HP StorageWorks Rapid Backup Solution for mySAP Business Suite using SQL Server 2000 — technical blueprint

Solution Family Guide

Executive summary

For many enterprises relying on mySAP Business Suite applications for their mission-critical processes, Microsoft® SQL Server 2000 is the relational database management system of choice. To ensure the on-going availability of these applications and associated data to users across the organization, enterprises strive to minimize or even eliminate any impairment of SQL Server availability during backup.

While a traditional full backup typically implies hours of additional load on a SQL Server database, the HP StorageWorks Rapid Backup Solution methodology for HP StorageWorks Enterprise Virtual Arrays (EVAs) and HP StorageWorks XP disk array storage systems returns SQL Server to unimpaired availability within minutes.

Overview

HP StorageWorks Rapid Backup Solution for mySAP Business Suite for SQL Server provides reliable, scalable, and cost-effective solutions that minimize service impairment during backup.

This is achieved by offloading the backup process from the database server. HP StorageWorks Rapid Backup Solution uses Business Continuance Volumes (BCVs) by creating a virtual copy of the SQL Server data residing on the storage system. The physical backup to tape is performed by a dedicated backup server that reads the data from the newly created BCVs and writes them to the tape, thereby relieving the database server of backup tasks and allowing SQL Server to return to production mode while the backup is in progress.

HP StorageWorks Rapid Backup Solution has been developed to complement SAP business applications designed for businesses that must run 24 x 7 SQL Server databases. Minimizing the impact of backup procedures on the database server and simplifying backup management, HP StorageWorks Rapid Backup Solutions deliver measurable business benefits. These integrated storage solutions address the major business issues associated with large-scale data backup:

- Shrinking backup window
- Ever-growing database size
- Growing complexity of backup
- Production environment service level requirements during backup

Scope

This paper applies to mySAP Business Suite using Microsoft SQL Server databases in combination with EVA or XP disk array data storage systems.

Business issues of backup-related service level impairment

In a mission-critical SAP and SQL Server 24 x 7 production environment, the IT organization must perform regular full online backups to protect mission-critical data. During regular (that is, non-rapid) backup, users might experience performance impairment on the SAP system because the SQL Server must handle additional load during the backup period caused by the required read of data to be backed up (typically several hours).

Delivering on service level expectations

To consistently provide the service levels required by business organizations—particularly the service level qualities laid down in Service Level Agreements (SLAs)—IT organizations strive to dramatically

reduce the time during which SAP availability, performance, or both are impaired for backup reasons.

HP StorageWorks Rapid Backup Solutions enable IT organizations to deliver on SLAs by leveraging BCVs to minimize any backup-related impact on the database server. These solutions help customers to achieve fast return on investment (ROI) in several ways:

- Reduced time during which the database is in backup mode during online backup
- Less time required to get the SAP system up and running after a failure that requires data to be restored
- In the event of a disaster affecting the production environment, faster recovery initiated with minimum lead time

HP StorageWorks Rapid Backup Solutions overview

The Rapid Backup Solutions for mySAP Business Suite using SQL Server leverages the ability of storage subsystems to create a BCV of a given logical unit (LUN). This BCV is created in the available freespace.

The creation of BCVs on the disk subsystem has been integrated with the DBUTIL utility. The DBUTIL utility controls the entire backup procedure of SQL Server databases. The execution time of DBUTIL is critical to the availability of the SQL Server databases to the users of an organization.

Dedicated backup server

The Rapid Backup Solutions use a dedicated backup server that relieves the database server of backup tasks, thereby minimizing the impact on the database server.

To reduce the load on the database server, the backup process is largely offloaded from the database server to the backup server. The backup server uses dedicated commands for communicating with the storage system controller to:

- Create the BCV.
- Mount the BCV on the backup server.
- Unmount the BCV from the backup server upon completion of the backup to tape.
- Delete the BCV.

Refer to **Figure 1** for a flowchart of the rapid backup process. The use of a dedicated backup server means that the bulk of these operations are performed without any impact on the database server.

Role of BCVs

The Rapid Backup Solutions use BCVs to minimize any impact on the database server during backup.

Note
BCV is a generic name for "clone," "snapshot," "snapclone," "Vsnap," "Vsnapshot," and "Vsnapclone," irrespective of the method (clone, snapshot, split mirror, and so on) by which it was created.
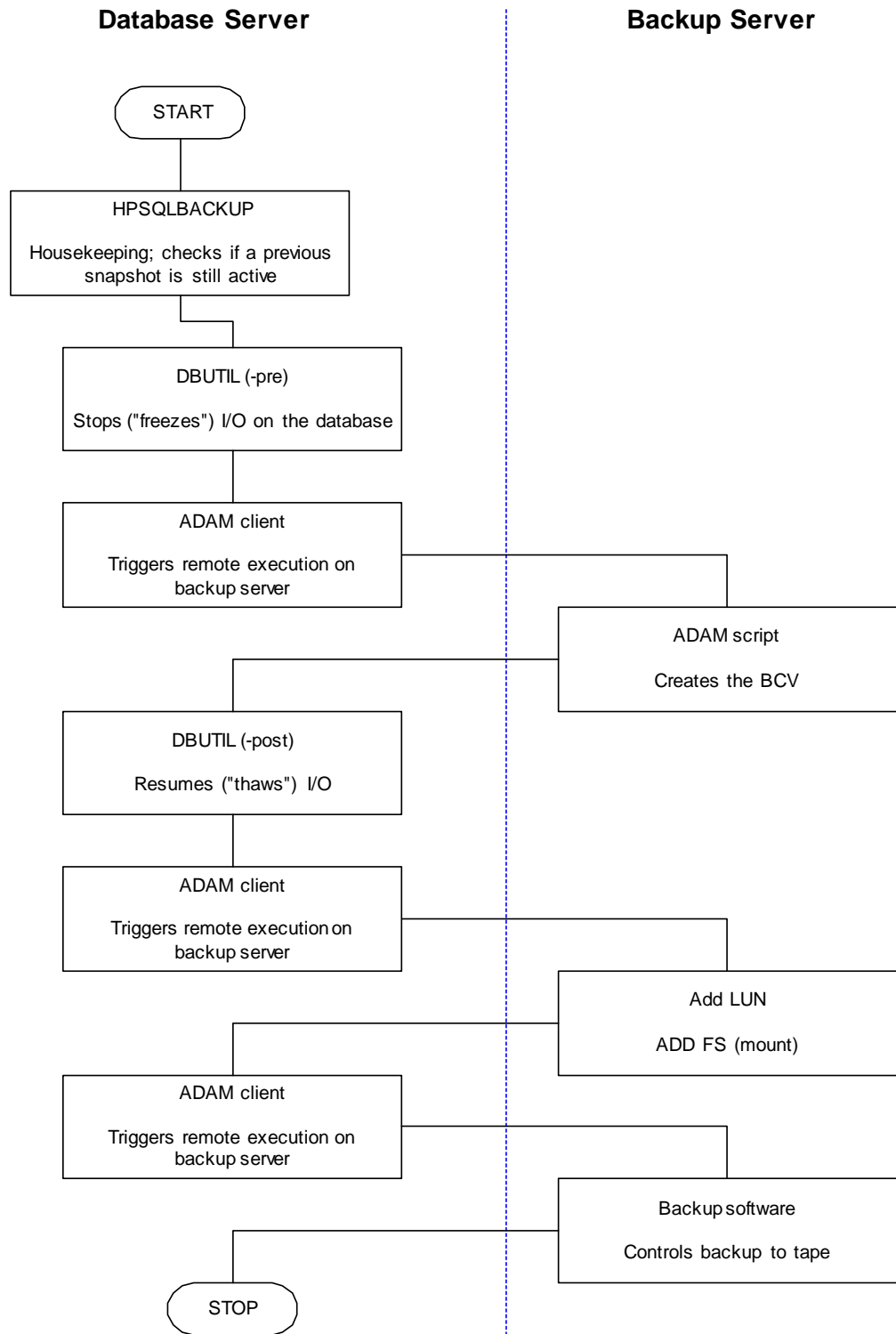

The general procedure comprises the following stages:

1. Creating a BCV of a LUN in a storage subsystem
2. Streaming the BCV to tape

Rapid backup process flow

Figure 1 illustrates the general procedure for online rapid backup using BCVs.

Figure 1. Rapid backup process flowchart

Database Server	Backup Server

```
                        ┌──────────┐
                        │  START   │
                        └──────────┘
                             │
         ┌───────────────────────────────────────┐
         │           HPSQLBACKUP                  │
         │                                        │
         │  Housekeeping; checks if a previous    │
         │       snapshot is still active         │
         └───────────────────────────────────────┘
                             │
         ┌───────────────────────────────────────┐
         │            DBUTIL (-pre)               │
         │                                        │
         │  Stops ("freezes") I/O on the database │
         └───────────────────────────────────────┘
                             │
         ┌───────────────────────────────────────┐
         │             ADAM client                │
         │                                        │
         │     Triggers remote execution on       │
         │            backup server               │
         └───────────────────────────────────────┘

                                          ┌───────────────────────────┐
                                          │        ADAM script         │
                                          │                            │
                                          │      Creates the BCV       │
                                          └───────────────────────────┘

         ┌───────────────────────────────────────┐
         │            DBUTIL (-post)              │
         │                                        │
         │        Resumes ("thaws") I/O           │
         └───────────────────────────────────────┘
                             │
         ┌───────────────────────────────────────┐
         │             ADAM client                │
         │                                        │
         │     Triggers remote execution on       │
         │            backup server               │
         └───────────────────────────────────────┘

                                          ┌───────────────────────────┐
                                          │         Add LUN            │
                                          │                            │
                                          │      ADD FS (mount)        │
                                          └───────────────────────────┘
         ┌───────────────────────────────────────┐
         │             ADAM client                │
         │                                        │
         │     Triggers remote execution on       │
         │            backup server               │
         └───────────────────────────────────────┘

                                          ┌───────────────────────────┐
                                          │      Backup software       │
                                          │                            │
                                          │   Controls backup to tape  │
                                          └───────────────────────────┘
                        ┌──────────┐
                        │   STOP   │
                        └──────────┘
```

The process illustrated in **Figure 1** comprises the following sequence of steps:

1. On the database server, the HPSQLBACKUP command does housekeeping; that is, HPSQLBACKUP initially checks whether a BCV generated during a previous rapid backup is still active. Provided that there is no active BCV, the HPSQLBACKUP command starts the DBUTIL utility.
2. The DBUTIL utility stops the writes on the database, thus suspending the database. If this step fails, the DBUTIL process is killed. While the database is suspended, no data files or indexes can be added or created within the database. However, data in existing files can be changed.
3. After the database is suspended, the DBUTIL utility invokes the Adaptive Disk Array Manager (ADAM) client (on the database server), which remotely executes the ADAM script on the backup server to create the BCV.
4. When the BCV has been created, the DBUTIL utility on the database server restarts the database by resuming its I/O, making the SQL Server database, and thereby the mySAP system, fully available again to users.
5. The DBUTIL utility invokes the ADAM client (on the database server), which remotely executes the ADAM script on the backup server. The ADAM script on the backup server creates a LUN for the BCV and then adds and mounts a file system for this BCV to the backup server.
6. From the database server, the ADAM client remotely executes the customer's backup software on the backup server for a full database file system backup. This is the software that controls the physical backup (full file system backup) to tape.

Example: small storage system

Figure 2 shows an example of a small storage system containing three LUNs.

Figure 2. General layout of a small storage system
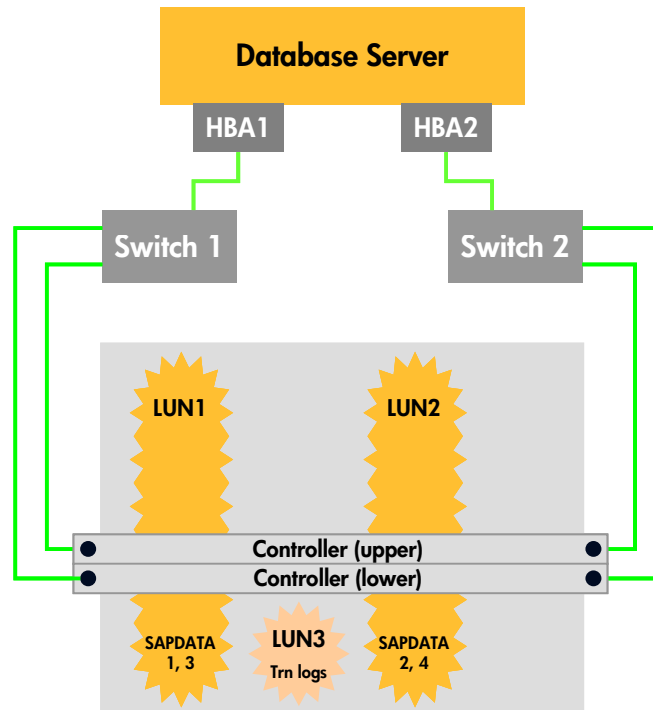
Connections

- The database server of this small storage system is equipped with two host bus adapters (HBAs). Each of these HBAs is connected to the storage system by way of a separate switch to avoid a single point of failure.
- The storage system is equipped with two controllers. Each of these HP StorageWorks HSV Controllers has two 2-Gb/s ports.
- Each HBA of the database server is physically connected to both controllers to avoid a single point of failure.

Internal structure

The storage system includes three LUNs: LUN1 and LUN2 for SAPDATA plus a separate LUN for transaction logs.

- LUN1 (served by HBA1) holds SAPDATA 1 and 3.
- LUN2 (served by HBA2) holds SAPDATA 2 and 4.
- LUN3 holds the transaction logs.

Rapid backup procedure

Figure 3 illustrates the typical sequence of events during a rapid backup of the SQL Server database file system backup using BCVs.

Stage 1: Creating a BCV of LUNs

A BCV is initiated for each LUN of the database. These BCVs are logically read to create LUN1', LUN2', and LUN3' outside of LUN1, LUN2 and LUN3, respectively, in the storage system.

Figure 3. Creating BCVs
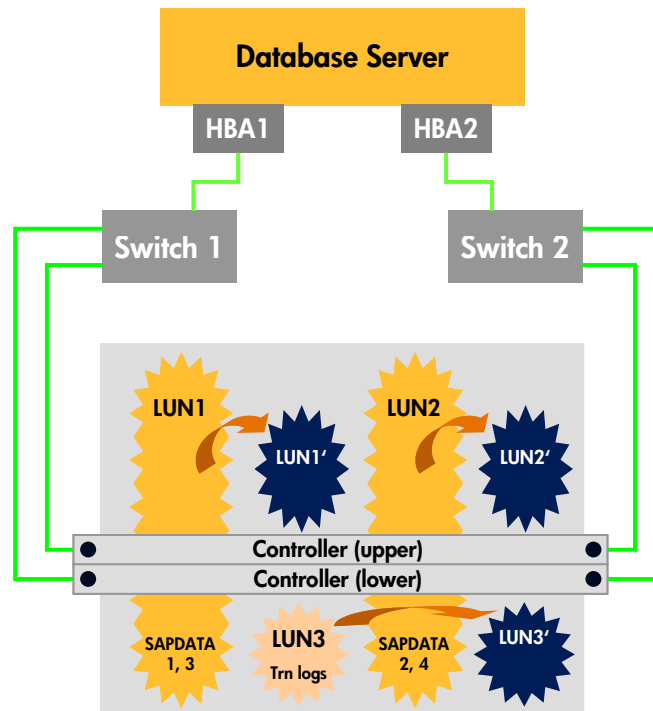
Any blocks that remain unchanged after this point will be read from the original LUN. Blocks that change will be read from the corresponding BCV for consistency.

On the operating system level, the scenario shown in **Figure 3** is represented as follows:

- LUN1 = DBSERVER\1
- LUN1' = BACKUPSRVR\1
- LUN2 = DBSERVER\2
- LUN2' = BACKUPSRVR\2
- LUN3 = DBSERVER\3
- LUN3' = BACKUPSRVR\3

Stage 2: Streaming BCVs to tape

At this stage, the dedicated backup server becomes relevant. This backup server shares both switches with the database server. The tape devices (one or multiple drives) are connected to the backup server by an HBA, a switch, and an HP StorageWorks Network Storage Router (NSR), which basically is an advanced Fiber Channel to SCSI converter.

Figure 4. Backup server streams BCVs to tape
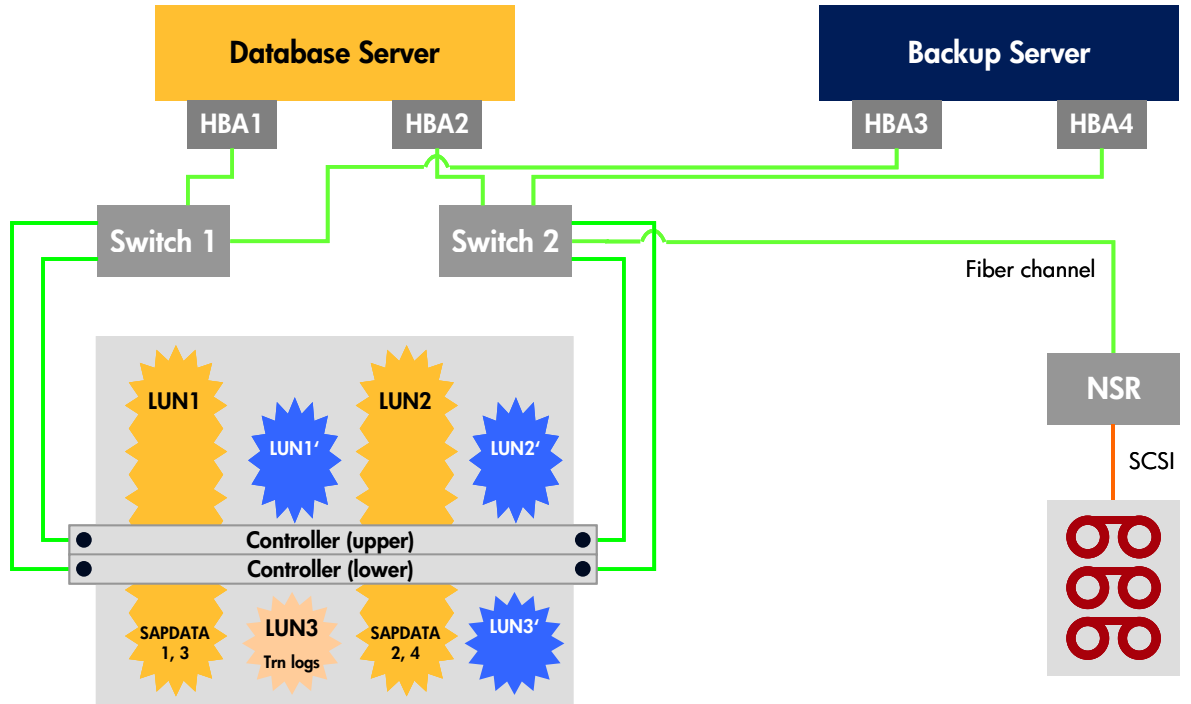
Example: large storage system

Figure 5 shows an example that illustrates the use of BCVs in a production environment equipped with a large storage system. While the small storage system shown in **Figure 4** uses two LUNs for SAPDATA, the large storage system shown in **Figure 5** uses four LUNs for SAPDATA.

Figure 5. Large storage system
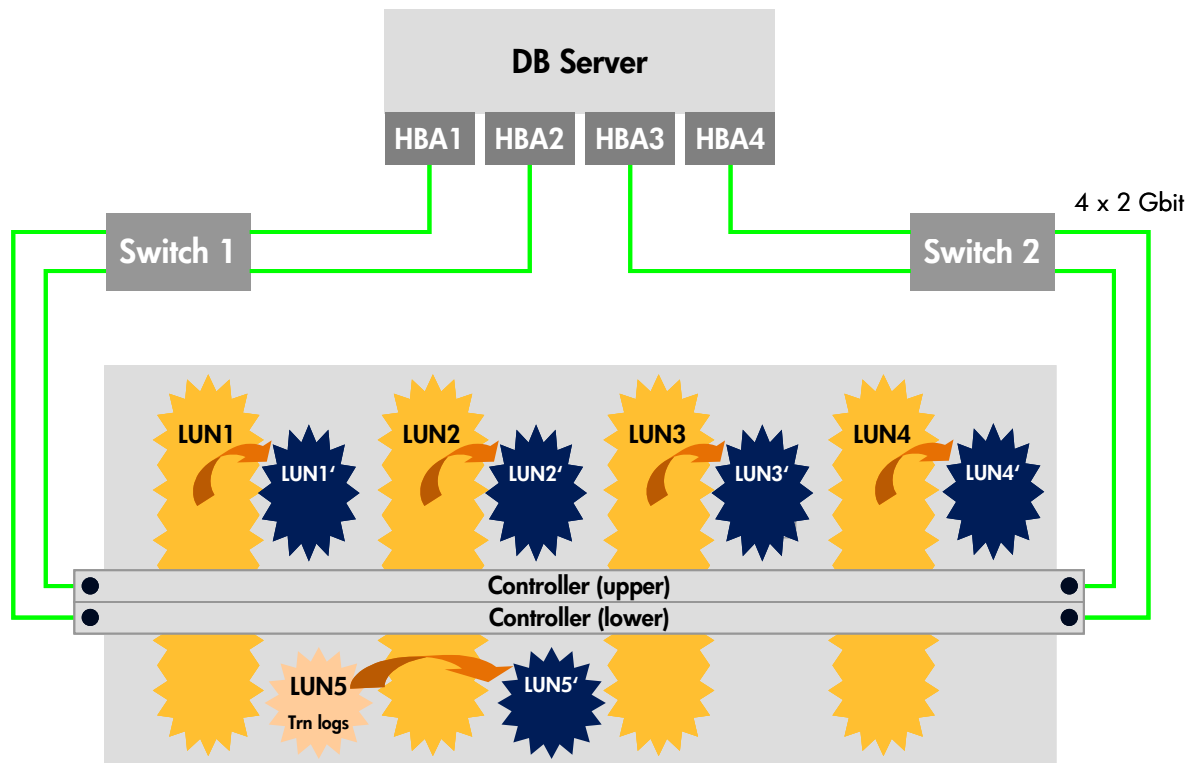
Connections

- The database server of this large storage system is equipped with four HBAs. Two switches are shared by these HBAs.
- The storage system is equipped with two controllers. Each of these controllers has two 2-Gb/s ports.
- By way of the two switches, each HBA of the database server is physically connected to both controllers to avoid a single point of failure.

Internal structure

The large storage system includes a total of four LUNs for SAPDATA plus a separate LUN for transaction logs.

- LUN1 (served by HBA1) holds SAPDATA 1.
- LUN2 (served by HBA2) holds SAPDATA 2.
- LUN3 (served by HBA3) holds SAPDATA 3.
- LUN4 (served by HBA1) holds SAPDATA 4.
- LUN5 holds the transaction logs.

Each switch can handle multiple 2-Gb/s logical cross connections internally. Two switches are sufficient in this configuration. Additional switches would not yield any extra performance.

Rapid backup procedure

The backup procedure for the large storage system is similar to that of the small storage system, except that five LUNs are involved in the rapid backup.

Typical backup chronology

An example of the chronological "sequence of events" during a rapid online backup procedure is provided in Table 1, illustrating that the impact of the backup procedure on production operations is minimized.

Table 1.

Time	Event
00:00:00	The HPSQLBACKUP command does housekeeping and then suspends the SQL Server database.
00:01:42	**SQL Server database is suspended.**
00:01:43	Database I/O stops.
00:01:44	BCV creation is initiated.
00:02:19	BCV creation is completed.
00:02:19	Database I/O resumes.
00:02:20	**Database is restarted and fully available.**
00:02:20 – 00:02:41	BCV is mounted to backup server.
00:02:43	Backup to tape is started (by dedicated backup server, detached from database server).
04:50:01	Physical backup to tape is completed.

Business case—Reducing backup time from hours to minutes

The BCV methodology used by HP StorageWorks Rapid Backup Solutions dramatically shortens, by orders of magnitude, the backup-related time span during which SQL Server service levels are impaired. **Figure 6** illustrates this dramatic improvement by way of an example involving a 2 x 750 GB database. In this real-life example, the backup mode time is reduced from nearly nine hours to less than seven minutes.

Figure 6. Reducing backup time from hours to minutes
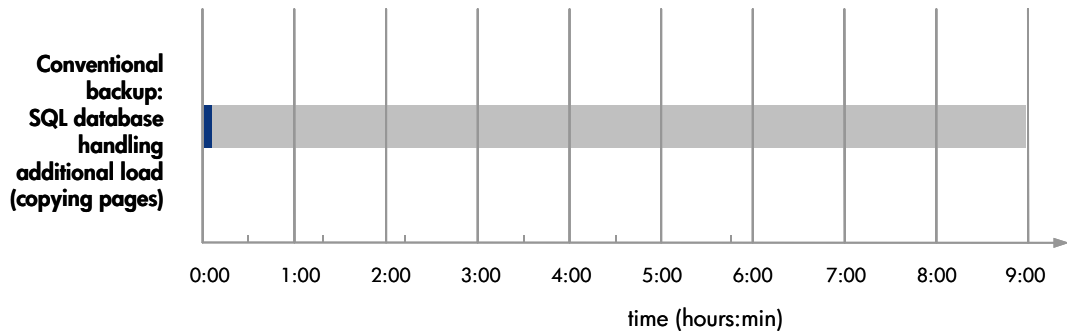
Faster by orders of magnitude

Using the Rapid Backup Solution, the backup to tape involves BCVs streamed to tape by way of a dedicated server. The backup procedure is thus detached from the database server. The time during which the SQL Server database must handle additional load caused by the backup process is reduced to a few minutes. During conventional backup, however, SQL Server must handle the additional backup load (that is, copying additional pages) until the entire backup to tape procedure has been completed.

The following diagram gives a general impression of the improvements experienced by organizations that deploy these solutions.

Figure 7. Rapid backup compared to conventional online backup

HP Rapid Backup

Start HPSQLBACKUP	SQL freezes	SQL thawed	Terminate backup
00:00:00	00:02:15	00:07:02	04:30:00

Create BCV
Backup to tape

SQL frozen for a few **minutes**

Conventional Backup

Native SQL backup	Start copying pages	Finished copying pages	Terminate backup
00:00:00	00:02:15	05:39:40	05:41:00

Backup to tape

SQL handling additional backup load for **hours**
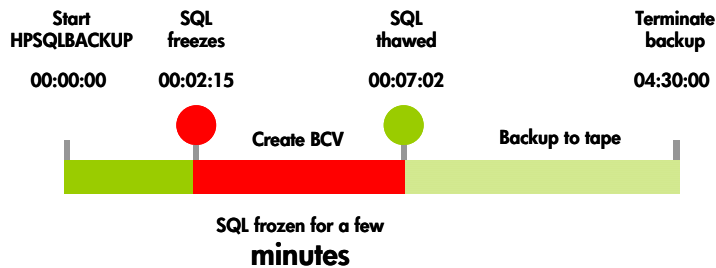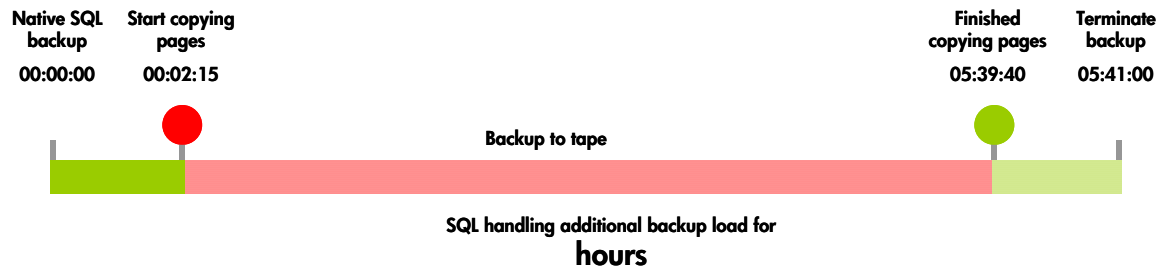
Laboratory proof points—Conventional backup compared to HP StorageWorks Rapid Backup

The BCV methodology used with the Rapid Backup Solution dramatically reduces the additional SQL Server load caused by reading the whole database during backup. The larger the database, the more significant the time advantage over conventional backup methods. The Rapid Backup Solution thus provides a major contribution to business continuity in 24 x 7 production environments.

Conventional backup methods

Figure 8 reflects empirical data on the backup-related impact on the service levels of three different database sizes: 400 GB, 1.5 TB, and 2 x 750 GB (the 1.5-TB database distributed across two storage systems). Although users can access the system during this period, the impact on database performance is considerable.

- During conventional (that is, native SQL Server) backup, the 400-GB database must handle additional load (copying pages) for around three hours and 24 minutes.
- For the 1.5-TB database, additional backup-related load must be handled for around eight hours and 50 minutes.
- The 2 x 750-GB database using two storage systems must handle additional backup-related load for eight hours and 59 minutes.

Note
The results shown with database load largely depend on the type and amount of load on the database during the time of backup. Customer experience is expected to differ from system to system.

Figure 8. Impact of conventional backup on database availability
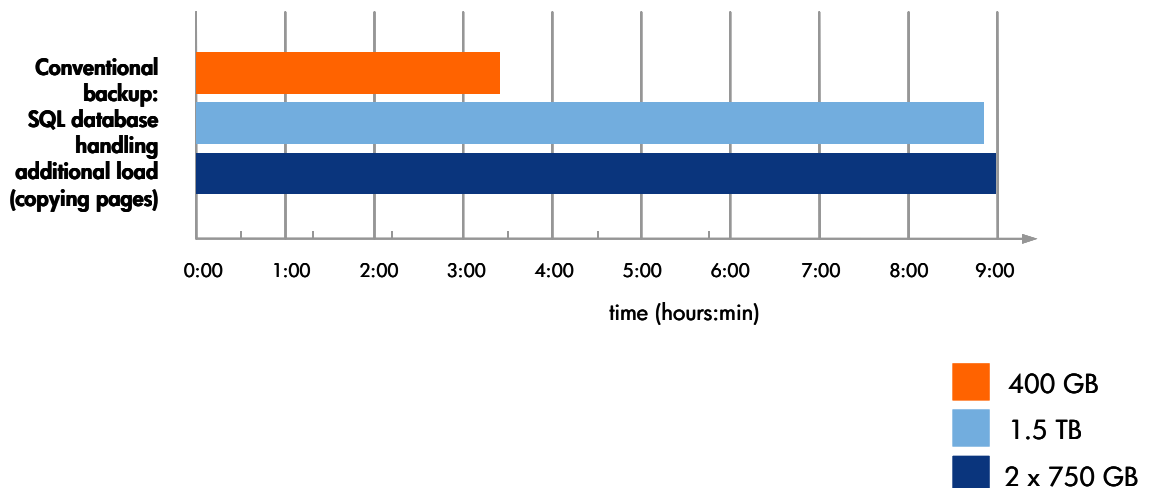
HP StorageWorks Rapid Backup Solution methodology

Minimizing any load on the database server during backup, the BCV methodology used by the Rapid Backup Solution helps IT organizations deliver on the database service level expectations of their enterprise.

- During rapid backup from the backup server, database performance is slightly degraded. While the database is suspended (that is, while the database handles additional backup load), no data files or indexes can be added or created within the database. However, data in existing files can be changed.
- The 400-GB database handles additional backup-related load (copying pages) for just under four minutes.
- The 1.5-TB database handles additional backup-related load for six minutes.
- The 2 x 750-GB database using two storage systems handles additional backup-related load for less than seven minutes.

For comparison, the shaded "original" bars in **Figure 9** indicate the impact of conventional backup.

Figure 9. BCV methodology minimizes impact on database availability
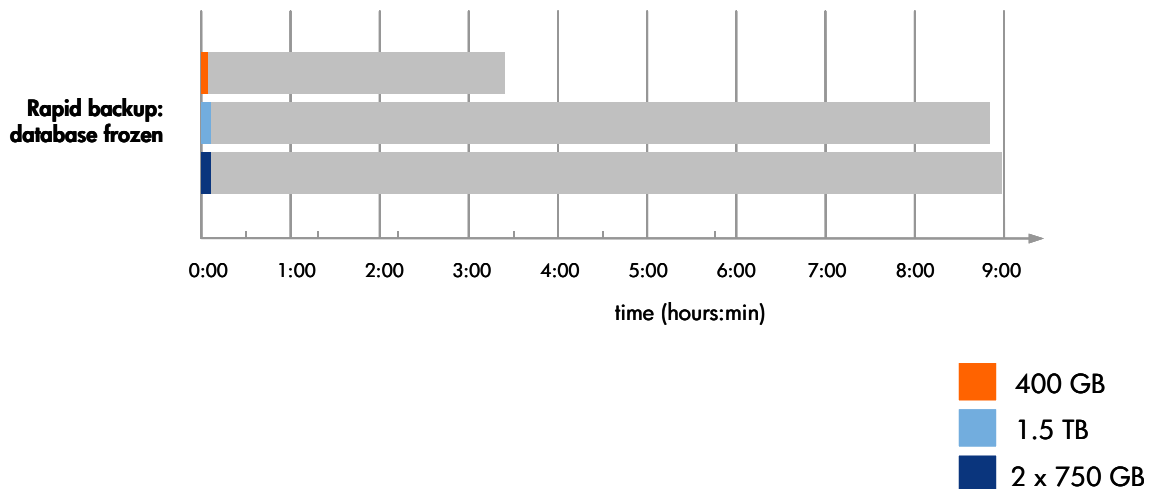
Restore

The data on the backup media can be restored to the database server by way of the storage area network (SAN). Only a **full restore** of a successful rapid backup can be performed.

Figure 10. Restore by way of the SAN
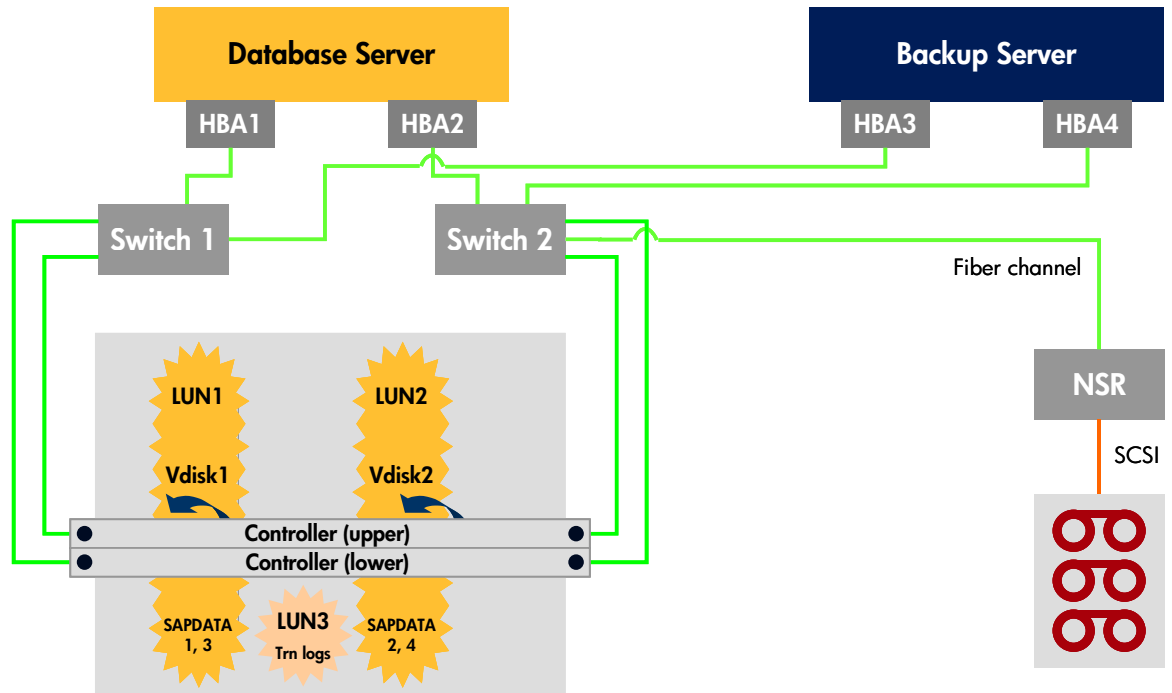
Restoring data from tape to LUNs in the production environment requires skill and experience. The following descriptions provide a general overview of many methodologies. For specific instructions, refer to the documentation supplied with the backup software. Also, the pertinent SAP recommendations and guidelines should be observed.

Rapid backup facilitates restore and recovery

The Rapid Backup Solution creates BCVs of the tablespaces virtually instantaneously, so that only a few transaction log backups need be applied to recover the SQL Server database. The Rapid Backup Solution methodology thus helps to minimize the time it takes to get a database up and running.

General recovery procedure

If the SQL Server database must be restored to its status before a failure, perform the following steps:

1. Perform a full file system restore from tape or from the most recent snapshot (if available).
2. Use the ZSQLRESTORE utility to put the database into its loading state so all additional transaction log backup can be applied.
3. Apply all available transaction log backups.

General recommendations

In terms of storage subsystem I/O performance, mySAP Business Suite using SQL Server poses many tough challenges. To ensure that the storage system delivers on mySAP Business Suite and SQL Server service level expectations, the following recommendations should be followed.

Backup policy

- Perform a full backup once a day.
- Perform a transaction backup every hour on the database server.

Infrastructure requirements

- The database server must have an even number (a minimum of two) of HBAs.
- A dedicated backup server is required. This server can be a scaled-down sibling of the database server. The backup server must run the same operating system as the database server. The backup server must have a sufficient (preferably even) number of HBAs for connecting to the storage system.
- One or more additional HBAs can be installed for communication with the tape devices.
- The backup utility must conform to the HP Enterprise Backup Solution. Refer to "HP StorageWorks Enterprise Backup Solution—Overview and features" at http://www.hp.com/go/ebs.
- The backup server must be able to read off the BCVs fast enough to keep the backup devices in streaming mode.
- The hard disk of the backup server must be dimensioned such that it provides adequate space for the backup log and the backup tape index. A backup of the backup server index files must be scheduled.
- Sufficient space must exist on the storage subsystem for BCVs, particularly for dynamic Vsnaps.
- One or more NSRs are required for connecting the tape devices to the SAN. Because the backup is performed by the backup server and data is to be restored to the database server, both servers must share the same tape devices. For this reason, an NSR is needed to link the tape library or tape drives to the SAN. The NSR converts from Fiber Channel to SCSI. Alternatively, a new tape library with a built-in Fibre Channel interface can also be used.
- An adequate number of tape drives is required.
- Backup and database servers connected to 2-G/s SAN switches are required.

Backing up the transaction logs

Before starting the rapid backup procedure presented in this paper, be sure to back up the SQL Server transaction logs. Having the SQL Server transaction log backup available facilitates the restore and recovery after the completion of an SQL Server database rapid backup. HP recommends that a transaction log backup be performed every hour on the database server.

Configuring the backup server

The backup server must be included in a high-availability (HA) configuration:

- Set up redundancy and backup of the backup server itself to ensure HA.
- Be sure to schedule a regular (ideally daily) backup of the internal database of the backup server.

Backup software on the backup server

The backup software uses an internal database that keeps the information about the location of media, drives configured, when backup is taken, which tape has been used, which media contains which logs, and so on. The location where this information is kept on the system differs from vendor to vendor. This information is very valuable when the database files are restored from tape; hence, it must be secured by backing up the internal database regularly.

When the backup software is installed on the backup server, choose a disk (other than operating system disk) that provides sufficient space for the growing internal database of the backup software. Also, be sure to provide the disk with a high protection level by configuring RAID 1 on a Smart Array or VRAID 1, depending on the storage technology in use.

If the information is lost, it can be retrieved by scanning the tapes. This process is slow and tedious; therefore, HP highly recommends regular backups of this information.

Integration with SAP SM36 Batch Scheduling Transaction

The HP StorageWorks Rapid Backup Solution for SQL Server is fully integrated with SAP background scheduling. To simplify job planning and scheduling, external commands that use the Rapid Backup Solution functionality for online backup can be added to the SAP executable directory. The background job transaction SM36 can be used to schedule and call the external HPSQLBACKUP command instead of the native SQL Server command. **Figure 11** shows an example of an online backup command.

Figure 11. Defining the background job example

Support matrix

The following table indicates the support matrix (status: September 2004) of HP StorageWorks Rapid Backup Solution for mySAP Business Suite using SQL Server.

Table 2.

Operating system	SQL Server	HP OpenView Storage Data Protector	VERITAS NetBackup	VERITAS Backup Exec	Legato Networker	SAP version	
						4.6C/D	**4.7**
Microsoft Windows® 2000	x		x			x	x
Windows 2003 32-bit	x		x			x	x

Note
Cells marked "x" indicate tested configurations. Cells marked "(x)" indicate other configurations that have not yet been fully tested.

Required products

HP StorageWorks Rapid Backup Solution for mySAP Business Suite using SQL Server builds on HP StorageWorks Business Copy. The following products are required:

- The ADAM utility from HP StorageWorks
- Business Copy Replicated TB
- HP StorageWorks Business Copy license for the storage system to be used
- For Windows-based system:
    - HP StorageWorks Secure Path 4.0B for Windows 2000 and Windows 2003 or later
    - Windows 2000 and Windows 2003 Professional Resource Kit

For more information

HP SAP alliance
http://www.hp.com/go/sap

HP network storage solutions
http://www.hp.com/go/storage

HP StorageWorks Enterprise Backup Solution—Overview and features
http://www.hp.com/go/ebs

HP white papers
http://www.compaq.com/storage/whitepapers.html - soft
http://h18006.www1.hp.com/storage/arraywhitepapers.html

Procedures for booting Windows from a SAN
http://www.compaq.com/support/storage/open_vendor/support/RAIDarray/boot_support_external_web.html

HP support—reference library—customer advisories for the EVA
http://h71025.www7.hp.com/support/reference_library/viewreferencelibrary.asp?countrycode=1000&catid=2058&famid=2184&prodid=2185|Enterprise+Virtual+Array

Storage virtualization and the EVA
ftp://ftp.compaq.com/pub/products/storageworks/whitepapers/Storage_VirtualizationWP.pdf

Wwidmgr, firmware user manuals
ftp://ftp.digital.com/pub/Digital/Alpha/firmware

HP SAN product support, design reference guides
ftp://ftp.compaq.com/pub/products/storageworks/techdoc/san

Connecting single HBA servers to the EVA without multi-path software
ftp://ftp.compaq.com/pub/products/storageworks/whitepapers/SingleHBAforEVA_F.pdf

SPC benchmark 1 executive summary
http://www.storageperformance.org/Results/SPC-1/HP-EVA2C12D_2002-12-06/hp_EVA2C12D_ExecSummary_2002-12-06A.pdf

Microsoft links

http://www.microsoft.com/

SAP links

http://www.hp.com/go/sap

SAP documentation library
http://help.sap.com/

SAP OSS note 515014 "mySAP Business Suite on the Enterprise Virtual Array"
http://service.sap.com/notes

HP StorageWorks Continuous Access EVA specifications
http://h18006.www1.hp.com/products/storage/software/conaccesseva/specifications.html

Continuous Access EVA
http://h18006.www1.hp.com/products/storage/software/conaccesseva/index.html

HP StorageWorks Continuous Access EVA design reference guide
http://h20000.www2.hp.com/bizsupport/TechSupport/DocumentIndex.jsp?contentType=SupportManual&docIndexId=3124&locale=en_US&prodTypeId=12169&prodSeriesId=316118

HP StorageWorks Enterprise Virtual Array configuration guide for mySAP Business Suite
http://h18006.www1.hp.com/storage/solutionwhitepapers.html