WHITE PAPER

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Compaq Computer Corporation

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Continued

Compaq Recovery Server Solutions for SAP R/3 on Various Database Platforms

EXECUTIVE SUMMARY

Compaq has developed a number of products to minimize downtime for business-critical application servers like those running SAP R/3. Several features like redundant power supply, backup processor, ECC memory, hot-pluggable disks, and disk array fault tolerance make the likelihood of a server failure extremely low. Nevertheless, Compaq keeps working on increasing the availability and dependability of its platforms and has released two new products that further guarantee the reliability of Compaq platforms: Standby Recovery Server and On-Line Recovery Server.

The Compaq Standby Recovery Server offers minimum downtime for customers with SAP R/3 servers where on-site technical expertise is not available. With the Compaq automated switchover process, a second identically configured server becomes the active server and is back on-line in a matter of minutes.
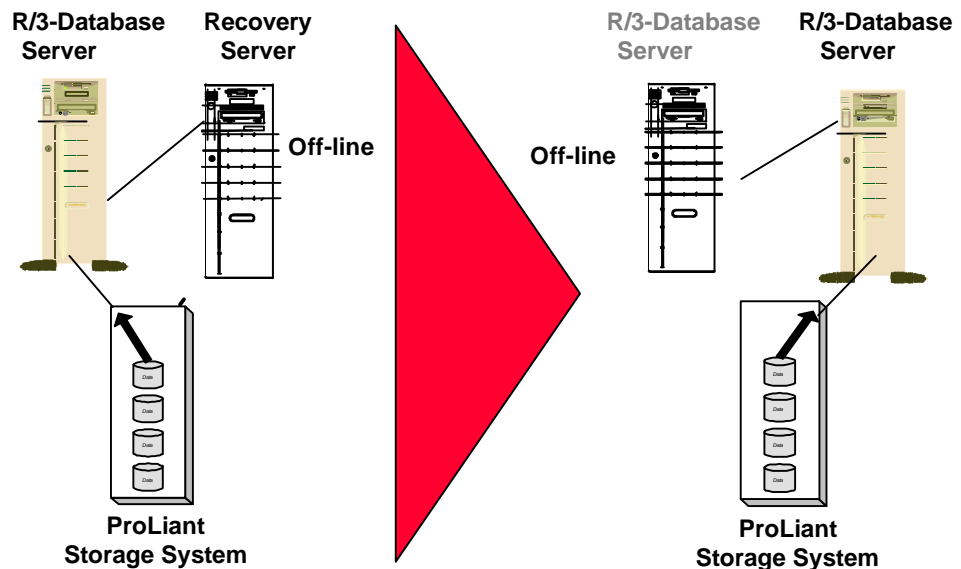
Figure 1. Standby Recovery Server

In the Standby Recovery Server configuration, two Compaq ProLiant servers are attached to a Compaq ProLiant Storage System containing a copy of the Microsoft Windows NT operating system, R/3 application software, database software, and the database itself. If the R/3-Database server fails, the ProLiant Storage System automatically switches to the recovery server. The recovery server then boots, and the system is back on-line in minutes without administrator intervention.

The Compaq On-Line Recovery Server offers a cost-effective means of increasing capacity and availability of business-critical SAP R/3 applications for customers with numerous servers operating in the Windows NT 3.5x environment. This Recovery Server solution pairs two independently operating Compaq ProLiant servers as hot (on-line) partners for each other while maintaining flexibility for multiple server configurations.
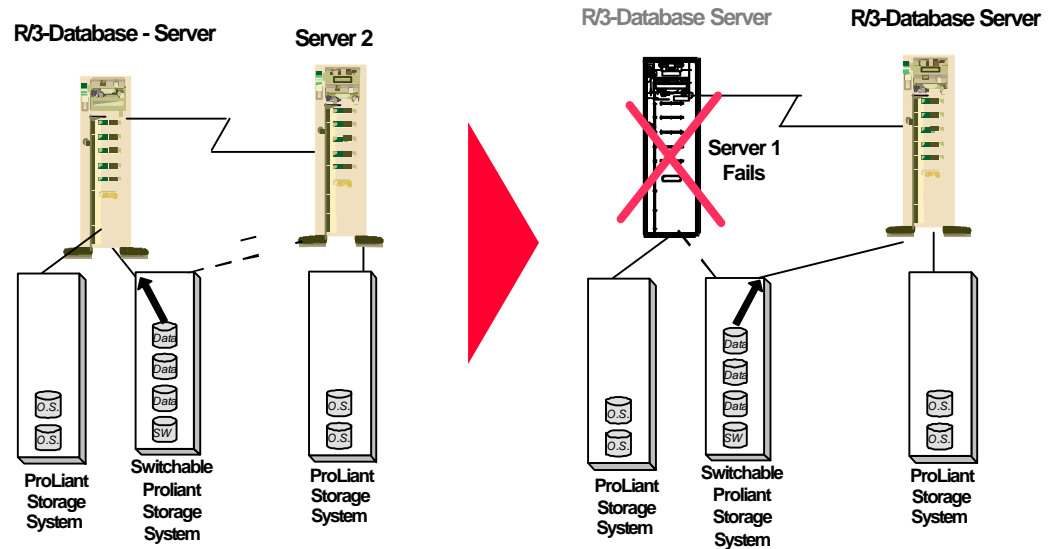
Figure 2. On-Line Recovery Server in an Asymmetrical Configuration

The On-Line Recovery Server allows users from one system to be supported by another system automatically in the event of a failure. The On-Line Recovery Server allows applications to be up and running with minimal interruption, and is designed to work with the comprehensive alert features of Compaq Insight Manager. The On-Line Recovery Server also allows servers to be serviced or replaced easily.

Details associated with operating environment, application software, and existing hardware should be examined before making final decisions to deploy the Recovery Server solutions. This white paper focuses on configuration and implementation aspects that are specific to SAP R/3 platforms.

The solutions described in this white paper are available for Microsoft SQL Server 6.5 , Oracle 7.2, and Software AG ADABAS/D 6.1.1.

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Compaq Recovery Server Solutions for SAP R/3 on various platforms

INTRODUCTION

The purpose of this White Paper is to help customers implement Compaq Recovery Server solutions in an environment using SAP R/3 with its related database platform. This White Paper addresses the process for:

- Setting-up the platforms for either Compaq Standby Recover Server or Compaq On-Line Recovery Server

- Configuration specifications necessary for SAP R/3

- Using the database to be implemented in a recovery mode

This White Paper includes information extracted from other Compaq White Papers and technical documentation. The level of detail in this White Paper should explain the technical concepts fully and provide information on implementing the concepts in practical situations. You can find additional details in the following Compaq White Papers:

Compaq Standby Recovery Server (document number 180B/0495)

Compaq On-Line Recovery Server (document number 043A/1095)

You can also find details in the *Recovery Server Option User Guide* (part number 213818-002), which comes with the Recovery Server Option Kit and is also available as an independent product.

The majority of this White Paper discusses the On-Line Recovery Server implementation. Because the Standby Recovery Server solution is application-independent, SAP R/3 requires no special or specific configuration changes. The On-Line Recovery Server solution requires specific configuration and implementation processes to automatically start up the database and the SAP R/3 instance on the recovery server. This process of starting the database and R/3 is illustrated by means of script files, which are platform-specific and must be adapted to the particular configuration of each platform.

The modular, distributed architecture of SAP R/3 makes it suitable for either of the Compaq Recovery Server solutions. Due to the sophistication of this architecture, and the critical nature of a R/3 system, the recovery procedures must be fully compliant with the specifications for recovery software provided by the *SAP High Availability Guide*. This document describes methods and techniques that have been tested as specified in that guide.

COMPAQ RECOVERY SERVER SOLUTIONS OVERVIEW

In the Standby Recovery Server configuration, one server functions as the primary server and another server functions as a hot standby recovery server that remains idle until a there is a switchover. All disk storage is external to both servers. The disk storage switches from the primary server to the recovery server when a fault is detected via the Compaq Recovery Server Switch. The Recovery Server Switch is an electrically controlled SCSI switch that allows selected storage devices to be switched dynamically from the failed server to the surviving server.

The On-Line Recovery Server configuration pairs an independently operating Compaq server as an automatic, hot standby for the primary server. If the primary server fails, the ProLiant Storage System(s) attached to the failed server will be automatically switched over to the surviving server via the Compaq Recovery Server Switch.

Table 1 summarizes the differences between the two recovery server configurations.

TABLE 1
COMPARISON OF STANDBY AND ON-LINE CONFIGURATION

Standby	On-Line
Single network identity. Only the primary server is active on the network.	Two network identities. The primary on recovery server are active servers on the network.
Single active server.	Two active servers.
Switchover restores operating system and applications.	Switchover restores only switched disks. Operating system is stored and runs of on local disks.
Benefits all applications.	Benefits specific application(s).
No local disks.	Local disk (to contain at least the operating system) required along with switched disks.

SAP R/3 AND RECOVERY SERVER SOLUTIONS IMPLEMENTATION CONSIDERATIONS

A typical R/3 platform consists of one database server and a variable number of application servers, depending on the processing requirements imposed by the workload. SAP R/3 services are distributed among these servers according to processing requirements imposed by the user workload. Some of these services can have several instances running on different servers, but others must run just once on a certain server in the configuration. These are single points of failure of a R/3 system.

To minimize unplanned R/3 system downtime, all single points of failure in a system should be secured. A single point of failure can be defined as a component that will lead to (severe) service loss in case of failure.

Table 2 shows the services offered by the R/3 system. Single points of failure appear in italics and are underlined.

TABLE 2
R3 SERVICES

Service	Number of Instances
DBMS	*1 per R/3 System*
Dispatcher	1 per App-Server
Dialog service	1 ... n per App-Server
Update service	0 ... n per App-Server
Enqueue service	*1 per R/3 System*
Batch service	0 ... n per App-Server
Message service	*1 per R/3 System*
Gateway service	1 per R/3 Instance
Spool service	1 per App-Server

If only one single point of failure is protected, some R/3 services will still be left unprotected. If one of the remaining single points of failure subsequently fails, the R/3 system will be unavailable (until R/3 has been reconfigured and restarted). It is therefore recommended to concentrate all single points of failure on a server that is protected by one of the Compaq Recovery Server solutions.

The database server, also running the enqueue and message services, as well as sapcomm and saprouter, is a primary candidate for a recovery server implementation because its availability is crucial to the functioning of the whole R/3 system. If an R/3 application server fails, users are still able to work because they can reconnect to a dialog instance running on a different application server or on the database server. Furthermore in such a case, the reconnection could be automatically provided by the R/3 load balancing mechanism.

STANDBY RECOVERY SERVER TECHNOLOGY

The Standby Recovery Server solution automatically switches all shared disk storage from a failed R/3-Database server to a standby recovery server that is waiting to boot the Windows NT operating system and re-establish access to database files that are stored on the shared drives. When a switchover occurs, the recovery server electrically switches all of the disk storage from the primary server to the disk controller contained in the recovery server. When the switchover is complete, the recovery server begins a normal operating system boot sequence using the same disks that were previously attached to the primary server.

The primary and recovery server systems are not required to be identical. However, there are configurations guidelines that must be met in order for the Standby Recover Server configuration to function properly. Although, Compaq recommends that the two servers be identical.

Both the primary server and recovery server are connected by a SCSI cable to a Compaq ProLiant Storage System, which holds a single copy of the Windows NT operating system, R/3 application software, database executables, and the database.

The Recovery Server Switch, an electrically controlled SCSI switch, must be installed in each switchable Compaq ProLiant Storage System. This Recovery Server Switch actually accomplishes the electrical switching of the disk storage that has a SCSI cable connection to the primary and recovery servers. All disk storage in Standby Recovery Server configurations must be contained in external ProLiant Storage Systems that have had the Recovery Server Switch installed. No disks can be installed internal to the Compaq server. No disks can be attached to the integrated SCSI controller of the Compaq server. The integrated SCSI controller can however be used for CD-ROM drives and tape drives.

The primary and recovery servers are physically linked as shown in Figure 3 by the Recovery Server Interconnect, a RS-232 serial cable with specific pinout connections required for the Standby Recovery Server solution. The Recovery Server Interconnect is required for proper operation.

NOTE: The Standby Recovery Server solution will NOT function with other serial cables such as null modem cables.

The primary and recovery server's hardware configuration should be identical down to the slot number of each controller board. Theoretically the servers could differ in memory and CPU configuration as these are dynamically determined by the Windows NT operating system during the boot process. However, Compaq strongly recommends that the primary and recovery servers have identical hardware configurations.

Each server contains at least one SMART SCSI Array Controller or SMART-2 SCSI Array Controller. SMART and SMART-2 Array Controllers can only be attached to disk drives that are contained in external ProLiant Storage Systems that have the Recovery Server Switch installed. Corresponding array controllers in primary and recovery servers that are connected to the same ProLiant Storage System MUST be of the same type - either both SMART Array Controllers or both SMART-2 Array Controllers. Corresponding array controllers in the primary and recovery servers MUST have the same slot placement in each system.

Each server's network interface controller (NIC) must be identical in type, slot placement, and configuration. Integrated NICs can only be used if they are identical between the primary and recovery servers. Otherwise, the integrated NIC must be disabled and identical NICs must be installed in the same expansion slot number and identically configured in each server.

The Recovery Server Option Driver must be installed on the Windows NT Server configured as the primary server. The Standby Recovery Server failure detection mechanism is based on the Recovery Server Option Driver running on the primary server. As long as the recovery server receives the heartbeat message within the time-out interval, it assumes that the primary server has not failed. Any failure in the primary server that stops the Recovery Server Option Driver from generating the periodic heartbeat message will be a detectable failure. The Recovery Server Option Driver can be obtained from the Compaq Support Software Diskette for Microsoft Windows NT (Windows NT SSD).

Normal Operation

Figure 3 illustrates normal operation of Standby Recovery Server. Both the primary and recovery servers are attached to the same network. The primary R/3-Database server supports users attached to it via the network and the standby recovery server is idle.

Under normal operation, as soon as the recovery server has completed its power-on self test (POST) sequence, it executes the Compaq Recovery Agent contained in the system ROM BIOS. The Recovery Agent monitors a periodic "heartbeat message" transmitted by the Recovery Server Option Driver to the recovery server via the Recovery Server Interconnect. At this point, no operating system is loaded on the recovery server. Thus, the standby recovery server is electronically attached to the network but is not accessible via the network. Its only function is to wait for the R/3-Database server to fail.

The receipt of the heartbeat message within a configured time-out period indicates that the R/3-Database server is functioning properly. The recovery server responds to each heartbeat with an acknowledgment message across the serial connection. As long as the recovery server continues to receive heartbeats according to schedule, it remains in the idle mode.

The Recovery Server Option is an extension of the Automatic Server Recovery (ASR) functions currently supported in Compaq ProLiant servers. See the Compaq Hardware documentation that came with the server for more information about ASR.
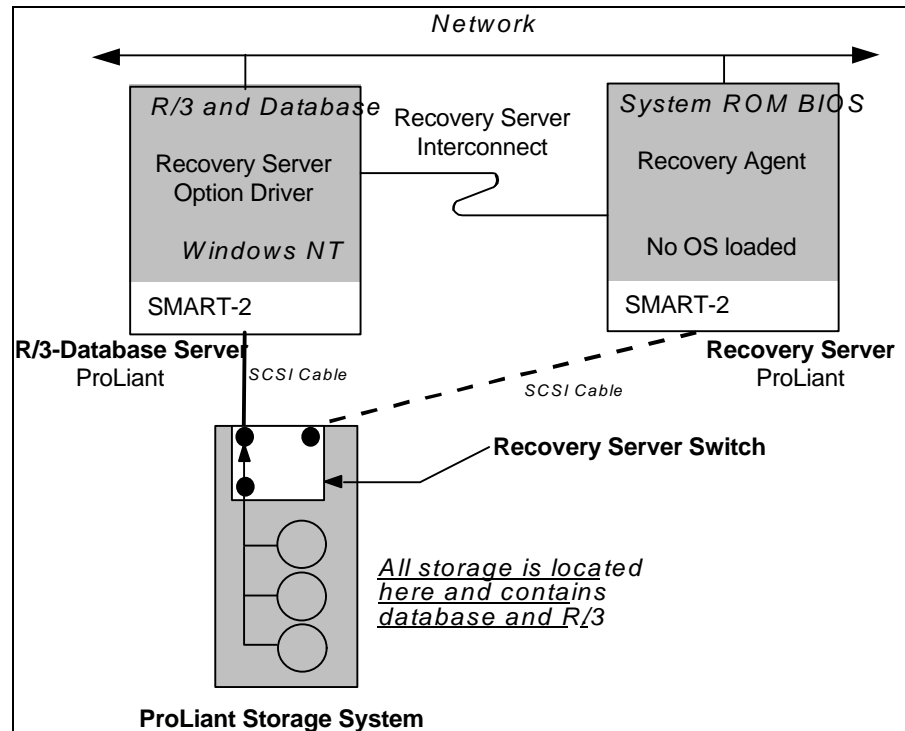
Figure 3. Standby Recovery Server—Normal Operation

Switchover Events

Switchover from the R/3-Database primary server to the standby recovery server occurs when the R/3-Database server fails. If the recovery server does not receive a heartbeat message within the time-out value set by the system configuration utility, the recovery server presumes that the R/3- Database server has failed. (Loss of the heartbeat message could occur either because the R/3- Database server has failed or because the connection of the Recovery Server Interconnect cable has been broken.)

The switchover events occur as follows:

1. The Compaq Recovery Agent in the system ROM BIOS sends commands over the SCSI bus to the Recovery Server Switch installed in the common set of ProLiant Storage Systems. These commands cause the switch to disconnect the storage drives electrically from the primary R/3-Database server and then to connect them electrically to the standby recovery server.

2. The standby recovery server proceeds through a normal boot sequence using the disk storage that was previously attached to the R/3-Database server.

3. Because the servers are identically configured, when the boot process is completed, the recovery server assumes the logical network identity that was previously held by the primary R/3-Database server.

4. The Application Server R/3 instances are restarted.

5. At this point, after restarting the database and R/3, the users can log on to R/3.

With the Compaq automated switchover process, the recovery server becomes the active server and is back on-line in a matter of minutes, without administrator intervention.

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Figure 4 illustrates a standby recovery server configuration after the switchover has occurred. The recovery server has assumed the function of the R/3-Database server. The R/3-Database server has completed an ASR reboot and is waiting to be serviced. The effects of server failure and switchover on clients are discussed later in this paper, in the section entitled "Client Behavior." See the Compaq Hardware documentation that came with the server for more information about the ASR reboot.

If power is lost to both servers in a Standby Recovery Server configuration, the R/3-Database server will *not* boot in an unattended manner when the power is restored. An external power failure of this type will be recorded in the R/3-Database server NVRAM as a server failure requiring service, not as a power outage. Thus, when the R/3-Database server is powered on, the administrator is prompted to run diagnostics or to press **F8** to continue a normal boot sequence. This illustrates the importance of an uninterruptible power supply.

If the system is unattended when the power is restored, the recovery server times out, switches the storage disks, and boots from the disks because the R/3-Database server is not sending the heartbeat message to the standby server.
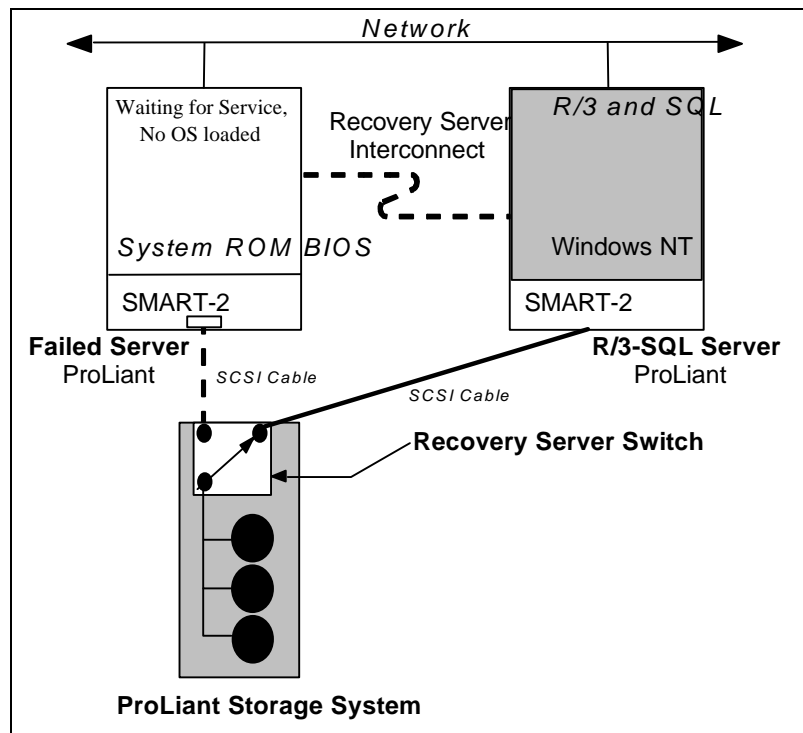
Figure 4. Standby Recovery Server—After Switchover

Switchover Time

The Standby Recovery Server is designed for business-critical servers that cannot sustain periods of downtime exceeding several minutes. The time required for the recovery server to assume the function of the R/3-Database server is the sum of the following six factors:

1. The time that elapses from the moment at which a failure occurs in the primary processor to the moment at which that failure manifests itself in the loss of a heartbeat message. This time period may be very short (a few seconds) in the case of catastrophic failures such as loss of the processor, or it may be relatively long (several minutes) in the case of certain software failures.

2. The defined time-out period that the Recovery Agent in the system ROM BIOS waits for a heartbeat message before initiating a switchover is the ASR time-out value. It is set in the system configuration with a default value of 10 minutes. Available values range from 5 to 30 minutes.

3. Once a switchover has been initiated, the time required to initialize the SMART Controllers and begin the Windows NT operating system boot process from the drives, which by this time are electrically connected to the recovery server. This is typically between 2 and 4 minutes.

4. The time required for the Windows NT operating system to boot. This is dependent upon the size and number of disk drives that are attached, but is usually accomplished within 3 minutes.

5. The time required for the database to start and recover from the previous failure once the Windows NT operating system is active and the time required for R/3 to start and be available to users. This phase depends on the length of the database recovery period, which is difficult to predict, but generally takes less than 5 minutes.

6. The time for the users to login.

Faults

Many factors affect server operation. In the Standby Recovery Server configuration, several types of faults can occur such as the following:

- Failures of the R/3-Database server, the types of faults for which the Recovery Server Option was designed

- Loss of heartbeat resulting from serial cable problems, not from server problems

- Failures that affect operation of the R/3-Database server but do not cause a switchover

Failure Detection

The failure detection mechanism in the Standby Recovery Server is based on the Recovery Server Option Driver software that runs in the R/3-Database server. As long as the recovery server receives the heartbeat message within the time-out period, it presumes that the R/3-Database server has not failed. Any failure in the R/3-Database server that stops the Recovery Server Option Driver from generating the periodic heartbeat message will be a detectable failure. Examples of detectable failures include:

- Catastrophic and unrecoverable hardware failure in the R/3-Database server such as loss of the processor or uncorrectable memory errors

- Loss of the R/3-Database server power supply

Generally, any failure that is detected by ASR will be detected and acted upon by the recovery server.

NOTE: There is a class of failures that causes the R/3-Database server to malfunction without causing loss of the heartbeat message. For example, failure of the Network Interface Controller could render the R/3-Database server unusable, but the Recovery Server Option Driver would still send the heartbeat message to the recovery server. Failures of this type cannot be detected by the recovery server; therefore, an automatic switchover will not occur. Generally, the failures detected by the recovery server are the same ones that are detected by the ASR mechanism.

Potential Interconnect Failures

The Recovery Server Interconnect can experience three types of failures. These failures and the behavior they cause are described as follows.

NOTE: This discussion assumes that Compaq Insight Manager is being used.

- R/3-Database Server Cable Failure

    If the Recovery Server Interconnect is disconnected from the R/3-Database server, the recovery server cannot receive the heartbeat message. The Recovery Server Option Driver in the R/3-Database server can detect this condition. It sends an Insight Manager alarm indicating that the R/3-Database server has detected a cable fault and that it is shutting down the Windows NT operating system in anticipation of the switchover that will occur because the recovery server is no longer receiving the heartbeat message.

- Recovery Server Cable Failure

    If the Recovery Server Interconnect is disconnected from the recovery server, the recovery server detects this condition and does not attribute loss of the heartbeat message to failure of the R/3-Database server. Because the R/3-Database server can no longer receive the acknowledgment message from the recovery server, however, the R/3-Database server sends an Insight Manager alarm indicating possible failure of the recovery server.

- Damaged Cable

    If the Recovery Server Interconnect is physically cut, the heartbeat message and the acknowledgment message cannot travel between the R/3-Database server and the recovery server. Loss of the acknowledgment message causes the R/3-Database server to send an Insight Manager alarm indicating possible failure of the recovery server. Meanwhile, loss of the heartbeat message for longer than the time-out period causes the recovery server to switch the storage disks from the R/3-Database server to the recovery server and then boot.

Upon failure, the R/3-Database server normally becomes totally inactive. In the case of a damaged cable, however, the R/3-Database server continues running after its connection to the storage disks has been lost and the recovery server has booted. The Windows NT operating system on the R/3-Database server can no longer function correctly, but the network protocol portion of the Windows NT operating system is still active.

When the recovery server boots, it presents the same network identification as that used by the original R/3-Database server. As a result, network clients might not be able to log in to the server because both the primary and recovery servers are using the same network identification.

This type of failure is unlikely and is preventable with simple precautionary steps to protect the serial cable and its connections. Screw the serial cable down securely; and for maximum cable protection, rack mount the servers.

Servicing the Failed Server

To re-establish Standby Recovery Server operation after a switchover, a failed R/3-Database server must be repaired or replaced and brought back on-line. The Standby Recovery Server makes it possible for the system administrator to schedule service on the R/3-Database server at a convenient time while the recovery server is active. The R/3-Database server hardware can be serviced on site or off site.

Once a switchover occurs, no drives are electrically attached to the disk controllers in the R/3-Database server For this reason, there might be some constraints on diagnostic activities that can be performed on the failed R/3-Database server on site. However, by disconnecting the R/3-Database server from the Recovery Server Interconnect and adding other drives to the R/3-Database server, full on-site diagnosis can be performed on the failed R/3-Database server while the recovery server is running, The failed R/3-Database server can also be disconnected from the recovery server and the ProLiant Storage System and moved off site for service.

Restoring the Configuration After Switchover

After the R/3-Database server has been serviced or replaced, restore the original configuration. The recovery server and ProLiant Storage Systems must be power cycled to reinitialize the Recovery Server Switch. The disk drives will be electrically connected to the original R/3-Database server and it will boot the Windows NT operating system. The recovery server will return to its role of listening for the heartbeat message from the R/3-Database server.

After setting up and configuring both the primary and recovery servers, verify that both servers operate correctly and will switch over when needed.

Client Behavior

When a failure of the R/3-Database server occurs, users attached to it experience a service outage. The length of this outage is described previously in section "Switchover Time." The symptoms experienced by the users vary depending on whether their dialog instance was on the R/3-Database server or on a dedicated application server. In the former case, an error message displays, communicating to the user that the application server has been shutdown. In the latter case, the SAPGUI will become unresponsive.

Disk Subsystem Considerations

The following sections discuss disk subsystem considerations, which include disk integrity, disk volume configuration for Windows NT, and performance considerations.

Disk Integrity

Failure of the R/3-Database server can be caused by several different conditions ranging from software faults in the Windows NT operating system to hardware failure. Depending on the nature of the fault and the disk activities occurring at the time of the fault, the disk data structures can be corrupted and might require corrective processing before the recovery server boots the Windows NT operating system. In Microsoft Windows NT 3.5x, the disk integrity check and corrective processing are performed automatically.

Disk Volume Configuration for Windows NT 3.5X

Compaq recommends that the NTFS file system be used for all Windows NT disk partitions. Additionally, Compaq recommends that the Windows NT system disk and other executables be placed on a separate SMART or SMART-2 controller logical drive. Use other logical drives to store data.

Performance Considerations

In a Standby Recovery Server configuration, the Array Accelerator, which serves as a read/write cache for I/O requests directed to the SMART or SMART-2 Array Controller, must be disabled when using a SMART controller or changed to 100% read cache when using a SMART-2 controller.

For the SMART controller, the Compaq System Configuration Utility automatically disables the Array Accelerator when the SMART controller is attached to switchable disks in a Standby Recovery Server configuration. For the SMART-2 controller, the Compaq Array Configuration Utility automatically changes the Array Accelerator to 100% read cache when the SMART-2 controller is attached to switchable disks in a Standby Recovery Server configuration.

The system performance impact of changing the Array Accelerator configuration is determined by the interaction of the controllers with software and other hardware in the system and by tuning of the system. As a result, the performance of the overall system(s) needs to be considered to determine if adjustments are required to compensate for this factor. In certain cases, changing the Array Accelerator configuration will degrade system(s) performance.

For example, the database might be tuned so that it is processor constrained and not I/O constrained. In this case, enabling or disabling the SMART Controller Array Accelerator would have little effect on overall system performance. However, an I/O-constrained system, disabling the Array Accelerator would lower the system performance. In all cases, system performance should be considered when planning for a Standby Recovery Server configuration

SETTING UP A STANDBY RECOVERY SERVER

The following sections discuss setting up a Standby Recovery Server, which include information on system configuration, testing the configuration, and R/3- Database specific settings.

System Configuration

The primary and the recovery server must have identical hardware configurations, including identical slot locations of all controller boards. Anytime there is a change to both the primary and the recovery server, you must run the Compaq System Configuration Utility on each system.

NOTE: When configuring the SMART controller that is connected to the Recovery Server Switch, set the Array Accelerator Status to Disabled on both the primary server and the recovery server. When configuring the SMART-2 controller that is connected to the Recovery Server Switch, set the Array Accelerator to 100% read cache on both the primary server and the recovery server. Failure to properly configure the Array Accelerators could result in the disk drives attached to the controller becoming corrupted after returning to the primary server from the recovery server.

When configuring the recovery server, be sure to set the ASR time-out value higher than the total time required for the primary server to boot and become operational.

A finite amount of time is required for the primary server to boot from the operating system and become operational. If the Automatic Server Recovery (ASR) time-out value is set for less than that amount of time, then the recovery server times out and triggers a switchover, even though no server failure has occurred.

If the original, verified system configuration is changed, it is necessary to reconfigure the system and to verify that the new configuration is correct. For example, if you add a disk drive, you must reconfigure the system.

To reconfigure the system, follow these steps:

1. Shut down the application software and operating system on the primary server.

2. Turn off the primary server.

3. Turn off the recovery server.

4. Turn off the ProLiant Storage System(s).

5. Make the hardware changes: Add or remove disks, add or remove adapter cards, etc.

6. Power on the ProLiant Storage System(s).

7. Power on the primary server.

8. Run the System Configuration Utility to configure the primary server if necessary. If using a SMART Controller, ensure that the Array Accelerators are disabled. If using a SMART-2 Controller, ensure that the Array Accelerators are set to 100% read cache.

   NOTE: If you are using a SMART-2 Controller and you have made changes to the disk configuration, you will need to run the Compaq Array Configuration Utility to configure the Array Accelerator setting.

9. Verify that the application software and the operating system are functioning correctly.

10. Shut down the application software and the operating system on the primary server.

11. Turn off the primary server.

12. Turn on the recovery server.

13. Press the **F8** key on the recovery server to switch the storage disks manually to the recovery server.

14. Run the System Configuration Utility to configure the recovery server if necessary. Verify that all SMART Controller Array Accelerators are disabled. Verify that all SMART-2 Controller Array Accelerators are set to 100% read cache.

    NOTE: If you are using a SMART-2 Controller and you have made changes to the disk configuration, you will need to run the Compaq Array Configuration Utility to configure the Array Accelerator setting.

15. Verify that the application software and the operating system are functioning correctly.

16. Shut down the application software and the operating system on the recovery server.

17. Turn off the recovery server.

18. Turn off the ProLiant Storage System(s).

19. Turn on the ProLiant Storage System(s).

20. Turn on the primary server.

21. Turn on the recovery server.

22. The primary server should boot. The recovery server should begin monitoring the primary server.

23. Test the configuration to verify that it will switch over properly to the recovery server.

Testing the Configuration

Once you have set up and configured both the primary and recovery servers, you must verify that both servers operate correctly and will switchover when needed. You can use two methods to perform a switchover test, which are:

- Recommended Switchover Test

- Alternate Switchover Test

Recommended Switchover Test Method

Compaq recommends testing a configuration by powering down the primary server while the operating system is running. This allows the recovery server to detect that the primary server is not available, to switch access to the storage disks from the primary server to the recovery server, and to boot the operating system on the recovery server.

To perform this test, turn off the primary server while it is active with the operating system and applications. After the recovery server ASR time-out period expires, the recovery server switches the storage system(s) from the primary to the recovery server. The recovery server then boots from the storage disks. This test verifies the configuration and demonstrates the effect of the failure and switchover event.

Alternate Switchover Test Method

You can also perform a manual switchover from the primary server to the recovery server.

To perform this test, follow these steps:

1. Shut down the operating system and power off the system on the primary server.

2. Press the **F8** key while this message displays on the recovery server:

    > Press F8 to switch now.

3. Press the **Y** key to confirm your selection on the recovery server.

After a brief period, the recovery server boots the operating system and assumes the role of the primary server. If the recovery server does not boot, check your configuration and repeat the test.

R/3 Software Specific Settings

Because of the application-independence of this solution, no special SAP R/3 Database specific configuration is required. Of course the surviving application server has to stop and start their SAP application services to bind to the physical different machine. However, ensure that R/3 and the database automatically start at boot time so that after a switchover no intervention is required. You can ensure this by developing a script to perform the necessary tasks and installing it as a service with Automatic startup. You can set this up with a Microsoft Windows NT Resource Kit tool called SRVANY.

The following steps describe the installation procedure:

1. Copy *SRVANY.EXE* to your system and install it as a Windows NT service with a meaningful name, for example:

    INSTSRV R3UP c:\reskit35\srvany.exe

2. Configure as automatic via the Services applet ("Startup..." dialog) of the Control Panel.

3. Set the account for the service (the SAP administrator) via the Services applet ("Startup..." dialog) of the Control Panel.

4. Run the Registry Editor (*REGEDT32.EXE*):

    a) Create a "Parameters" key under the following:
        KEY_LOCAL_MACHINE\SYSTEM\CURRENTCONTROLSET\SERVICES\R3UP

    b) Under the Parameters key, create an "Application" value of type REG_SZ and specify there the full path of your application executable (including the extension). For example:

        Application: REG_SZ: C:\WINNT35\SYSTEM32\R3UP.BAT

The R/3 and database startup scripts could be similar to the following:

```
echo off
cls
rem Windows NT Resource Kit must be installed on all servers
REM Stopping the R/3 Instance on other application servers
d:\usr\sap\cpq\sys\exe\run\sapsrvkill CPQAPP2_CPQ_05
........
rem CHANGE DIRECTORY AND SERVICE NAMES ACCORDING TO YOUR
CONFIGURATION
rem Add  one pair of lines similar to the following per application server
netsvc SAPOsCol \\CPQAPP /start 2>&1 > c:\users\cpqadm\r3up.log
netsvc SAPCPQ_05 \\CPQAPP /start 2>&1 > c:\users\cpqadm\r3up.log

rem Starting SAP R/3 on DB server
rem CHANGE PATHS AND PROFILE NAMES ACCORDING TO YOUR CONFIGURATION
d:\usr\sap\CPQ\sys\exe\run\sapstart pf=d:\usr\sap\CPQ\sys\profile\START_DVEBMGS00 2>&1
>> c:\users\cpqadm\r3up.log

rem Starting SAP R/3 on App. servers.
rem CHANGE PATHS AND PROFILE NAMES ACCORDING TO YOUR CONFIGURATION
d:\usr\sap\CPQ\sys\exe\run\sapstart pf=d:\usr\sap\CPQ\sys\profile\CPQ_D05
SAPDIAHOST=CPQAPP 2>&1 >> c:\users\cpqadm\r3up.log
exit
```

Sample Automatic Start-Up Command File: R3UP.BAT

NOTE: Two licenses need to be ordered for the SAP R/3 system, since the license key is issued for a specific customer key. The customer key is based on information specific to the server where "saplicense - get" is executed.

ON-LINE RECOVERY SERVER TECHNOLOGY

The On-Line Recovery Server configuration pairs two independently operating Compaq ProLiant Servers as automatic, hot standbys for each other. The two active servers are interconnected via the Recovery Server Interconnect cable so that ProLiant Storage Systems attached to either server remain accessible to clients even if one server fails.   The Recovery Server Interconnect is a RS-232 serial cable with specific pinout connections required for the On-Line Recovery Server solution. The Recovery Server Interconnect is required for the proper operation of the On-Line Recovery Server solution. The solution will NOT function with other serial cables such as null modem cables.

The Recovery Server Option Driver must be installed on the Windows NT Servers configured in the On-Line Recovery Server partnership. The failure detection mechanism is based on the Recovery Server Option Driver running on the servers. As long as the recovery server receives the heartbeat message within the time-out interval, it assumes that the primary server has not failed. Any failure in the primary server that stops the Recovery Server Option Driver from generating the periodic heartbeat message will be a detectable failure. The Recovery Server Option Driver can be obtained from the Compaq Support Software Diskette for Microsoft Windows NT (Windows NT SSD).

If one server fails, the ProLiant Storage System(s) attached to the failed server automatically switches over to the surviving server via the Recovery Server Switch—without administrator intervention. The Recovery Server Switch is an electrically controlled SCSI switch that must be installed in each switchable Compaq ProLiant Storage System.

When the switchover of the shared drives occurs, the operating system on the surviving server need not be restarted. Selected applications running on the surviving server are notified of the switchover. As a result, clients of the failed server can quickly regain access to their data and programs from the surviving server.

NOTE: A variety of configurations are possible with the On-Line Recovery Server. The configuration which Compaq recommends in SAP R/3 environments is the "asymmetrical configuration." In this configuration, switchover only takes place in one direction, from the R/3 database server to another server.

Because all configurations work in a similar fashion, the easiest way to understand how the On-Line Recovery Server works is to look at an example. Figure 6 illustrates a pre-switchover asymmetrical configuration in which only one of the paired servers has switchable external storage. The servers switch in only one direction. The primary and recovery controllers are standard SMART Controllers which perform the specified roles.
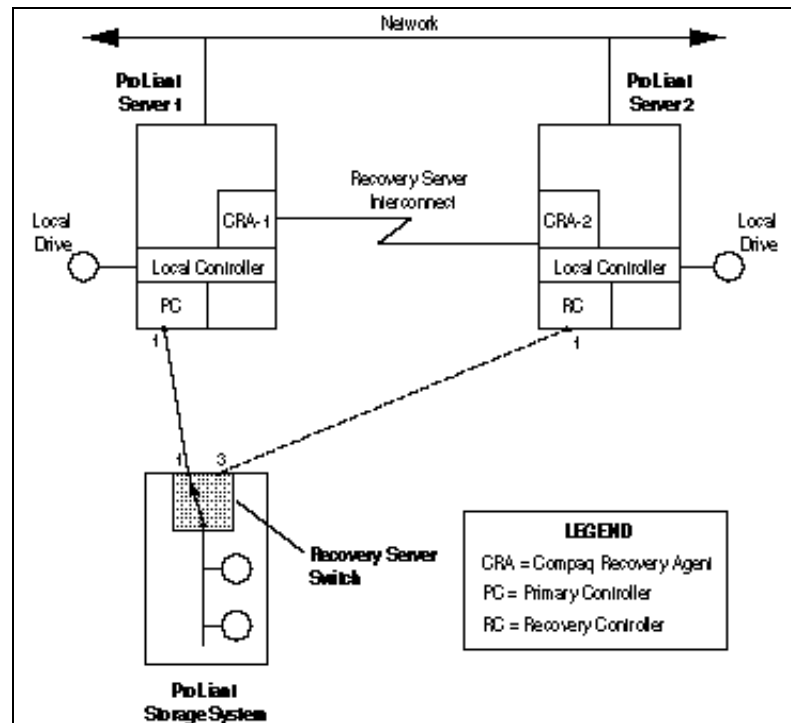
Figure 6. NormalOperation of an Asymmetrical Configuration Before Switchover

Figure 7 illustrates the pair *after* a switchover.
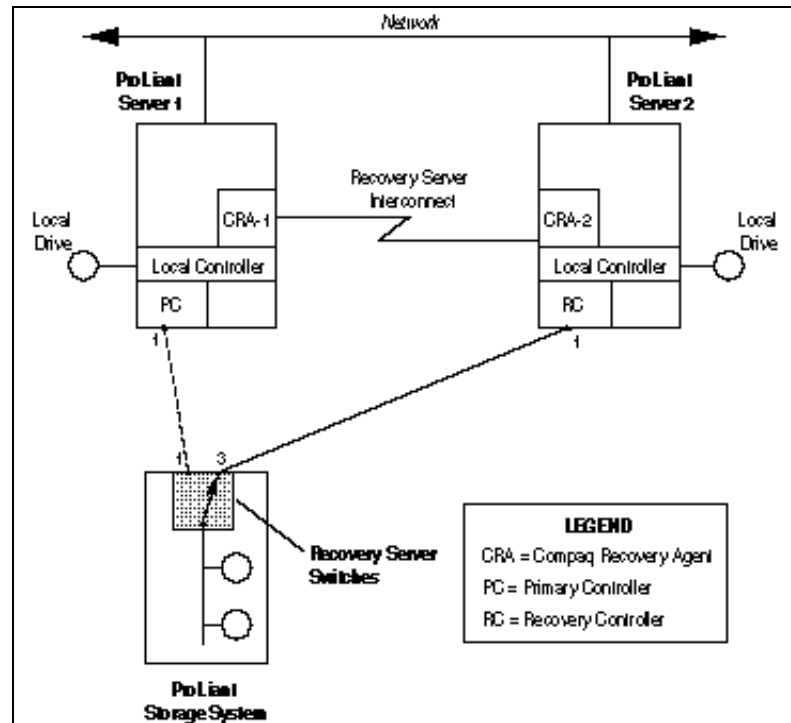
Figure 7.   An Asymmetrical Switchover Configuration

Two things about this configuration are particularly important:

1. The ProLiant Storage System(s) are *not* shared by the two servers. That is, they are not electrically connected to both servers at the same time.

2. A Recovery Server Switchmust be installed in each *switchable* ProLiant Storage System.

IMPORTANT: If the primary controller is a SMART Array Controller, the recovery controller connected to the same ProLiant Storage System must also be a SMART Array Controller. If the primary controller is a SMART-2 Array Controller, the recovery controller connected to the same ProLiant Storage System must also be a SMART-2 Array Controller. SMART and SMART-2 Array Controllers MUST NOT be mixed when connected to the same storage system.

For each SMART Controller involved in switchover in the Primary Server there has to be a corresponding SMART Controller in the Recovery Server.

*   The SMART controller in the Primary Server , called Primary Controller, connects the Primary Server to its own switchable ProLiant Storage System during normal operation. During normal operation. the data flow to/from the switchable ProLiant Storage System takes place via the Primary Controller.

*   The SMART controller in the Recovery Server, called Recovery Controller, is only electrically connected to the switchable ProLiant Storage System AFTER the fail-over has occurred. Now, after the fail-over the data flow to and from the switchable ProLiant Storage System takes place via the Recovery Controller.

Each SMART Controller has two ports for SCSI connectors and can support either one or two ProLiant Storage System(s). For each Primary Controller in the Primary Server there must be an associated Recovery Controller in the paired server. Therefore, if one or both servers in an On-Line Server Pair have more than two switchable ProLiant Storage Systems, you need additional SMART Controllers.

A local controller in one or both paired servers can be a SMART Controller However, this local controller cannot be connected to a switchable ProLiant Storage System. In the On-line Recovery Server configuration SMART controllers have to be exclusively dedicated to switchable ProLiant Storage Systems and their function cannot be split between local storage and switchable storage.

The serial ports of the two paired servers are connected by a Recovery Server Interconnect cable. Each server runs a Compaq Recovery Agent (CRA), software that communicates with its counterpart in the other server via this cable.

To indicate that the server is still on-line and operating normally, the CRA periodically transmits a heartbeat message to the CRA in the paired server. Each CRA listens for heartbeats from the other server. If it receives the expected heartbeat, the CRA transmits an acknowledgment message to the other CRA. If the expected heartbeat is not received within the time-out interval defined in the System configuration, the CRA presumes that the other server has failed and initiates a switchover.

An LED indicator located on the back of each ProLiant Storage System indicates if a switchover has occurred. During normal operation the LED glows green. It changes to amber if the storage system is switched over to the other server.

SAP R/3 IMPLEMENTATION CONSIDERATIONS FOR ON-LINE RECOVERY SERVER

When a site has more than one server, either because the R/3 platform is distributed or because there are other Compaq servers, it could be possible to set up one of them as the On-Line Recovery Server for the database or R/3 server. It should be carefully considered whether the availability of the candidate Recovery Server is guaranteed. It might happen that a test server that plays the role of Recovery Server is temporarily out of order because of a running test. If the Primary Server fails at that time, the switchover would not take place and R/3 would not be restarted and made available to users. Besides, a test server is very likely to have a different operating system version, which might make the switchover not work. Therefore Compaq recommends not to use a test server as a recovery server. The wisest choice would be to configure one of the application servers as Recovery Servers. Application servers are normally available and not used for purposes other than running the R/3 system. In these scenarios, it is also possible to dedicate an additional server exclusively as a Standby or On-Line Recovery Server.

The configuration of the On-Line Recovery Server has a number of implications which must be considered before implementing the solution, which are:

• Disk Layout of the R/3- Database Server
  The SAP and used database software, as well as the database owned data and log files, should be located in partitions on disks in external storage cabinets so that they can be switched over after a server failure. The Windows NT operating system should be on an independent disk or logical volume that could be either internal or external, but not switchable. Although On-line Recovery Server supports drive letter change after a switchover, it is desirable for the sake of simplicity, to avoid such a situation by making sure that letters assigned to the recovery server drives do not match those of the switchable drives of the primary server.

• Processing Requirements
  If the recovery server has less processing power than the R/3-Database server, the recovery server could not support the same load and number of users. The situation would be even worse if the recovery server must still perform its normal role. Compaq recommends configuring the recovery server with at least the same number and types of processors, and suspending its normal role while it functions as an R/3-Database server. Alternatively, because the switchover is a momentary situation, users might be willing to accept a certain amount of performance degradation. In this case alternative profiles for the R/3 instance should be prepared according to the less powerful configuration of the recovery server.

• Memory Capacity
  After the switchover occurs, the recovery server supports the database instance (with all related services) and the R/3 instance. This requires as much memory as there was before on the failed R/3-Database server if the performance level is to be maintained.

• Page File Size
  As a result of the previous point, the page file(s) of the recovery server should be large enough to accommodate the paging needs of the database and R/3.

• Backup Devices
  Typically, the R/3-Database server has the necessary backup devices to back up its own disks and those of the other server(s). The recovery server might be equipped with some backup devices to allow it to perform incremental backups while the R/3-Database server is down.

- Primary Domain Controller Setup
  Compaq does *not* recommend setting up the R/3-Database server as a Primary Domain Controller, because it would take CPU cycles away from its main activity. If it is, then the Recovery Server or any other server in the network should be configured as a Backup Domain Controller. That would allow Domain users to log on to the domain after an eventual switchover.

- IP identity
  Communication between the components of the R/3 System is mostly based on TCP/IP sockets, although the Windows NT implementation also uses named pipes. In order to reach a specified process on a particular host from a location external to the node, TCP/IP uses an address pair which consists of the IP address and port number (the port number specifies the process to be addressed). Clients do not normally use the IP address, but use logical hostnames instead, which are mapped to the IP address with some sort of address database service (such as c:\winnt\system32\drivers\etc\hosts, DNS, WINS). On the lower layers, IP addresses are translated into ethernet addresses (48 bits) using the Address Resolution Protocol (ARP). Processes running on the node often use system calls or commands to get the local name of the machine. Although the local names and the external (i.e. network) names do not necessarily need to match, they usually do; however, they represent two different concepts.

  With On-line Recovery Server, the IP address and hostname of the failed primary server must be taken over after the switchover. This allows external clients to reattach to the service using the same address as before.

- License
  Two licenses need to be ordered for the R/3 system, since the license key is issued for a specific customer key, which is based on information specific to the server where "saplicense -get" is executed.

Normal Operation

Beginning with startup, On-Line Recovery Server operation can shift through several phases. Some phases are optional and depend on the user's choice of configuration parameters.

Once the On-Line Recovery Server hardware and software are installed and configuration is complete, the On-Line server pair is ready for startup.

When all ProLiant Storage Systems and both servers have been turned on, the CRA in each server listens for an "All is well" heartbeat message from its counterpart in the other server. If the expected heartbeat message arrives at both CRAs within the startup time-out period specified during installation, then the servers shift immediately into normal operation. However, if the heartbeat message does not reach one of the CRAs within the startup time-out value, one of two things occur:

- If the startup time-out was not enabled during installation, the CRA that did not receive the heartbeat message waits indefinitely for a heartbeat.

- If the startup time-out was enabled during installation, the CRA that did not receive the heartbeat message within the startup time-out period initiates a switchover. This allows one server to come on-line handling its own workload and supporting the ProLiant Storage System(s) switched over from the other server.

If power is lost to paired servers at roughly the same time and then is restored to both at roughly the same time, the CRAs respond exactly as they do at System startup.

The CRA in each server monitors heartbeat messages. If both systems have connected over the Interconnect and at some later point in time one of the CRAs does not detect a heartbeat, this CRA checks the status of the Recovery Server Interconnect. If it appears to be working normally, the CRA presumes that the paired server has failed and initiates a switchover sequence.

The On-Line Recovery Server can detect only those faults that cause loss of the heartbeat messages from a server; in other words, only those faults that are detectable by Automatic Server Recovery (ASR). For example, loss of the processor power supply will be detected. On the other hand, failure of a network interface card will not be detected unless it stops the CRA that sends the heartbeat message. Compaq Insight Manager would detect the loss of a network interface card independently from the On-Line Recovery Server.

During normal operation, the CRAs monitor the status of the Recovery Server Interconnect. If a CRA detects a cable fault, the fault is noted in the Windows NT Event Log and the CRA sends a cable fault message to the Compaq Insight Manager console. The most likely cause of a cable fault is an unplugged cable. Other possibilities are failure of a serial port, a software problem preventing transmission of the heartbeat message, or physical damage to the cable.

Switchover Events

To simplify the explanation of switchover events, refer to the previous figures and presume the following:

1. The heartbeat from Server 1 has been lost.

2. The Recovery Server Interconnect is functioning normally.

3. The CRA in Server 2 (CRA-2) initiates a switchover. CRA-2 sends a switchover command to the Recovery Controller in Server 2 (RC-2). RC-2 then sends a command to the Recovery Server Switch in ProLiant Storage System 1, causing it to toggle the electrical connection of Storage System 1 from the Primary Controller in Server 1 (PC-1) to RC-2 in Server 2.

4. CRA-2 commands the operating system on System 2 to mount the switchable drives of Storage System 1. CRA-2 assigns new drive letters to the switched disk drives. When that is done, normal operation resumes with RC-2 controlling communication between Server 2 and the switched disk drives in the ProLiant Storage System 1. Notice of the successful switchover is entered in the Windows NT Event Log and sent to the Compaq Insight Manager console.

Application Notification

The On-Line Recovery Server includes an Application Notification Interface. It is a Compaq Application Program Interface (API) that allows software provided by the customer to register with the CRA. When a switchover occurs, registered software is immediately informed of the switchover and notified of the new drive letters the CRA has assigned to the switched disk drives.

Software whose primary purpose is to launch another application or applications is termed an *application launcher.* Compaq supplies a generic Windows NT application launcher on the Compaq Support Software diskette for Microsoft Windows NT, included in the On-Line Recovery Server Kit. This launcher (CPQRSGL) allows customers to execute a batch command file when a switchover occurs. This batch command file can be used to set up execution environments and start other applications on the surviving server using the new drive letters.

Applications to be launched after switchover can reside either on the local disk(s) of the surviving server or on the switched ProLiant Storage Systems. Once an instance of a registered application has been started on the surviving server, clients of the failed server can log on to the

surviving server and resume their work. Use of the application notification and launcher capabilities of the On-Line Recovery Server significantly reduces the time required for clients of the failed server to regain access to business-critical programs and data after a switchover.

The Compaq generic launcher works in the following sequence:

1. The customer writes a batch command file using dummy parameters for the drive letters (d1, d2, . . .dn) to start the application or applications. (The On-Line Recovery Server Kit contains a sample batch file that illustrates the use of these dummy parameters.)

2. CPQRSGL, the Compaq generic application launcher, is a Windows NT command line application. It accepts a single command line parameter which is the name of the batch file that is invoked when a switchover occurs. When CPQRSGL begins execution, it registers with the CRA and its execution is blocked until a switchover occurs.

3. When the switchover occurs, the batch file specified in the command line parameter is invoked with a set of parameters that include the newly assigned drive letters and other status information that can be used by the batch file. The batch file typically contains commands to launch the desired application or applications that process the data on the disks that have been switched over to the surviving server.

Switchover Time

The time required to cause a switchover is composed of five sequential activities or time intervals. These are as follows:

1. Loss of heartbeat
   This is the activity that causes loss of heartbeat. The time required for this activity can be very short such as when a power supply fails in a server. The time can take longer in the case of software faults where the system operation degrades over a period of time until the thread that sends the heartbeat message is no longer scheduled to run (operating system lockup) and the heartbeat is lost.

2. Time-out
   This is the time period during which the heartbeat must be absent in order for the Recovery Agent to declare that its partner server has failed.

3. Switchable Disk Recovery
   This is the time required to effect the electrical switchover of the disks from the failed system and to have the recovery SMART Controllers comprehend these disks. The Recovery Agent logic activates the recovery SMART Controllers in parallel so that their operations overlap. The time required for this activity is approximately one minute.

4. File System Integrity Check
   During this activity, the Windows NT CHKDSK program is run against each new disk partition (new assigned drive letter.) The instances of CHKDSK are run simultaneously on all disks.

5. Database and R/3 startup
   The time required by the database to be started up depends on the duration of the automatic recovery, which in turn depends on the "dirtiness" of the database buffer at the time the R/3-Database server failed. Generally this phase is completed within five minutes, but could take longer on large databases.

To illustrate the effect of these factors, consider the example of an On-Line Recovery Server configuration consisting of two Compaq ProLiant 4500 servers. The R/3-Database server has:

- Two 100-Mhz Pentium processors

- 256 Megabytes of memory

- Two internal 2.1-Gigabyte disks attached to a SMART controller

- Five external 2.1-Gigabyte drives in a switchable storage expansion cabinet attached to a second SMART Controller

The recovery server has:

- One 100-Mhz Pentium processor

- 128 Megabytes of memory

- Two internal 2.1-Gigabyte drives attached to a SMART Controller

The recorded times for an automated switchover event of this configuration are shown for a sample installation in Table 3:

TABLE 3
ON-LINE RECOVERY SERVER
AUTOMATED SWITCHOVER TIME

Activity	Time
Time-out after an R/3-Database failure (Time-out set to 30 seconds)	90 seconds
Switchover	72 seconds
Disk verification by Windows NT	152 seconds
database and R/3 startup	274 seconds
TOTAL	9.8 minutes

Planned Shutdown

The On-Line Recovery Server allows the system administrator to perform a planned shutdown of one server in the On-Line pair without triggering an automatic switchover. Performing a normal Windows NT system shutdown does not cause a time-out and switchover.

The On-Line Recovery Server also allows the system administrator to force an immediate switchover. This capability is used at startup to test the configuration and to verify that an automatic switchover can be performed if one of the paired servers fails.

Faults

The only faults that are detectable by On-Line Recovery Server are those that cause loss of the heartbeat messages from a server. This is the same class of faults that are detectable by Automatic Server Recovery (ASR.) Therefore, loss of processor power supply would be detected. Failure of a Network Interface Controller (NIC) will not be detected unless it locks up the Windows NT scheduler and the Recovery Agent thread that sends the heartbeat message is no longer scheduled. However, with Compaq Insight Manager, loss of the NIC would be detected, independent of the On-Line Recovery Server

Cable Fault

Cable faults occur when the serial interconnect cable is either unplugged or is severed. It is important to attach the serial interconnect cable securely to the two servers. Additionally, it is important to protect the cable from damage. The different cable fault failure cases and their results are as follows:

1. Local cable fault - In this case, the Recovery agent detects that the serial interconnect has been unplugged locally, that is, from this server, not from the partner server. After the time-out period elapses, the Recovery Agent commences a shutdown of the operating system in preparation for a switchover of its switchable disks to the other system. This is due to the fact that the other system will have lost the heartbeat message since the serial interconnect was unplugged from this server.

2. Remote cable fault - The Recovery Agent has a limited ability to determine that a cable has been unplugged from its partner server. If the Recovery Agent loses the heartbeat message for the switchover time-out period and the possibility of a remote cable fault is indicated, it will wait an additional 60 seconds after the switchover time-out before switching over the disks from its partner server. This is to allow adequate time for the other system to shutdown.

3. Severed cable - In this case the serial interconnect has been physically cut. Both systems will sense this as a remote cable fault and both will initiate a switchover of their partner server's switchable disks as documented in the previous step.

Servicing the Failed Server

After a switchover occurs, the failed server must be repaired or replaced to restore the server pair to their normal, high availability operation. The On-Line Recovery Server enables the system administrator to schedule service on the failed server while the surviving server is active. Maintenance on the failed server can be performed on or off site by disconnecting the Recovery Server Interconnect and SCSI buses from the failed server.

After the failed server is serviced or replaced, the original On-Line Recovery Server configuration must be restored. This can be done *only* by power-cycling both servers and all external storage systems.

Restoring the Configuration After Switchover

The following section discuss restoring the configuration after a switchover, which include information on repairing the failed server.

Repairing the Failed Server

A switchover occurs because a detectable fault has occurred. After the switchover, the surviving server has all switchable disks attached to it. Assuming that it is doing productive work, it is important to not disturb its operation while repairs are being performed on the failed server.

If the failed server is capable of bootingWindows NT, it is important to run the control panel applet for the Recovery Server Option Agent anddisable "switchover" for the failed server. This will ensure that during the time that repairs are being performed, the Recovery Agent in the failed system will not attempt a switchover since the Recovery Agent in the surviving server is not running in this state.

Client Behavior

During a switchover, clients of the failed server experience a service outage of several minutes. Because the two paired servers in the On-Line Recovery Server configurationhave different network addresses, clients of the failed server must log on to the surviving server manually to connect to it and regain access to storage disks that have been switched over.

By knowing the address or name of the recovery server, it is possible to program logic into client software to effect an automated switchover to the surviving server. This programming could reduce the duration of the service outage experienced by clients during a switchover. Nevertheless, there would still be a time interval during which the switched drives were not available to the client.

Performance Considerations

In an On-Line Recovery Server configuration, the Array Accelerator, which serves as a read/write cache for I/O requests directed to the SMART or SMART-2 Array Controller, must be disabled when using a SMART controller or changed to 100% read cache when using a SMART-2 controller.

For the SMART controller, the Compaq System Configuration Utility automatically disables the Array Accelerator when the SMART controller is attached to switchable disks in an On-Line Recovery Server configuration. For the SMART-2 controller, the Compaq Array Configuration Utility automatically changes the Array Accelerator to 100% read cache when the SMART-2 controller is attached to switchable disks in an On-Line Recovery Server configuration. These change of the cache setting of course reduce the performance of the system overall. Measurements in the lab led to a reduction about 10% overall of the database server.

The system performance impact of changing the Array Accelerator configuration is determined by the interaction of the controllers with software and other hardware in the system and by tuning of the system. As a result, the performance of the overall system(s) needs to be considered to determine if adjustments are required to compensate for this factor. In certain cases, changing the Array Accelerator configuration will degrade system(s) performance.

For example, the database engine might be tuned so that it is processor-constrained and not I/O-constrained. In this case, enabling, disabling, or changing the Array Accelerator configuration would have little effect on overall system performance. However, an I/O-constrained system, disabling or changing the Array Accelerator could lower the system performance. In all cases, system performance should be considered when planning for an On-Line Recovery Server configuration.

SETTING UP AN ON-LINE RECOVERY SERVER

The On-Line Recovery Server includes both software and hardware components. On-Line Recovery Server software is a specific installation item on the Compaq SSD for Microsoft Windows NT. This software is provided in the Compaq Recovery Server Option Kit (Compaq part number 213817). The software and hardware requirements for On-Line Recovery Server are described in the Table 4.

TABLE 4
SYSTEM REQUIREMENTS FOR THE ON-LINE RECOVERY SERVER

System Component	Requirement	Installation Notes
Network operating system	Microsoft Windows NT 3.5X	Must be stored in local storage.
Application software	The On-Line Recovery Server can support any application for which an appropriate application launcher is available.	Application software designed to behave predictably upon system failure will have less chance of data corruption during a service outage.
Recovery Server Option Kit	One kit for each switchable ProLiant Storage System.	See the *Recovery Server Option User Guide* kit contents and installation instructions.
Servers	Two Compaq ProLiant servers including any of these models in any combination: Compaq ProLiant 5000, 5000R, 4500, 4500R, 4000, 4000R, 2000, 2000R, 1500, or 1500R.	The two servers need not have identical hardware configurations. They must, however, be located within 3 meters of each other.
SMART Controllers	The number required depends on the configuration. Primary and Recovery Controllers in the On-Line Recovery Server configuration must be SMART Controllers. Use of SMART Controllers with local storage disks is optional.	The Array Accelerator on the SMART Controllers must be disabled. For the On-Line Recovery Server, the System Configuration Utility forces the Array Accelerators to be disabled for controllers attached to switchable disks.
	Each SMART Controller can support up to two ProLiant Storage Systems. However, the SMART Controller must be dedicated to only one function: either Primary Controller or Recovery Controller.	The Array Accelerator on the SMART-2 Controllers must be set to 100% read cache. For the On-Line Recovery Server, the Compaq Array Configuration Utility forces the Array Accelerators to be set to 100% read cache for controllers attached to switchable disks.
Disk Controllers	One for each server to support its local disk drives (non-switchable, internal or external drives).	Compaq 32-Bit SCSI-2 Controllers or SMART Controllers (recommended) may be used with local storage disks.
Internal Hard Drives in Server	Can be used only as local disk drives. They are non-switchable.	For internal CD-ROM and tape drives, integrated controllers may be used.
COM Port	One serial port on each server for communication between the paired servers.	The same COM port need not be used on both servers.

continued

System Requirements for the On-Line Recovery Server *continued*

System Component	Requirement	Installation Notes
External SCSI Cables	Standard-to-wide cables required to connect Primary and Recovery Controllers in each server to the Recovery Server Switch in the associated storage system(s).	See the *Recovery Server Option User Guide* for cabling requirements.
Switchable External Disk Storage	A minimum of one switchable ProLiant Storage System between the paired servers. Any ProLiant Storage System may be used except Compaq part numbers 146700 (North America) and 146750 (outside North America).	All switchable disk drives must be located in an external storage unit. A Recovery Server Switch must be installed in each switchable external storage unit.
Local Disk Drives	Each ProLiant Server must have a minimum of one local (non-switchable) disk drive on which the operating system is stored.	Application software may also be stored on local disk drives; however, nothing stored on local disk drives switches over if a server fails.

A number of hardware configurations steps must be performed according to the instructions on the *Recovery Server User Guide* delivered with the Recovery Server Option Kit. These steps are:

- Install the SMART Controllers

- Install Recovery Server Switches required for this configuration

- Connect SCSI Cabling

- Connect Serial Interconnect Cabling

System Configuration

The following sections discuss the system configuration, which include updating the SMART controller firmware, configuring the system, installing the SMART controller driver, and setting up a switchable storage.

Updating the SMART Controller Firmware

On each of the two servers, the Compaq Options ROMPaq diskette is used to install and update SMART Controller firmware that is required for the On-Line Recovery Server. To update the firmware, follow these steps:

1. Boot each server using the Options ROMPaq disk.

2. Follow the instructions on the screen to update the SMART Controller firmware.

Configuring the System

You must use the Compaq System Configuration Utility to configure the two servers. On each of the servers, follow these steps:

1. Run the Compaq System Configuration Utility. Compaq recommends that you obtain the latest version of the Compaq System Configuration Utility since there could be changes incorporated into the new releases that affect On-Line Recovery Server and Compaq hardware. The selections for the On-Line Recovery Server appears in the SMART Controller configuration section.

2. Designate each SMART Controller that is attached to a switchable ProLiant Storage System as being an On-Line Recovery Server "primary" or an On-Line Recovery Server "recovery" controller in the SMART Controller configuration section. All SMART Controllers used for local storage will be designated as On-Line Recovery Server "disabled."

3. Configure Automatic Server Recovery to "Boot Compaq Utilities."

4. Complete all other configuration activities.

5. Exit the configuration utility.

6. Restart Windows NT.

Installing the SMART Controller Driver

Depending on the hardware configuration and the procedure that was used to install Windows NT, it might be necessary to install the SMART controller device driver. The driver is located on the Compaq SSD for Microsoft Windows NT. Normally the drivers are installed by default using the Compaq SmartStart. In any case you should check the version and test if the right and most update driver is installed on your system.

A subject of attention is the order of the Smart Controller in both servers. To avoid future extensions and changes, which may prevent the SAP R/3 installation from starting on the recovery server, the order of the controller and the used slot number must be the same in both systems. This means if the first Smart Controller is positioned in slot 1 in the primary server the corresponding Smart Controller must be positioned in the same slot in recovery server. The same must be done for the further Smart Controller. This avoids problems with the enumeration of the partitions during the failover.

To make it easier to identify the failover devices, the used drive letters in the primary server should be selected in a way that after the failover the drive letters correspond to that on the recovery server. In the other case, the adaptation for the failover scripts (see appendix) and the related Windows NT services is much more complex and will reach beyond the limit of this white paper.

Setting Up Switchable Storage

At this point, you can use the Windows NT Disk Administrator to initialize the switchable disks that are attached to the Primary SMART Controllers. Compaq recommends using NTFS as the file system for these switchable disks. Once these drives are formatted, they are available for use.

On-Line Recovery Server Software Installation

This section describes the installation of the On-Line Recovery Server software from the Compaq SSD for Microsoft Windows NT. The installation process installs the software components and sets configuration values. After the setup process is completed, the installation of the Recovery Agent is verified. The Windows dialog box that is used to prompt for configuration values during the installation process is the same as that used by the Configuration and Control applet. Certain testing functions are disabled during the installation process.

Installing and Configuring the On-Line Recovery Server Software

To install the On-Line Recovery Server software components, execute the file *SETUP.CMD* that is found on the Compaq SSD for Microsoft Windows NT. This starts the setup process to install the On-Line Recovery Server software.

During the execution of *SETUP.CMD*, the "On-Line Recovery Server" item is selected for installation. Installation of the On-Line Recovery Server option requires installation of the Compaq System Management support. If System Management is not explicitly selected, the SETUP program makes sure that it is installed in addition to the Recovery Server software components.

During the SETUP installation process, you are prompted to set configuration parameters for the On-Line Recovery Server.

Table 5 lists these parameters and their settings:

TABLE 5
ON-LINE RECOVERY SERVER
CONFIGURATION PARAMETERS

Parameter	Description
Enable/Disable Switchover	Switchover is normally enabled. The only time it is not enabled is when an asymmetrical configuration is being used and the switchover only occurs in one direction.
Communications Port	The communications port default is COM1 unless the installation software determines that the port is used by another service. The next port used is COM2, and so on through COM4.
Switchover Time-out	This is the time period that is used to determine if the partner server has failed. If no heartbeat message is received during a time interval of this length, then the partner server will be considered to have failed.
Enable/Disable Startup Time-Out	Use this checkbox to enable or disable the startup time-out function.
Startup Time-out	With the startup time-out disabled, the On-Line Recovery Server Recovery Agent waits indefinitely for a serial interconnect heartbeat without timing out and initiating a switchover. If the startup time-out is enabled, the Recovery Agent will time-out on initial startup if it does not receive a heartbeat within the startup time-out period.
	The use of the startup time-out is an operational decision. For example, if both servers suffer a simultaneous power interruption and during restoration of power one of the servers fail, then it would be desirable for the Recovery Agents to be configured with a startup time-out enabled. This allows the surviving server to switchover the disks from the failed server. If you enable the startup time-out, Compaq suggests that you select a value that is large enough to cover the differences in the operating system times between the two servers in the On-Line Recovery Server pair. That is, if one server boots much more rapidly than the other server and its startup time-out value is too short, it might time-out and switchover before the other server has a chance to start the Recovery Agent service and produce a heartbeat.
Enable/Disable Network Connectivity Check	This is enabled by default. You must supply the server name of the partner server if you enable the network connectivity check.
Paired Server Name	This is the server name of this server's partner server. This name is used as the network address for the network connectivity function. The two servers must be in the same Windows NT domain.

Windows NT Security Considerations

In the case of a switchover, disk drives are attached to the partner server. It is necessary to plan the security configuration of the partner Windows NT systems so that clients can log in to the partner server (that is, the surviving server of the pair) and be able to access the drives that have been switched over.

Recovery Agent Service Security Context

The default user ID that the Compaq Recovery Agent CRAservice CPQRSYS executes under is System Account. This default user ID has resource access limitations such as network access. If you wish to change the user ID underwhich CPQSYS executes, use the Windows NT Control Panel Applet Services Manager.

NOTE: From the software examples attached that in the case of handling SAP R/3 this user account HAS to be changed to the administrative account of the R/3 system, <SID>adm.

Generic Application Launcher

The Generic Application Launcher, *CPQRSGL.EXE*, is provided with the On-Line Recovery Server. It provides a mechanism for launching applications or Windows NT commands in response to a switchover. *CPQRSGL.EXE* is a command-line Windows NT program and is installed during the installation of the Compaq Recovery Agent.

The Generic Application Launcher replaces the need to write software that calls the Application Notification API.

The generic application launcher is invoked from the Windows NT command line as follows:

CPQRSGL <launched-file-name>

Where <launched-file-name> is the name of a file such as a .BAT, .CMD, or .EXE that is invoked when a switchover occurs.

When a switchover occurs, the launched-file-name executes. The command line that is created by *CPQRSGL.EXE* is as follows:

Example: <launched-file-name> <status>…

where <launched-file-name> is the name of the file to execute

       <status> is the status byte value returned…etc.

launched-file-name status disks partitions d1 d2 d3 d4...dn

Where launched-file-name is the string supplied as a command line parameter to *CPQRSGL.EXE*, status is the status byte value returned by the Application Notification API after a switchover, disks is the number of new disks acquired as a result of the switchover, partitions is the number of new partitions that were acquired during the switchover, d1, d2, ... dn are the drive letters that were assigned during the switchover.

The status byte values indicate if the switchover was successful. The returned values are as follows:

- 0 = The switchover was successful

- 1 = Unable to switch drives
  This indicates a that a low-level error occurred while the drive switching operation was executed.

- 2 = Error in mounting drives.
  This indicates that the operation to have Windows NT mount the switched drives failed.

- 3 = Error in getting drive letters assigned to the switched drives.
  Insufficient free drive letters may have been available for assignment.

- 4 = Non-zero CHKDSK return code.
  CHKDSK reported possible errors during its check of the file system on one or more of the switchable disks. Refer to the Windows NT event log for details.

When *CPQRSGL.EXE* registers with the Compaq Recovery Agent, its execution is suspended until a switchover occurs and it is notified of the switchover. When this happens, CPQRSGL creates a new Windows NT process for the command line that it launches (Windows NT exec function). The launched program executes with its own virtual command line console. The command line is launched regardless of the status returned by the Application Notification API

Auto Launch Command File

To aid in automatically starting an application launcher or other program, the Compaq Recovery Agent service executes a .CMD file when it begins execution. The file name is *CPQRSYS.CMD* This file is located in the directory %SYSTEMROOT%\SYSTEM32.

When the On-Line Recovery Server software is installed, a *CPQRSYS.CMD* file is created. The installed *CPQRSYS.CMD* file contains no commands. You can edit this file or create one of the same name. The commands in the file are executed after the Recovery Agent has completed its initialization activities before it attempts to receive its partner server's heartbeat message.

This file can be used to start an Application Launcher automatically. If *CPQRSYS.CMD* is not present, no error occurs. However, the Recovery Agent puts an informational message to that effect in the Windows NT event log. The programs executed from *CPQRSYS.CMD* execute before anyone has logged into the system. Hence, there is no window or command line environment in which they can display output.

Testing the Configuration

This section describes how to verify that the system is operating properly in the On-Line Recovery Server configuration To test the configuration, follow these steps:

1. Shut down and restart both Windows NT systems.

2. Run the Windows NT Services control panel applet to verify that the On-Line Recovery Server Recovery Agent service is started and running.

3. Run the Configuration and Control (CC) panel applet on both systems and make certain that both systems are enabled for switchover.

4. Go to the Windows NT Administrative Tools program group when these steps have been completed on both servers, and start the On-Line Recovery Server monitoring application on both servers.

If the system is operating properly, the On-Line Recovery Server monitoring application should display a status of the following on both systems:

Normal State: Serial interconnect heartbeat is being received

Verification of Network Connectivity

To verify the network connectivity, follow these steps:

1. Enabled the Network Connectivity check, which its operation must be verified.

2. Run the CC applet.

3. Select *Test Network Connectivity* If the Network Connectivity check is successful, the following displays:

```
Network Connectivity Check
Successful
```

If the Network Connectivity check is *not* successful, the following displays:

```
Network Connectivity Check
Failed
```

Verify Switchover

It is important to verify proper system operation by testing the switchover function. The Configuration and Control applet (CC) provides a command that causes an immediate switchover. Before using this command, Compaq recommends that you perform a normal system shutdown on the partner server before the disks are switched to the other system.

For example, assuming that both servers are up and running Windows NT, follow these steps:

1. Perform a normal Windows NT system shutdown on the Primary Server.

2. Run the CC applet on the Recovery Server.

3. Select *Perform immediate switchover.*

4. Observe the On-Line Recovery Server monitoring application. In a short time it should indicate that a switchover occurred and display the new drive letters that were assigned to the switched drives.

5. Use the file manager or other application to examine the switched drives to verify that they were successfully switched.

6. Shutdown both servers and all external storage units.

7. Cycle the power and perform the same sequence on Recovery ServerIf you have installed the Compaq Insight Manager, each switchover sends an alarm to the Compaq Insight Manager console to communicate that a switchover event has occurred and is either successful or unsuccessful.

Restoring the Configuration

After you verify the switchover, you need to restore the configuration of the On-Line Recovery Server. To restore the configuration, follow these steps

1. Restore the initial configuration by shutting down both Windows NT systems.

2. Power cycle all components; servers and the ProLiant Storage Systems. Power cycling the ProLiant Storage Systems resets the Recovery Server Option switches to their default setting. Port 1 is connected to the drives.

3. Start both Windows NT systems.

4. Use the On-Line Recovery Server monitoring application on both systems to verify proper operation.

R/3-Database Server Specific Settings

The application-specific actions required on the recovery server after a switchover depend on whether this server is an R/3 application server, or another kind of server. For another kind of server, the actions consist of adding the necessary profiles, registry entries, services, and shares required by the R/3 instance.

For an R/3 application server, the profiles, registry entries, services, and shares related to the application instance must be disabled or removed. Once the preparations before failure have been completed, then you will need to create a batch file to perform the necessary steps after a failure has occurred.

The following steps provide a general overview of what needs to be done for an application server to become the recovery server of a failed primary server:

1. Remove share 'saploc' pointing to the application server instance directory

2. Create 'sapmnt' and 'saploc' shares pointing to the directories of the switched disks, according to the drive letters after the switchover.

3. Stop R/3 application server instance on the recovery server.

4. Stop R/3 instances on all the other application servers.

5. Stop R/3 services SAPOsCol and SAP<Instance>_<InstanceNumber> of the application server instance on the recovery server

6. Stop the SAP<Instance>_<InstanceNumber> service on all the other application servers.

7. Set the IP address of the Recovery Server to that of the failed Primary Server.

8. Set the hostname of the Recovery Server to that of the failed Primary Server.

9. Set user environment paths.

10. Create alternative SAP R/3 start and instance profiles for the central instance to run on the application server after the switchover.

11. Create alternative SAP R/3 start and instance profiles for the other application servers to access the recovery server after the switchover.

12. Prepare the adapted registry settings for the database instance (comaptible to the installation on the primary server).

13. Start the database services:
    ADABAS: "ADABAS: <SID>" and the "XServer".
    ORACLE: "OracleService<SID>", "OracleTPCListener"
    MSSQL: "Microsoft SQL Server" and "SQLExecutive"

14. Create and start the services SAPOSCol and SAP<Instance>_<InstanceNumber> of the central instance to run on the recovery server.

15. Start the SAP<Instance>_<InstanceNumber> services on the other application servers.

16. Start the R/3 central instance on recovery server.

17. Start R/3 instances on the other application servers.

The following sections provide more detailed information on how to setup the systems.

Naming Conventions and Configurations

For the sake of simplicity, actual names are used instead of placeholders from now on, according to the following configuration:

- R/3 System
SAP Instance Name (SID)	**CPQ**
R/3 Administrator Account (SIDadm)	**cpqadm**
used database	**ORACLE**

- Primary Server/Database and Central Instance
  R/3-Database Server
Computer and Host Name	**primary**
SAP Instance Number	**00**
IP Address of Primary Server	**pri-ip**
Location of operating system	**C:\WINNT35**
Location of SAP R/3	**E:\usr\SAP**
Location of database executables	**E:\ORANT**
Location of the Log Files	**G:\cpqlog**
Location of R/3 Database	**F:\cpqdata**
CD-ROM Drive	**D:**

- Recovery Server/Application Server 1
  R/3-Database Server
Computer and Host Name	**recovery**
SAP Instance Number	**01**
IP Address of Primary Server	**rec-ip**
Location of operating system	**C:\WINNT35**
Location of R/3 Software Directory	
(before recovery)	**C:\usr\SAP**
(after recovery)	**E:\usr\SAP**
Location of database executables	
(before recovery)	**C:\ORANT**
(after recovery)	**E:\ORANT**
CD-ROM Drive	**D:**

- Application Server 2
  R/3-Application Server
  Computer and Host Name   **app-srv**
  SAP Instance Number   **02**
  Location of operating system   **C:\WINNT35**
  Location of R/3 Software Directory   **C:\usr\SAP**
  Location of database client tools   **C:\ORANT**
  CD-ROM Drive   **G:**

Preliminary Preparation Actions

To prepare, follow these steps:

1. Install a full copy of the database into the subdirectory **c:\orant** on RECOVERY. Use the same values as was used during the original install of R/3. (Normally no changes on the defaults.) This enables the database related network components on the server side. The equivalents for ADABAS/D are **c:\adabas** and MSSQL **c:\mssql**.

2. Install the necessary services for R/3 ('**SAPCPQ_00**') on RECOVERY and for the database using instsrv.exe from the Windows NT Resource Kit:
   ORACLE: **OracleServiceCPQ**
   MSSQL: automatical during setup - no extra services required
   ADABAS/D: "**Xserver**" as described in the SAP R/3 manual and
   the "**ADABAS: CPQ**" service
   DO NOT SET THE STARTUP TYPE IN THE CONTROL PANEL TO "AUTOMATIC".

3. Prepare the Registry entries for the file **ORS_ORA_REG.INI** which is later used for the adoption of the switched over database (see appendix) and the counterpart **ORG_ORA_REG.INI ORS_ORA_REG.INI** bases on the information of PRIMARY and is executed during the switchover, **ORG_ORA_REG.INI** bases on the information of RECOVERY and is used for the restoration of the original content of RECOVERY during the failback. Make the same for the two other databases (see appendix)

4. Create the following subdirectories on PRIMARY:
   e:\usr\sap\prfclog
   e:\usr\sap\put

5. Create alternate profiles for the recovery server on PRIMARY in the **e:\usr\sap\cpq\sys\profile** subdirectory. (see Appendix 1)

6. Copy the file **START_D02_app-srv** to **START_D02_app-srv.org** on the PRIMARY in the **e:\usr\sap\cpq\sys\profile** subdirectory.

7. Create alternate profiles for the application server on the PRIMARY in the **e:\usr\sap\cpq\sys\profile** subdirectory. (see Appendix 3)

8. Share the subdirectory **e:\usr\sap\cpq\sys\profile** as **profs** on PRIMARY.

9. Create a profile directory: **c:\usr\sap\cpq\D02\profile** on the APP-SRV, and copy the following files from the **profs** share on primary (\\primary\profs):
   START_D02_app-srv
   START_D02_app-srv.org
   START_D02_app-srv.ors
   CPQ_D02_app-srv
   CPQ_D02_app-srv.org

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10. Edit the registry values for the Image Path of SAPCPQ_02 on the APP-SRV to:
    c:\usr\sap\CPQ\D02\exe\SAPNTSTARTB.EXE
    pf=c:\usr\sap\CPQ\D02\profile\START_D02_app-srv

11. Modify the User Environment variable PATH on the APP-SRV to be:
    PATH = c:\usr\SAP\CPQ\D02\exe

12. Modify the account information on the On-Line Recovery Server Agent on RECOVERY in order to enable the switchover program to control the R/3 services.

13. Set the account to CPQADM and enter the password in the Startup dialog box of the Service control panel applet.

In order to comply with SAP's requirement of the recovery server taking over the IP address of the primary server, Compaq has implemented this by a Compaq specific tool named CPQIPSET. This tool does not require the server to reboot for the IP address change to take effect which save time and is necessary for the correct functioning of the Online Recovery Server. For the best usage, identify the NIC MAC address using "ipconfig /all" from the Windows NT Resource Kit.

Handling Switchover with a Script

This method is appropriate when the switchover characteristics are known in advance, and particularly if drive letter changes can be avoided. The best way to avoid drive letter changes is to ensure that the original drive letters of the switchable partitions on the R/3-MSSQL Server are the first ones available on the recovery server. In these circumstances, all the required steps can be carried out from a simple command file.

1. Create the switchover script, *SWITCH.BAT.* (see Appendix 4)

2. Create the host related registry input file for *SWITCH.BAT.* (see Appendix 4)

3. Execute the script, *SWITCH.BAT,* when a switchover occurs by the Compaq Generic Launcher (*CPQRSGL.EXE*), which is registered with the Compaq Recovery Agent by invoking the *CQPRSYS.CMD* command file. To capture the output of *SWITCH.BAT,* you must use an intermediate command (*LSWITCH.BAT*) file. For example:

    CPQRSYS.CMD
        %SystemRoot%\system32\cpqrsgl.exe c:\users\cpqadm\lswitch.bat

    LSWITCH.BAT
        c:\users\cpqadm\switch.bat 2>&1 c:\users\cpqadm\switch.log

    CPQRSGL.EXE is provided by Compaq and installed together with the Recovery Driver.

5. Make a copy of the SAP Service Manager CPQ_01 icon and modify the following:

    Description: SAP Service Manager CPQ_00 ORS

    Cmd Line: c:\usr\SAP\CPQ\D01\exe\sservmgr.exe CPQ_00

    Working Dir: c:\usr\SAP\CPQ\D0l\exe

Figure 8 illustrates the sequence of actions when a switchover occurs.
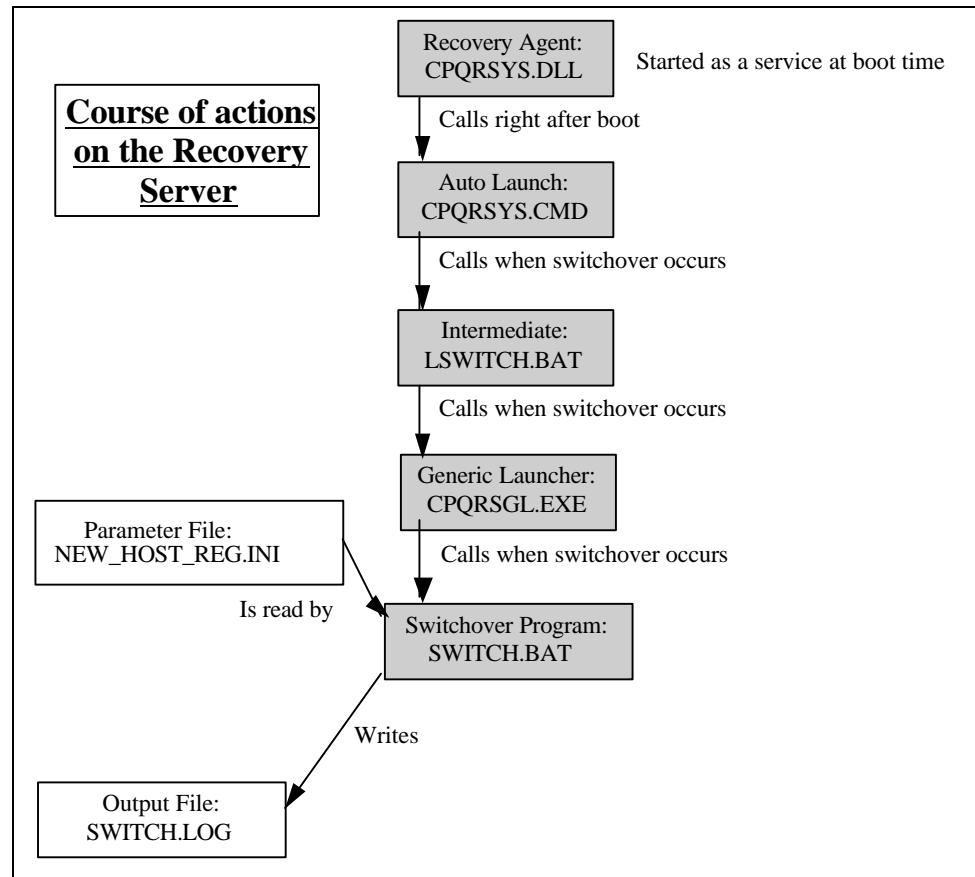
Figure 8. Switchover Sequence

After a switchover occurs and once the primary server is repaired and is ready to go back in production, the Recovery Server must be reset to keep playing the role it had before the switchover. Basically, all the changes that were made to it must be undone.

Handling Restore from Switchover with a Script

The script *UNSWITCH.BAT*(see Appendix 6), which would be manually executed by the system administrator, shows the necessary undo actions.

After running this script, the recovery server can be shutdown and switched off. The switched storage expansion cabinets must be then switched off so when they are switched on again, they are electrically connected to the repaired primary server.

If you must shut down the recovery server before the primary server has been repaired, follow these steps:

1. Run the "undo" script previously mentioned. (see Appendix 6)

2. Make sure that the Startup Time-out is enabled and set to a short interval before shutting down the recovery server.

3. Shut down the recovery server.

4. Switch off and on again the switchable storage expansion cabinets.

5. Reboot the recovery server.

Because the storage expansion cabinets would have been switched off and on again, the SCSI switch would be on Port 1 (electrically attached to the failed primary server). Otherwise, they would still be attached to the recovery server, which would complain at boot time because its EISA configuration was not aware of any disks attached to the recovery SMART controller. Once the recovery server is rebooted, the recovery server agent will miss the heartbeat from the primary server, and after the startup time-out interval, a switchover will be triggered and, as a result, Microsoft SQL Server and R/3 will be started up and made available to users.

GLOSSARY

Application Launcher	Software that registers with the Compaq Recovery Agent (CRA) Application Notification Interface and whose function is to initiate execution of another application or applications after switchover has occurred. Application launchers will use the information provided by the CRA, such as the drive letters of the newly acquired disk drives, to prepare the execution environment for the application that they will initiate. Compaq supplies a generic Windows NT application launcher with the On-Line Recovery Server. It can be used to invoke a batch command file after a switchover has occurred.
Application Notification Interface (API)	A Compaq API for the On-Line Recovery Server. The purpose of this API is to allow an application to register with a Compaq Recovery Agent (CRA). If a switchover occurs, registered applications on the surviving server are notified that a switchover has occurred and that new drive letters have been assigned to the switched disk drives.
Compaq Recovery Agent (CRA)	An OS agent in each server in an on-line server pair. It performs four functions:

- Sends heartbeats to the paired server via the Recovery Server Interconnect.

- Monitors and answers heartbeat messages received from the paired server via the Recovery Server Interconnect.

- Sends commands to the switchable SMART Array Controllers to initiate an automatic switchover.

- Notifies application programs registered with the CRA on the surviving server that a switchover has occurred.

Local Disk Drive	A non-switchable disk drive attached to only one server in an on-line server pair. In the On-Line Recovery Server configuration, each of the paired ProLiant servers must have at least one local disk drive that serves as the Windows NT boot disk. A local disk drive can be either internal or external to the server.
On-Line Recovery Server	A two-server configuration using the Recovery Server Option in which both ProLiant servers are active and operate independently of each other. If one of the servers fails, customer-selected ProLiant Storage Systems attached to that server are automatically switched over to the surviving server. The surviving server takes on the workload of both servers.
On-Line Server Pair	A pair of ProLiant servers in an On-Line Recovery Server configuration.
Primary Controller	In an on-line server pair, a SMART Array Controller physically attached by SCSI bus to port 1 of a ProLiant Storage System containing a Recovery Server Switch. During normal server operation, switchable disk drives are electrically attached to the primary controller.

Recovery Controller	In an on-line server pair, a SMART Array Controller physically attached by SCSI bus to port 3 of a ProLiant Storage System containing a Recovery Server Switch. During normal server operation, switchable disk drives are not electrically attached to the Recovery Controller. A switchover electrically detaches the switchable disk drives from their Primary Controller in the failed server and electrically attaches them to their Recovery Controller in the surviving server.
Recovery Server Interconnect	The serial cable that connects paired ProLiant servers when the Recovery Server Option is used in either the Standby Recovery Server mode or the On-Line Recovery Server mode.
Recovery Server Option	The Compaq option kit used to configure either the Standby Recovery Server or the On-Line Recovery Server. It includes the Recovery Server Switch (an optional board), the Recovery Server Interconnect cable to connect the paired servers, software for the Standby Recovery Server, software for the On-Line Recovery Server, internal cables, and user documentation.
Recovery Server Switch	The intelligent SCSI switch installed in a ProLiant Storage System that switches the electrical connection of the storage system from one server to another in the event of a server failure.
SCSI Cable	An I/O bus used to connect ProLiant servers to ProLiant Storage Systems. In the On-Line Recovery Server configuration, SCSI cables from the two servers attach to Recovery Server Switches installed in switchable ProLiant Storage Systems.
Standby Recovery Server	A configuration in which two identical ProLiant servers (an active primary server and an inactive standby server) are attached to a common set of ProLiant Storage Systems that contains a single copy of the operating system, applications, and stored data. If the primary server fails, the ProLiant Storage Systems automatically switch over from the primary to the recovery server. The recovery server then boots, and the system is back on-line in minutes without administrator intervention.
Switchable Disk Drives	In an On-Line Recovery Server configuration, disk drives in a ProLiant Storage System that has been modified by the installation of the Recovery Server Switch Option. These disk drives contain data and applications that will switch over if their primary server should fail.

APPENDIX 1: WINDOWS NT RESOURCE KIT TOOLS

In this appendix, a short introduction is provided for the tools from the Windows NT Resource Kit that are used for the failover. If the reader is interested in a more detailed description, see the original documentation from Microsoft.

NOTE: Only the parameter and settings used for the failover scenario are referred to.

INSTSRV

For the correct operation of the SAP R/3 system we have to prepare some services which are no existing on the Recovery Server by default or without the full installation of SAP R/3. Under normal operation these services remain idle, and in case of a switchover, the script starts them by means of the Windows NT Resource Kit utility NETSVC. The utility *INSTSRV.EXE* from the Windows NT Resource Kit allows the installation of Windows NT services in a convinient way.

The utility receives as a command line argument the complete path to the service binary image, which must exist at the time the service is created. Because the binary is located on one of the switched partitions, it is not available at the time the services are created on the recovery server. As an example we install the SAPCPQ_00 service.

- From a command line type the following (we use notepad.exe as a dummy. It can be any executable which is available on the system):

      instsrv SAPCPQ_00 c:\winnt35\notepad.exe

- In the "Startup" dialog box of the services control panel applet, set the startup mode to "Manual" for the service just created. Also set the logon account as SAPDOM\CPQADM, with the corresponding password, for the SAPCPQ_00 service.

- Change the startup parameter from automatically to manual.

- Modify the following registry entry for SAPCPQ_00 to change it to a senseful executable.

  HKEY_LOCAL_MACHINE\SYSTEM\CURRENTCONTROLSET\SERVICES

  ImagePath: REG_SZ: e:\usr\sap\CPQ\sys\exe\run\sapntstartb.exe
  pf=e:\usr\sap\CPQ\sys\profile\START_DVEBMGS00_primary.ORS

REGINI

This tool allows the editing of registry keys in a Windows NT system. It gets an ini-file as the input with the following syntax:

\Registry\Path ...\Key

> Value = Value_Type "Value_contents"

The Windows NT terminology differentiate between*key* and *value.* In general a *key* is a class of values while the value itself is the container of the information. A typical example is the prompt variable of the environment (it deifnes the look of the command prompt) which is saved in the registry as well:

path: \Registry\MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager

key: environment

key: prompt

value: pg

A setting to change this value will look like:

\Registry\MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\environment
        prompt = REG_SZ 'pg'

If we save this to a file like myprompt.ini we can use it for the input into regini.exe.

NETSVC

NETSVC is the startup utility for Windows NT services. It offers the possibility to start and stop on the local machine as well as on a remote server. For the remote use it is important that the calling account has the right to access the start and stop a service.

We use NETSVC in all cases in the same systax:

netsvc \\SERVERNAME "The Service" /Start

where servername is the name of the system (even necessary for the local system), "The Service" is the identifier for the service like it appears in the control panel service applet and the last option is "/Start" or "/Stop". The quotes for the service name are necessary if the identifier consists of more than one word like in the example.

APPENDIX 2: CPQIPSET

This tool is the Compaq implementation of the TCPIP switching for online recovery. It switches the ip address for a designated network interface card including the subnet mask and the gateway address.

The calling convention is

cpqipset -i ip_address -s subnet_mask -g gateway -a adapter

The parameter are

-i : this is the new ip address (normally the ip address of the PRIMARY server)

-s : this is the new subnet mask, it can be set only together with the gateway

-g : this is the new gateway address related to a new subnet mask

-a : this is the identifier for the adapter which should get the new binding

The fourth parameter is only necessary if there are more than one adapter cards in the system. The right adapter can be identified using the program "ipconfig /all". This program returns the list of the installed adapters and there properties. This makes it simple to identify the right adapter which should be changed.

Example:

cpqipset -i 129.13.13.100 -s 255.0.0.0 -g 129.0.0.254 -a cpqnf31

APPENDIX 3: POST-SWITCHOVER SCRIPT

Table 7 summarizes the actions taking place and implemented by the sample script shown after the table.

TABLE 7
ACTIONS TAKING PLACE AROUND SWITCHOVER

Action	Executes on	When	By Whom
Stop R/3 application server instance.	Recovery Server	After switchover	*SWITCH.BAT*
Stop R/3 instances in other servers.	Recovery Server	After switchover	*SWITCH.BAT*
Stop R/3 services SAPOsCol and SAPFAI_<InstanceNumber> of the application server instance on the recovery server.	Recovery Server	After switchover	*SWITCH.BAT*
Stop the SAP<Instance>_<InstanceNumber> service of the other application servers.	Recovery Server	After switchover	*SWITCH.BAT*
Remove share 'saploc' pointing to the application server instance directory (usually <drive>:\USR\SAP).	Recovery Server	After switchover	*SWITCH.BAT*
Change Recovery Server´s IP address and hostname	Recovery Server	After switchover	*SWITCH.BAT*
Create alternative SAP R/3 profiles for the central instance to run on the application server after the switchover.	Primary Server	Additional setup step	Administrator
Create alternative SAP R/3 profiles for the other application servers to access the recovery server after the switchover.	Application Servers	Additional setup step	Administrator
Save registry hives that must be modified: SYSTEM and SOFTWARE under HKEY_LOCAL_MACHINE	Recovery Server	After switchover	*SWITCH.BAT*
Add/Change environment variables required by the central instance and the database to run, according to the drive letters after the switchover.	Recovery Server	After switchover	*SWITCH.BAT*
Start database instances	Recovery Server	After switchover	SWITCH.BAT
Create 'sapmnt' and 'saploc' shares pointing to the directories of the switched disks, according to the drive letters after the switchover.	Recovery Server	After switchover	*SWITCH.BAT*
Create the service SAP<Instance>_<InstanceNumber> of the central instance to run on the application server.	Recovery Server	During Setup	Administrator

continued

Actions taking place around switchover *continued*

Action	Executes on	When	By Whom
Start the services SAPOsCol and SAP<XXX>_<XX> of the Recovery Server central instance on the application server.	After switchover		*SWITCH.BAT*
Start the SAPFAI_<InstanceNumber> services on the otherRecovery Server application servers.	After switchover		*SWITCH.BAT*
Start the R/3 central instance on recovery server	Recovery Server	After switchover	*SWITCH.BAT*
Start R/3 instances on the other application servers.	Recovery Server	After switchover	*SWITCH.BAT*
Undo all configuration changes	Recovery Server	After Primary Server is repaired	*UNSWITCH_BAT* executed by Administrator

SWITCH.BAT

```
rem switch script for SAP R/3 3.0c with ADABAS 6.1.1, ORACLE 7.2, MS SQL 6.5
rem
rem This script is initiated by the CPQRSGL.EXE
rem
rem copyright by Compaq Computer EMEA GmbH 1996
rem
rem Version 1.0
rem
rem **************************************************

echo. start failover script now !

rem Change the environment first
rem      change here the driveletter
         set SAPMNT=e:\usr\sap

         set path=%path%;%SAPMNT%\CPQ\sys\exe\run


rem **************************************************
rem the following section must be customized for the used database
rem uncomment the used database and patch where it is necessay
rem **************************************************
rem ORACLE ONLY ***********************************
rem **************************************************
rem      set ORACLE_HOME=e:\orant
rem      set SAPARCH=e:\oracle\saparch
rem      set SAPBACKUP=e:\oracle\sapbackup
rem      set SAPCHECK=e:\oracle\sapcheck
rem      set SAPREORG=e:\oracle\sapreorg
```

```
rem      set SAPSTAT=e:\oracle\sapstat
rem      set SAPTRACE=e:\oracle\saptrace
rem      set ORACLE_SID=CPQ
rem ***************************************************
rem ORACLE ONLY END *********************************
rem ***************************************************
rem
rem Change the timeout depending on your performance
rem DEFAULT = 8, slow 15, fast= 6
         set SAPTIMEOUT=8

rem Now we stop all existing Instances of the existing R/3
rem we stop the application server first
rem If you have further application server remove the remarks
rem as necessary and change the appropriate servernames, e.g.
rem    sapsrvkill app-srv_CPQ_02
rem    sapsrvkill <SERVERNAME>_<SID>_<INSTANCE>
rem .....

rem now we stop the central instance
rem change here recovery server name, sid and instance of the recovery server:
rem      sapsrvkill recoveryservername_sid_instance
         sapsrvkill recovery_CPQ_01

rem now we wait for the services to terminate
         sleep %SAPTIMEOUT%

rem the NT based R/3 services are the next parts to be stopped
rem change here the SID, the instance and the name of the recovery server
         netsvc SAPCPQ_01 \\RECOVERY /STOP
         netsvc SAPOsCol \\RECOVERY /Stop
         sleep %SAPTIMEOUT%

rem the same must be done for the application server
rem change here the SID, the instance and the name of the application server
         netsvc SAPCPQ_02 \\app-srv /Stop
         netsvc SAPOsCol  \\app-srv /Stop
rem    remove the remarks for the appropriate server number
rem    and replicate the following lines
rem    netsvc SAPCPQ_03 \\APPLICATIONSERVER3 /Stop
rem    netsvc SAPOsCol  \\APPLICATIONSERVER3 /Stop
rem ....
         sleep %SAPTIMEOUT%

rem now we switch the shares to the privious locations
rem of the PRIMARY on the switched devices
rem change here NOTHING
         net share saploc /DELETE /Y
         net share sapmnt /DELETE /Y
         net share saploc=%SAPMNT% /unlimited
         net share sapmnt=%SAPMNT% /unlimited
```

```
        sleep %SAPTIMEOUT%


rem here we change the ip address using cpqipset
rem change here all necessary parameters
        c:\users\cpqadm\cpqipset -i 193.141.225.12 -s 255.255.255.0 -g 193.141.225.12
                            -a CpqNF31


rem change here the file new_host_reg.ini
        regini c:\users\cpqadm\new_host_reg.ini


rem ****************************************************
rem now follow the database related parts
rem remove the comments for the used database and adapt the parameter for
rem the appropriate drive letters and paths
rem ****************************************************
rem ADABAS ONLY *************************************
rem ****************************************************
rem initialize the ADABAS databas for R/3 on the RECOVERY
rem      regini c:\users\cpqadm\ors_adasvc_reg.ini
rem
rem the ADABAS specific XServer must be started now
rem
rem      netsvc \\RECOVERY "XServer" /Start
rem      netsvc \\RECOVERY "ADABAS: CPQ" /Start
rem      sleep %SAPTIMEOUT%
rem ****************************************************
rem ADABAS ONLY END*********************************
rem ****************************************************


rem ****************************************************
rem MSSQL ONLY ***************************************
rem ****************************************************
rem initialize the MSSQL database for R/3 on the RECOVERY
rem      regini c:\users\cpqadm\ors_mssql_reg.ini
rem
rem      netsvc \\RECOVERY "MSSQLServer" /Start
rem      netsvc \\RECOVERY "SQLExecutive" /Start
rem      sleep %SAPTIMEOUT%
rem ****************************************************
rem MSSQL ONLY END **********************************
rem ****************************************************


rem ****************************************************
rem ORACLE ONLY ************************************
rem ****************************************************
rem      regini c:\users\cpqadm\ors_ora_reg.ini
rem      netsvc \\RECOVERY OracleServiceCPQ /Start
rem      netsvc \\RECOVERY OracleTCPListener /Start
rem ****************************************************
rem ORACLE ONLY END *********************************
rem ****************************************************
```

```
rem now follow the two SAP servcies
rem change here the SID, the instance and the recover server name
        netsvc SAPOsCol \\RECOVERY /Start
        netsvc SAPCPQ_00 \\RECOVERY /Start
        sleep %SAPTIMEOUT%


rem start the central instance
rem change here the server names (PRIMARY and RECOVERY !) and the SID
        sapstart
pf=\\RECOVERY\sapmnt\CPQ\SYS\profile\START_DVEBMGS00_primary.ors
        sleep %SAPTIMEOUT%


rem At the end we take a look at the other application servers.
rem First we copy the new appropriate configuration files then
rem we restart all related services.
rem change here the application server name, the SID and the instance
rem and replicate the following lines for as many application servers as needed
        copy \\app-srv\saploc\CPQ\D02\profile\START_D02_app-srv.ors
                \\app-srv\saploc\CPQ\D02\profile\START_D02_app-srv
        netsvc SAPOsCol \\app-srv /Start
        netsvc SAPCPQ_02 \\app-srv /Start
        sleep %SAPTIMEOUT%
        sapstart pf=\\app-srv\saploc\CPQ\D02\profile\START_D02_app-srv
                        SAPDIAHOST=app-srv

echo ... End of switch.bat script switch.bat
```

Sample Command File: SWITCH.BAT

APPENDIX 4: POST SWITCHOVER INI-FILES

In the file NEW_HOST_REG.INI we need the security token from the <SID>ADM.

```
\registry\user\S-1-5-21-2062420453-699613232-848847219-1001\environment
        PATH = REG_SZ 'e:\usr\SAP\CPQ\sys\exe\run'
```

Sample Command File: NEW_HOST_REG.INI

Now follow the ini-files for the used databases in alphabetical order. The first one is the switchover ini-file, the following always the unswitch ini-file which reverts the conversion. All samples are related to our sample installation. **Attention: Please be aware that your own installation may use different drive letters or directories. Before you change any existing parameter please write down the original value and check any change carefully.**

ADABAS/D:

```
\Registry\MACHINE\SYSTEM\CurrentControlSet\Services\ADABAS-CPQ\Parameters
        DBRoot = REG_SZ "E:\ADABAS"
        Version = REG_SZ "C-RTE  6.1.1    NT/INTEL DATE 1995-09-12"

\Registry\MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\environment
        DBROOT = REG_SZ "E:\ADABAS"
        lib = REG_EXPAND_SZ "%DBROOT%\lib"
        include = REG_EXPAND_SZ "%DBROOT%\incl"
        Path = REG_EXPAND_SZ
"%SystemRoot%\system32;%SystemRoot%;C:\RESKIT\;%DBROOT%\bin;%DBROOT%\pgm;
%DBROOT%\sap"
```

Sample Command File: ORS_ADASVC_REG.INI

```
\Registry\MACHINE\SYSTEM\CurrentControlSet\Services\ADABAS-CPQ\Parameters
        DBRoot = REG_SZ "C:\ADABAS"
        Version = REG_SZ "C-RTE  6.1.1    NT/INTEL DATE 1995-09-12"

\Registry\MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\environment
        DBROOT = REG_SZ "C:\ADABAS"
        lib = REG_EXPAND_SZ "%DBROOT%\lib"
        include = REG_EXPAND_SZ "%DBROOT%\incl"
        Path = REG_EXPAND_SZ
"%SystemRoot%\system32;%SystemRoot%;C:\RESKIT\;%DBROOT%\bin;%DBROOT%\pgm;
%DBROOT%\sap"
```

Sample Command File: ORG_ADASVC_REG.INI

MSSQL:

```
\Registry\MACHINE\Software\Microsoft\MSSQLServer\MSSQLServer\Parameters
       SQLArg0 = REG_SZ "-dE:\MSSQL\DATA\MASTER.DAT"
       SQLArg1 = REG_SZ "-eE:\MSSQL\LOG\ERRORLOG"
```

Sample Command File: ORS_MSSQL_REG.INI

```
\Registry\MACHINE\Software\Microsoft\MSSQLServer\MSSQLServer\Parameters
       SQLArg0 = REG_SZ "-dC:\MSSQL\DATA\MASTER.DAT"
       SQLArg1 = REG_SZ "-eC:\MSSQL\LOG\ERRORLOG"
```

Sample Command File: ORG_MSSQL_REG.INI

ORACLE:

```
\Registry\Machine\Software\Oracle
       API=REG_EXPAND_SZ 'E:\ORANT\DBS'
       DBA_CPQ_AUTHORIZATION = REG_SZ 'BYPASS'
       MSHELP_TOOLS = REG_EXPAND_SZ 'E:\ORANT\MSHELP'
       NLS_LANG = REG_EXPAND_SZ 'AMERICAN_AMERICA.US7ASCII'
       NLSRTL31 = REG_EXPAND_SZ 'E:\ORANT\NLSRTL31'
       ORA_NLS = REG_EXPAND_SZ 'E:\ORANT\NLSRTL31\DATA'
       ORACLE_GROUP_NAME = REG_EXPAND_SZ 'Oracle for Windows NT'
       ORACLE_HOME = REG_EXPAND_SZ 'E:\ORANT'
       PLSQL21 = REG_EXPAND_SZ 'E:\ORANT\PLSQL21'
       PLSQL22 = REG_EXPAND_SZ 'E:\orant\plsql22'
       PRO17 = REG_EXPAND_SZ 'E:\ORANT\PRO17'
       RDBMS71 = REG_EXPAND_SZ 'E:\orant\RDBMS71'
       RDBMS72 = REG_EXPAND_SZ 'E:\ORANT\RDBMS72'
       RDBMS72_ARCHIVE = REG_EXPAND_SZ 'E:\ORANT\DATABASE\ARCHIVE'
       RDBMS72_CONTROL = REG_EXPAND_SZ 'E:\ORANT\DATABASE'
       VS10 = REG_EXPAND_SZ 'E:\ORANT\BIN'
```

Sample Command File: ORS_ORA_REG.INI

```
\Registry\Machine\Software\Oracle
       API=REG_EXPAND_SZ 'C:\ORANT\DBS'
       DBA_CPQ_AUTHORIZATION = REG_SZ 'BYPASS'
       MSHELP_TOOLS = REG_EXPAND_SZ 'C:\ORANT\MSHELP'
       NLS_LANG = REG_EXPAND_SZ 'AMERICAN_AMERICA.US7ASCII'
       NLSRTL31 = REG_EXPAND_SZ 'C:\ORANT\NLSRTL31'
       ORA_NLS = REG_EXPAND_SZ 'C:\ORANT\NLSRTL31\DATA'
       ORACLE_GROUP_NAME = REG_EXPAND_SZ 'Oracle for Windows NT'
       ORACLE_HOME = REG_EXPAND_SZ 'C:\ORANT'
       PLSQL21 = REG_EXPAND_SZ 'C:\ORANT\PLSQL21'
       PLSQL22 = REG_EXPAND_SZ 'C:\orant\plsql22'
       PRO17 = REG_EXPAND_SZ 'C:\ORANT\PRO17'
       RDBMS71 = REG_EXPAND_SZ 'C:\orant\RDBMS71'
       RDBMS72 = REG_EXPAND_SZ 'C:\ORANT\RDBMS72'
       RDBMS72_ARCHIVE = REG_EXPAND_SZ 'C:\ORANT\DATABASE\ARCHIVE'
       RDBMS72_CONTROL = REG_EXPAND_SZ 'C:\ORANT\DATABASE'
       VS10 = REG_EXPAND_SZ 'C:\ORANT\BIN'
```

Sample Command File: ORG_ORA_REG.INI

APPENDIX 5: SAMPLE ALTERNATE PROFILES FOR RECOVERY SERVER

START_DVEBMGS00_primary.ORS

```
SAPSYSTEMNAME        = CPQ
INSTANCE_NAME        = DVEBMGS00
SAPSYSTEM            = 00
SAPGLOBALHOST        = primary
SAPLOCALHOST         = recovery
DIR_EXECUTABLE       =\\recovery\sapmnt\CPQ\sys\exe\run
DIR_EPS_ROOT         =\\recovery\sapmnt\trans\eps
DIR_EPS              =\\recovery\sapmnt\trans
DIR_INSTALL          =\\recovery\sapmnt\CPQ\SYS
DIR_INSTANCE         =\\recovery\sapmnt\CPQ\DVEBMGS00
DIR_PERF             =\\recovery\sapmnt\PRFCLOG
DIR_PUT              =\\recovery\sapmnt\put
DIR_TRANS            =\\recovery\sapmnt\trans
DIR_PROFILE          =\\recovery\sapmnt\CPQ\SYS\profile
#------------------------------------------------------------------
# start database
#------------------------------------------------------------------


_DB                  = strdbs.cmd
Start_Program_01     = immediate $(DIR_EXECUTABLE)\$(_DB) $(SAPSYSTEMNAME)


#------------------------------------------------------------------
# start message server
#------------------------------------------------------------------


_MS                  = msg_server.exe
Start_Program_02     = local $(DIR_EXECUTABLE)\$(_MS)
                        pf=$(DIR_PROFILE)\CPQ_DVEBMGS00_primary.ors


#------------------------------------------------------------------
# start application server
#------------------------------------------------------------------


_DW                  = disp+work.exe
Start_Program_03     = local $(DIR_EXECUTABLE)\$(_DW)
                        pf=$(DIR_PROFILE)\CPQ_DVEBMGS00_primary.ors
```

Sample Alternative Profile for Recovery Server: START_DVEBMGS00_primary.ORS

CPQ_DVEBMGS00_primary.ORS

```
SAPSYSTEMNAME         = CPQ
INSTANCE_NAME         = DVEBMGS00
SAPSYSTEM             = 00

SAPGLOBALHOST         = primary
SAPLOCALHOST          = primary

DIR_EPS_ROOT          = \\recovery\sapmnt\trans\EPS
DIR_EPS               = \\recovery\sapmnt\trans\
DIR_INSTALL           = \\recovery\sapmnt\CPQ\SYS
DIR_INSTANCE          = \\recovery\sapmnt\CPQ\DVEBMGS00
DIR_PERF              = \\recovery\sapmnt\PRFCLOG
DIR_PUT               = \\recovery\sapmnt\put
DIR_TRANS             = \\recovery\sapmnt\trans


#.************************************************
#.*  FOR MSSQL ONLY
#.************************************************
#.  rsdb/mssql/server          = recovery
#.  rsdb/mssql/sync_table_lists = D010LINF+D010L+TPFBA,D010L
#.  rsdb/rclu/lockrblog         = 1
#.  rsdb/update_max_attempt_no= 6
#.  rsdb/locale_ctype          = american_america.1252
#.************************************************
#.*  FOR MSSQL ONLY  END
#.************************************************


#.************************************************
#.*  FOR ORACLE ONLY
#.************************************************
#. SAPDBHOST                   =primary
#. rsdb/oracle_home            =E:\ORANT
#.************************************************
#.*  FOR ORACLE ONLY  END
#.************************************************


rdisp/wp_no_dia       = 2
rdisp/wp_no_vb        = 1
rdisp/wp_no_vb2       = 1
rdisp/wp_no_enq       = 1
rdisp/wp_no_btc       = 1
rdisp/wp_no_spo       = 1



…………….. continues ……
```

Sample Alternative Profile for Recovery Server: CPQ_DVEBMGS00_primary.ORS

APPENDIX 6: SAMPLE PROFILES FOR APPLICATION SERVER

START_D02_app-srv

```
#.*
#.*      generated by: R3INST
#.*
#.*-----------------------------------
SAPSYSTEMNAME        = CPQ
INSTANCE_NAME        = D02
SAPSYSTEM            = 02
SAPGLOBALHOST        = primary
DIR_EXECUTABLE       = $(DIR_INSTANCE)\exe


#-----------------------------------------------------------------------
# start replication
#-----------------------------------------------------------------------


_CP                  = sapcpe.exe
Start_Program_01     = immediate $(DIR_EXECUTABLE)\$(_CP)
                         pf=$(DIR_PROFILE)\CPQ_D02_app-srv


#-----------------------------------------------------------------------
# start application server
#-----------------------------------------------------------------------


_DW                  = disp+work.exe
Start_Program_02     = local $(DIR_EXECUTABLE)\$(_DW)
                         pf=$(DIR_PROFILE)\CPQ_D02_app-srv
```

Sample Application Server Local Profile File: START_D02_app-srv

CPQ_D02_app-srv

```
SAPSYSTEMNAME        = CPQ
INSTANCE_NAME        = D02
SAPSYSTEM            = 02
SAPGLOBALHOST        = primary
DIR_EXECUTABLE       = $(DIR_INSTANCE)\exe
DIR_CT_RUN           = $(DIR_INSTALL)\exe\run
rdisp/wp_no_dia      = 2



….. continues ….
```

Sample Application Server Local Profile File: CPQ_D02_app-srv

APPENDIX 7: SAMPLE ALTERNATE PROFILES FOR APPLICATION SERVER

START_D02_APP-SRV.ORS

```
SAPSYSTEMNAME         = CPQ
INSTANCE_NAME         = D02
SAPSYSTEM             = 02
SAPGLOBALHOST         = primary
SAPLOCALHOST          = app-srv
DIR_EPS_ROOT          = \\recovery\sapmnt\trans\EPS
DIR_EPS               = \\recovery\sapmnt\trans\
DIR_INSTALL           = \\recovery\sapmnt\CPQ\SYS
DIR_INSTANCE          = \\app-srv\saploc\CPQ\D02
DIR_PERF              = \\recovery\sapmnt\PRFCLOG
DIR_PUT               = \\recovery\sapmnt\put
DIR_TRANS             = \\recovery\sapmnt\trans
DIR_EXECUTABLE        = $(DIR_INSTANCE)\exe
DIR_PROFILE           = \\app-srv\saploc\CPQ\D02\profile


#-----------------------------------------------------------------------
# start replication
#-----------------------------------------------------------------------


_CP                   = sapcpe.exe
Start_Program_01      = immediate $(DIR_EXECUTABLE)\$(_CP)
                         pf=$(DIR_PROFILE)\CPQ_D02_app-srv.ors


#-----------------------------------------------------------------------
# start application server
#-----------------------------------------------------------------------


_DW                   = disp+work.exe
Start_Program_02      = local $(DIR_EXECUTABLE)\$(_DW)
                         pf=$(DIR_PROFILE)\CPQ_D02_app-srv.ors
```

Sample Application Server Alternative Profile File: START_D02_APP-SRV.ORS

CPQ_D02_APP-SRV.ORS

```
SAPSYSTEMNAME        = CPQ
INSTANCE_NAME        = D02
SAPSYSTEM            = 02
SAPGLOBALHOST        = primary
SAPLOCALHOST         = app-srv
DIR_EPS_ROOT         = \\recovery\sapmnt\trans\EPS
DIR_EPS              = \\recovery\sapmnt\trans\
DIR_INSTALL          = \\recovery\sapmnt\CPQ\SYS
DIR_INSTANCE         = \\app-srv\saploc\CPQ\D02
DIR_PERF             = \\recovery\sapmnt\PRFCLOG
DIR_PUT              = \\recovery\sapmnt\put
DIR_TRANS            = \\recovery\sapmnt\trans


DIR_EXECUTABLE       = $(DIR_INSTANCE)\exe
DIR_CT_RUN           = $(DIR_INSTALL)\exe\run

#.*****  the following line oracle only
#. rsdb/oracle_home        =C:\ORANT


rdisp/wp_no_dia      = 2
rdisp/wp_no_spo      = 1

…………. Continues ……..
```

Sample Application Server Alternative Profile File: CPQ_D02_APP-SRV.ORS

APPENDIX 8: SAMPLE UNSWITCH BATCH FILE

UNSWITCH.BAT

```
rem switch script for SAP R/3 3.0c with ADABAS 6.1.1, ORACLE 7.2, MS SQL 6.5
rem
rem This script is initiated by the SID account !!!!
Rem It switches the databse back to the primary server...
rem
rem copyright by Compaq Computer EMEA GmbH 1996
rem
rem Version 1.0
rem
rem ************************************************

echo start unswitch now !

set    SAPTIMEOUT= 8

rem stop the SAP instances first
        c:\usr\sap\CPQ\D01\exe\sapsrvkill RECOVERY_CPQ_00
        sleep %SAPTIMEOUT%


rem shutdown the R/3 instance service
        netsvc \\RECOVERY SAPCPQ_00 /Stop
        sleep %SAPTIMEOUT%



rem ************************************************
rem ADABAS ONLY ************************************
rem ************************************************
rem shutdown the ADABAS
rem      netsvc \\RECOVERY "ADABAS: CPQ" /Stop
rem      netsvc \\RECOVERY "XServer" /Stop
rem      regini c:\users\cpqadm\org_adasvc_reg.ini
rem ************************************************
rem ADABAS ONLY END********************************
rem ************************************************


rem ************************************************
rem MSSQL ONLY ************************************
rem ************************************************
rem      netsvc \\RECOVERY "MSSQLServer" /Stop
rem      netsvc \\RECOVERY "SQLExecutive" /Stop
rem      regini c:\users\cpqadm\org_mssql_reg.ini
rem ************************************************
rem MSSQL ONLY END *******************************
rem ************************************************
```

```
rem ***************************************************
rem ORACLE ONLY **************************************
rem ***************************************************
        netsvc \\RECOVERY OracleTCPListener /Stop
        netsvc \\RECOVERY OracleServiceCPQ /Stop
        regini c:\users\cpqadm\org_ora_reg.ini
rem ***************************************************
rem ORACLE ONLY END **********************************
rem ***************************************************

rem restore the hostname
        regini c:\users\cpqadm\org_host_reg.ini

rem stop, restore and start all other application server
        netsvc SAPCPQ_02 \\app-srv /Stop
        netsvc SAPOsCol  \\app-srv /Stop
        sleep %SAPTIMEOUT%
        copy \\app-srv\saploc\CPQ\D02\profile\START_D02_app-srv.org \\app-
srv\saploc\CPQ\D02\profile\START_D02_app-srv
        netsvc SAPOsCol  \\app-srv /Start
        netsvc SAPCPQ_02 \\app-srv /Start
        sleep %SAPTIMEOUT%
        sapstart pf=\\app-srv\saploc\CPQ\D02\profile\START_D02_app-srv
SAPDIAHOST=app-srv
rem do the same with all other application servers

rem restore the shares on the server
        net share sapmnt /delete /Y
        net share saploc /delete /Y
        net share saploc=c:\usr\sap /unlimited

        set path = %PATH%

        c:\users\cpqadm\cpqipset -i 193.141.225.13 -s 255.255.255.0 -g 193.141.225.13 -a
CpqNF31

echo \n\nNow bring up the whole system (DISKS / PRIMARY /RECOVERY).
pause
```