObject("CDOEXM.MailBoxStoreDB")
Set oPublicStoreDB = CreateObject("CDOEXM.PublicStoreDB")

'Set up Params

    if WScript.Arguments.Count = 4 then
        strServer = WScript.Arguments(0)
        strStorageGroup = WScript.Arguments(1)
        strMDB = WScript.Arguments(2)
        if WScript.Arguments(3) = "Mount" then
            bMount = true
            elseif WScript.Arguments(3) = "Dismount" then
                bMount = false
            else
                WScript.echo "4th parameter must be either Mount or Dismount"
            end if
        else
            WScript.echo "Usage Error, must enter 4 parameters"
            Call Usage
            WScript.quit
        end if

'Open up the server
oServer.DataSource.Open (strServer)

'Get an array of StorageGroup objects
oStorageGroups = oServer.StorageGroups

'Get the count of SGs
cSGs = UBound(oStorageGroups) - LBound(oStorageGroups)

'Go through the SGs and look for the Storage group the user wants
bFound = false
for iSGs = 0 to cSGs
    oFirstStorageGroup.DataSource.Open (oStorageGroups(iSGs))
    if oFirstStorageGroup.Name = strStorageGroup then
        bFound = true
        exit for
    end if
next
if not bFound then

```

```

        WScript.echo "Storage group not found"
        WScript.quit
    end if

    'Get an array of MBX DBs
    oDBs = oFirstStorageGroup.MailboxStoreDBs

    'Get count of DBs
    cDBs = UBound(oDBs) - LBound(oDBs)

    'Go through the MBX DBs and look for the one the user wants to dis/mount
    bFound = false
    for iDBs = 0 to cDBs
        oMailboxStoreDB.DataSource.Open (oDBs(iDBs))
        if oMailboxStoreDB.Name = strMDB then
            bFound = true
            exit for
        end if
    next

    'If we found the DB the user wants to Mount/Dismount
    'If not found try the PF DBs
    if bFound then
        if bMount then
            oMailboxStoreDB.Mount
            strActionDone = "Mounted"
        else
            oMailboxStoreDB.Dismount
            strActionDone = "Dismounted"
        end if
        WScript.echo oFirstStorageGroup.Name + " - " + oMailboxStoreDB.Name + " " + strActionDone
    else
        'Get an array of PF DBs
        oDBs = oFirstStorageGroup.PublicStoreDBs

        'Get count of DBs
        cDBs = UBound(oDBs) - LBound(oDBs)

        'Go through the PF DBs and look for the one the user wants to dis/mount
        for iDBs = 0 to cDBs
            oPublicStoreDB.DataSource.Open (oDBs(iDb))
            if oPublicStoreDB.Name = strMDB then
                bFound = true
                exit for
            end if
        next
        if bFound then
            if bMount then
                oPublicStoreDB.Mount
                strActionDone = "Mounted"
            else
                oPublicStoreDB.Dismount
                strActionDone = "Dismounted"
            end if
            WScript.echo oFirstStorageGroup.Name + " - " + oPublicStoreDB.Name + " " + strActionDone
        else
            WScript.echo "The DB was not found in the Storage group"
        end if
    end if

sub Usage
    Wscript.echo "Usage: Mount <Server> <Storage Group> <MDB> <Mount or Dismount>"
    Wscript.echo "Usage: The parameters are case sensitive"
    Wscript.echo "Usage: Parameters with a space must be enclosed in double quotes."
End sub

```

Appendix B: Overview of Compaq SANworks Virtual Replicator

SANworks Virtual Replicator V3.0 is a key component of the Compaq Enterprise Network Storage Architecture strategy (ENSA). *SANworks* Virtual Replicator provides advanced, centralized storage management capabilities in Windows 2000 computing environments. Using the virtual replication snapshot feature, you can decrease the amount of time required to restore an Exchange mailbox server. *SANworks* Virtual Replicator also provides an additional tool that is complementary to regular online backup techniques. Using snapshot technology, you can perform integrity checks and offline copies of the snapshot without stopping the core services of the Exchange Server. Snapshots should not be viewed as a replacement for tape backups or as a justification for unchecked growth of the Exchange Information Store.

Core Capabilities

Storage Pooling/Virtualization – enables the grouping of hardware array storage or physical disks into a logically concatenated pool of disk space. Multiple "virtual disks" can be created from the pool that behave and perform exactly like physical disks. Disk virtualization allows you to optimally tailor disk space to the size required by users and their applications. Storage devices can be added to a pool as needed, increasing the size of the pool. In addition storage from multiple hardware array controllers can be bound into a storage pool and a virtual disk can be created that spans these storage devices. Storage units with existing production data can be seamlessly imported into a virtual storage pool. The production data is automatically preserved to a virtual disk with any free storage capacity being allocated to the pool. Individual virtual disks up to a maximum size of 2 TBs can be created.

Snapshots – enable the instantaneous creation of multipurpose virtual replicas of Exchange database files. Snapshots function identically to ordinary physical disks with read and write capability. Snapshots are used without disrupting running applications. For example, when an Exchange Server is online, the snapshot can be checked for integrity or corruption. The snapshot then becomes a source for the last-known good copy if a restoration is required. Using Windows 2000 Task Scheduler, you can automate the processes for unattended creation, deletion, and integrity checking of snapshots. *SANworks* Virtual Replicator is also designed to integrate with scripts and schedulers for a wide range of products that are designed for Microsoft Windows 2000.

Online Volume Growth – lets you increase storage capacity without disrupting the Windows 2000 operating system. Typically when you grow a RAID set, the Microsoft Windows 2000 operating system does not recognize the size change until you reboot. The *SANworks* Virtual Replicator Online Volume Growth feature directs the operating system to update the size of a physical or virtual disk without a reboot.

This feature was tested in the Virtual Storage Management for Exchange 2000 solution, resulting in no disruption and no measurable system performance impacts.

SANworks Virtual Replicator Complements Your Backup Strategy

A snapshot is a copy of your Exchange database files that share the same disks in the storage pool as the virtual disk. The disks in the pool should be protected with fault-tolerant RAID arrays and a battery backed up controller that protects the volatile cache memory. The snapshot should never be a replacement for a tape backup. You can combine snapshots with a daily backup to tape as an effective strategy for availability.

SANworks Virtual Replicator General Requirements

Operating System: Microsoft® Windows 2000 Server or Advanced Server, SP2 (minimum)

For clustered environments: Microsoft Windows 2000 Advanced Server, SP2

Memory: 64MB min required

Disk space: 20MB for installation of software

SANworks Virtual Replicator can be deployed on Windows NT or Windows 2000 systems (server or workstation). It is complementary to industry backup solutions (such as VERITAS Backup Exec™ for Windows NT, Legato NetWorker® for Windows NT, CommVault Galaxy v3.7, and Computer Associates ARCserveIT® for Windows NT), as well as NT's basic built-in backup capability. When layered on top of Microsoft Cluster Server (MSCS), *SANworks* Virtual Replicator takes full advantage of MSCS high availability features.

Note: Exchange server requirements may exceed the minimum requirements for *SANworks* Virtual Replicator. Consult your Compaq sales or support representatives for assistance in optimizing your specific configuration.

SANworks Virtual Replicator Storage Management

Microsoft Management Console (MMC)

Microsoft Management Console (MMC) is a framework for running the management tools provided by Microsoft and other vendors. MMC allows management of local and remote computers. All *SANworks* Virtual Replicator functions can be managed locally or remotely using the MMC. *SANworks* Virtual Replicator provides two snap-ins for the MMC.

Snapshot Manager (SnapMgr) – Manages and presents information about pools, the virtual disks and their snapshots. For additional scripting capabilities, the SnapMgr provides command line interface (CLI) tools.

The MMC Snapshot Manager provides additional statistics to help manage your environment. Table B-1 provides descriptions for the POOL Properties Statistics Tab.

Table B-1. MMC POOL Properties Statistics Tab

Statistics Tab - MMC POOL Properties	
Read Received	The number of read I/O requests received by the pool software.
Reads issued to disk	The number of read I/Os issued to disk by the pool software. This includes reads caused by copy-out operations and split reads.
Split Reads	The number of read I/O requests that had to be split into two or more I/Os to disk because the read crossed a segment boundary, and the next segment was not contiguous with the current segment.
Write Received	The number of write I/O requests received by the pool software.
Write Issued to Disk	The number of write I/Os issued to disk by the pool software. This includes writes caused by copy-out operations and split writes.
Split Writes	The number of write I/O requests that had to be split into two or more I/Os to disk because the write crossed a segment boundary, and the next segment was not contiguous with the current segment.
Copy-outs	The number of segments that were copied to preserve data for snapshots.

Snapshot Planner

Use the Snapshot Planner, prior to installing *SANworks* Virtual Replicator, in order to plan your snapshot allocations. You can only use Snapshot Planner with drives that are not used in a pool and are formatted with NT Disk Administrator.

Snapshot Planner helps predict the cost of snapshots, in terms of disk space and extra I/Os. It tracks actual reads and writes to your existing drives and determines how much space a snapshot of each drive needs. Snapshot Planner also determines how many extra I/Os the snapshot would cause due to copy-out operations. Install Snapshot Planner on a server that simulates production load and is scheduled for Information Store (IS) Maintenance. The data presented by Snapshot Planner will help in planning the pool space required. Plan to run the Snapshot planner for at least 24 hours.

Copy-out is the physical copying of a 32 KB (default) segment of disk blocks in order to maintain snapshot integrity. Copy-out occurs only when a segment on the original virtual disk is modified for *the first time*. Subsequent changes to the same segment on the original disk do not require copy-outs. Disk space is allocated from the storage pool as needed for copy-outs. If parent and snapshot diverge, the parent keeps the original frames, while the snapshot is allocated new frames.

Table B-2. Windows 2000 System Monitor Counters Provided with the Snapshot Planner

Counter	Description
Writes to disk	The total number of writes issued by your applications and users.
Extra copy-out I/Os	The extra I/Os caused by the snapshot. This is the number of additional reads and writes incurred by copy-out operations.
Snapshot space (MB)	The disk space used by the simulated snapshot.
Snapshot space (%)	The disk space used by the simulated snapshot, expressed as a percentage of the space you would have used if you had made a normal copy of the disk. It is initially 0%, when you first create the snapshot. At worst it could rise to 100%.

Filter Driver: *SANworks* Virtual Replicator implements a filter driver (sddriver.sys) that intercepts and processes I/O requests bound for the underlying devices. Filter drivers are implemented under the NT I/O manager. Windows 2000 implements a filter driver for software RAID (ftdriver.sys). Other applications such as virus scanners, disk quota managers also install filter drivers. Filter drivers are integrated to use existing function calls within the Windows 2000 I/O subsystem.

SnapMgr Command Line Interface (CLI)

SANworks Virtual Replicator provides a command line interface (CLI) that enables batch jobs to automate tasks. The SnapMgr and NDMgr commands provide the same level of functionality as the two snap-ins for the MMC.

Note: SnapMgr CLI allows administrators to manage all the *SANworks* Virtual Replicator devices. The same functionality that exists locally is also available remotely.

Use these commands in scripts or from the Microsoft Windows NT Command Line.

Table B-3. SnapMgr Command Line Interface

Counter	Description
Writes to disk	The total number of writes issued by your applications and users.
Extra copy-out I/Os	The extra I/Os caused by the snapshot. This is the number of additional reads and writes incurred by copy-out operations.
Snapshot space (MB)	The disk space used by the simulated snapshot.
Snapshot space (%)	The disk space used by the simulated snapshot, expressed as a percentage of the space you would have used if you had made a normal copy of the disk. It is initially 0%, when you first create the snapshot. At worst it could rise to 100%.

Note: Remote administration from a Windows NT workstation or server, enables administrators or a service running with administrative privilege, to manage remote computers from the SnapMgr or NDMgr prompt.

Automated Scheduling

SANworks Virtual Replicator software includes automation and scripting capabilities that automate repetitive storage management tasks to simplify managing data and storage. A series of wizards provide a quick way to create a schedule for various snapshot activities that manage recurring tasks. Once created, these schedules automatically launch at your predefined times.

The following are some examples of tasks that can be scheduled:

- Creating and deleting snapshots
- Restoring from snapshots
- Performing unattended backup operations
- Monitoring resource usage to ensure pool capacity is not exceeded

The schedules can be automated using Windows NT Task Scheduler or a suitable alternative.

Descriptive Terms

Storage Units

SANworks Virtual Replicator storage units are the basic building blocks for physical storage. Storage Units for an Exchange Server should follow similar capacity planning exercises as a traditional disk subsystem for your primary storage. The storage unit requires physical storage that is available to the NT system. Storage units are either individual physical disks or logical disk devices (such as RAID sets). The disk must be unformatted and non-partitioned.

For an Exchange mailbox server, the disk subsystem for the database should be designed using Compaq's SMART or StorageWorks controllers set with RAID fault-tolerant settings. Storage units in a pool should have the same redundancy, read-write, and failure characteristics. Similar disk subsystem planning should be completed for storage units as for traditional database arrays. Additional planning is required to maintain an online snapshot copy of your database.

Storage Pool

A storage pool is a collection of one or more physical disks or controller-based fault-tolerant disk sets that can store virtual disks and snapshots. It is important to use controllers that protect the volatile cache memory. A maximum of 8 storage units can be pooled.

Use Storage Units with similar redundancy, read-write, and failure characteristics. Additional Storage Units can be added to a Storage Pool.

Virtual Disk

A virtual disk is a disk in a pool that was created as an empty disk of a specified capacity. To applications and users, a virtual disk looks just like a normal disk. You map a drive letter to it, partition and format it like a normal disk, and then read and write it like a normal disk. But a virtual disk has one special feature – you can make virtual copies of it in a matter of seconds. The copies are called snapshots.

Virtual Disks are created from available disk blocks in the storage pool. The virtual disk has the same properties as a physical disk device. Multiple virtual disks (8 max) can be created from the same storage pool. Virtual disks may also use blocks obtained from different storage units. For the Exchange Server database files, use blocks from a local primary Storage Unit.

When a Virtual Disk is deleted, the disk blocks are returned to the storage pool and available for reallocation.

Snapshot

The term snapshot may have different definitions for applications other than *SANworks* Virtual Replicator. A snapshot in *SANworks* Virtual Replicator is a disk in a pool that was created by making a virtual copy of the parent disk.

When the snapshot is first created, it is an exact virtual copy of the parent disk, made at an instant in time. It has the same capacity and label. It contains exactly the same data. It is as if you had a camera and took a picture of every single byte of data stored on the original disk at a single instant in time.

To applications and users, a snapshot looks like a normal disk. You can read and write to it like a normal disk. The snapshot can have an available drive letter mapped to it and be shared over the network. The snapshot drive appears as any other drive letter within the NT file system (NTFS).

When you first create a snapshot, it does not occupy any disk space. The snapshot only begins to take up disk space when you modify the data stored on either the snapshot or the parent disk. Subsequent snapshots can be created from the parent disk or the point-in-time snapshot replica.