# WHITE PAPER

December 1996

Compaq Computer Corporation

## Backup of Windows NT SAP R/3 Systems with ARCserve

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COMPAQ

### EXECUTIVE SUMMARY

*Cheyenne is the main partner of Compaq for backup solutions. According to the growing interest on professional backup solutions Compaq did an evaluation of the functionality and performance of Cheyenne ARCserve 6 for Windows NT, which is documented in this White Paper.*

*Compaq tested the functionality of ARCserve 6 but the main focus of the tests was to get performance data of backup and restore in various corner scenarios that will allow predictions for real-life behavior. All the tests were done with SAP R/3 on an Oracle system.*

*The maximum backup rate that was achieved for a backup on Windows NT file system level was 39 GB/h. Using the ARCserve Image Option that bypasses the Windows NT file system for even higher performance between 46 GB/h and 53 GB/h could be stored, depending on the type of tape RAID array. Compaq also did online R/3 backups, simulating different load conditions by using the SAP benchmark suite. The backup rate was between 20 GB/h with high R/3 load and 43 GB/h with low R/3 load.*

*The restore rate was not primarily determined by the tape drive subsystem, but in the high performance cases was restricted to the write performance of the disk subsystem. The maximum restore rate was between 19 GB/h and 25 GB/h depending on the type of the disk RAID array.*

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## TEST ENVIRONMENT

The following lists show what hardware and software was used in the test environment.

### Hardware

The following hardware was used for evaluating the Cheyenne ARCserve product:

| | |
|---|---|
| Computer | Compaq ProLiant 5000 |
| Processors | 2 x 200 MHz Pentium Pro, $L_2$ Cache 512 Kbytes |
| Memory | 1 gigabyte |
| Disks | C: 2 x 2.1 gigabyte RAID1 |
| | E: 2 x 2.1 gigabyte RAID1 |
| | F: 10 x 4.3 gigabyte RAID 5 |
| | G: 2 x 2.1 gigabyte |
| Controller | 4 x Compaq 32 bit Fast Wide SCSI-2 Controller for Compaq 15/30 DLT Tape Drives |
| | 2 x Compaq SMART-2 Array Controller for Disks |
| Tapes | 8 x Compaq 15/30 DLT Tape Firmware 840B |
| Network | 100 Mbit Ethernet |

### Software

The following software was used for evaluating the Cheyenne ARCserve product:

| | |
|---|---|
| Operating system | Windows NT3.51, Build 1057, SSD 1.18, Service Pack 4 |
| Database | Oracle 7.2.2.4.5 |
| Database Data | SAP IDES Client Version 3.0D |
| SAP R/3 | R/3 3.0D |
| SAP R/3 backup tools | SAPDBA 3.0C |
| Oracle Agent | Cheyenne R/3 Agent for Oracle 2.0 |
| Backint Agent | Cheyenne R/3 Agent for Oracle 2.0 |
| Backup product | Cheyenne ARCserve 6.0 |
| DLT driver | Cheyenne ARCserve DLT driver |

## TEST CONCEPT

The test scenarios discussed in this White Paper focused on the parallel operation of DLT tape devices to improve backup performance. Compaq testing verified the functionality of the integration solution and then investigated different off-line and online scenarios.

**NOTE:** Compaq does not recommend using DAT tape drives for production systems due to their low performance and reliability. All tests for this White Paper were run only with DLT tape drives.

Testing revealed that the particular configuration of a disk subsystem has much more influence on the performance than initially expected. As you read this White Paper, then, you will find some test scenarios using different disk subsystem configurations to show how the configurations effected performance.

Test scenarios, although carefully chosen, create certain results which might not always be achievable in all production sites. In addition, these tests are not meant to substitute or complement any of the vendor's quality tests of these software products.

To have representative data Compaq used the SAP IDES client. Together with the SAP R/3 benchmark client the database had a size of about 16 gigabytes. See the Appendix for detailed information.

The tests in this document are divided into the following parts:

- Functionality of ARCserve

  Testing the functionality of the ARCserve software.

- Compression tests

  The goal of these tests was to well understand hard- and software compression and to determine typical compression figures for R/3 on Oracle systems.

- Performance of the disk subsystem

  These tests determine the performance characteristics of the disk drive array.

- Backup tests

  Testing on Backup of files, Image backup, Online backup with ARCserve R/3 Agent for Oracle, Off-line and online backup with the *SAPDBA* via *backint.* See section "ARCserve Functionality" for detailed information about the different backup types.

- Restore tests

  Testing on Restore of files, Image restore, Restore with ARCserve R/3 Agent for Oracle, Restore with the *SAPDBA* via *backint.*

## ARCSERVE FUNCTIONALITY

The following section briefly describe the functionality of ARCserve. See the Cheyenne ARCserve documentation for more detailed information.

### ARCserve Installation

ARCserve is installed by simply calling the setup program on the ARCserve CD. The basic ARCserve component is installed first. The following options have to be purchased and installed separately:

- SAP R/3 agent for backup and restore of an Oracle based R/3 system. This agent includes the backint interface for an R/3 backup using the SAPDBA program. The SAP R/3 agent is similar to the Oracle database agent but additionally contains some special settings for R/3.
- Image option for fastest backup and restore of complete partitions, by passing the Windows NT file system.
- RAID engine for operating several physical tape drives in a drive array, which is very similar to the RAID operation of hard disks in a disk drive array.

After you have installed the core product plus all available options of ARCserve you get a program group in your Windows NT Program Manager as shown in Figure 1.

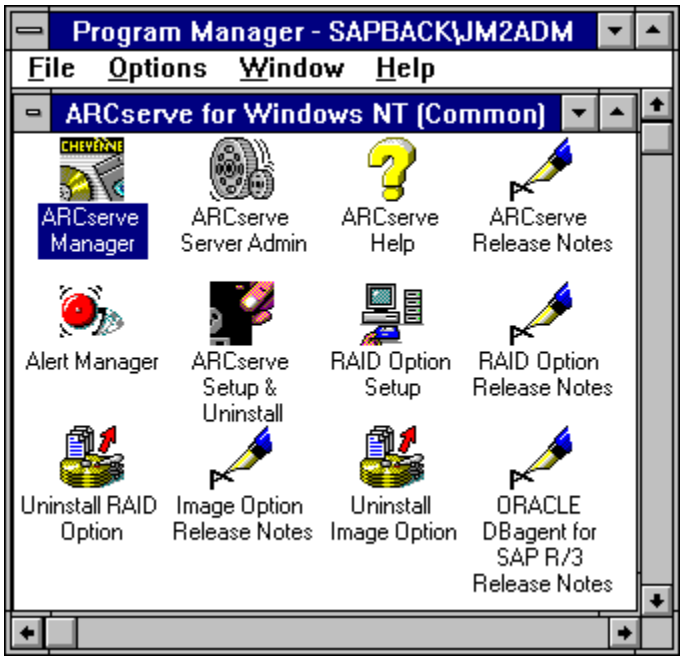



*Figure 1: ARCserve program group*

If you are using the backint interface you additionally have to:

- edit the init<SID>.sap parameter file that contains the settings for the R/3 backup and restore :
  backup_dev_type = util_file
  util_par_file = <name of the ARCserve parameter file, e.g. initJM2.utl>

- edit the ARCserve parameter file for backint (e.g. initJM2.utl) by defining the tapes that should be used for the backup (see Appendix for an example file)

Both files can be found in the %ORACLE_HOME%\database directory.

The following section will give you some brief information of the functionality of ARCserve 6.0 for Windows NT. See the ARCserve documentation or a product information of ARCserve for further information.

## ARCserve Manager

The ARCserve Manager is the main program that is used for nearly all operations.

After the startup of the ARCserve Manager you get the Quick Access window as shown in Figure 2 where you can decide which operation you want to start. You can chose between:

- Job Status
- Backup
- Restore
- Copy
- Media Pool Management
- Device Management
- Database
- Reports

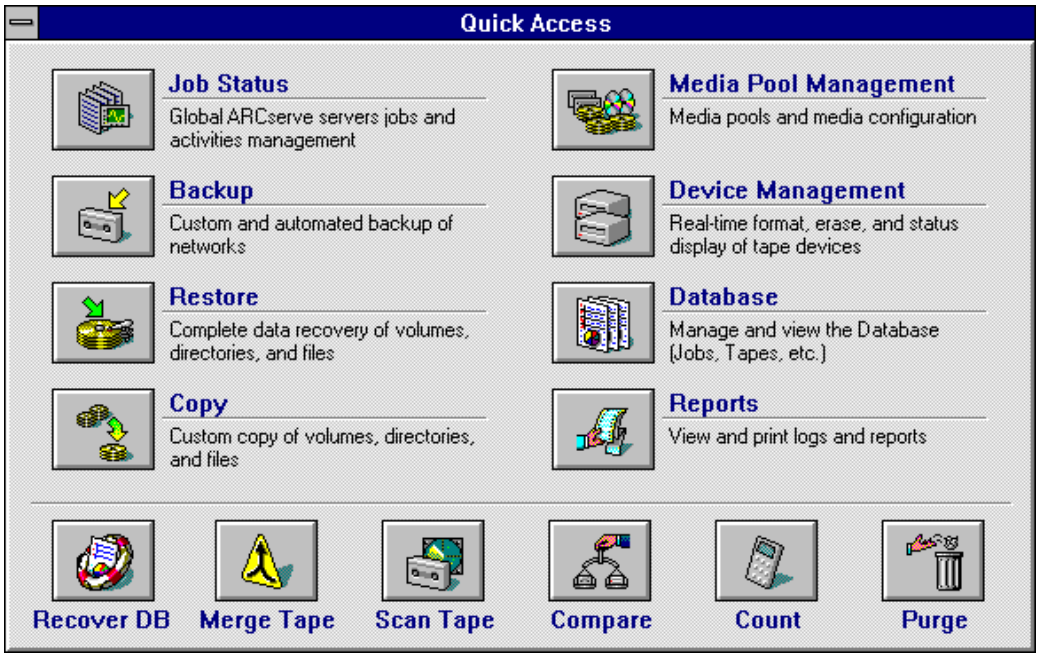



*Figure 2: Quick Access window*

You can switch to any other options after you started at any time.

## Backup

If you choose the backup item, the Backup window is displayed as shown in Figure 3. At this point, you can select which kind of backup you want to start or schedule.

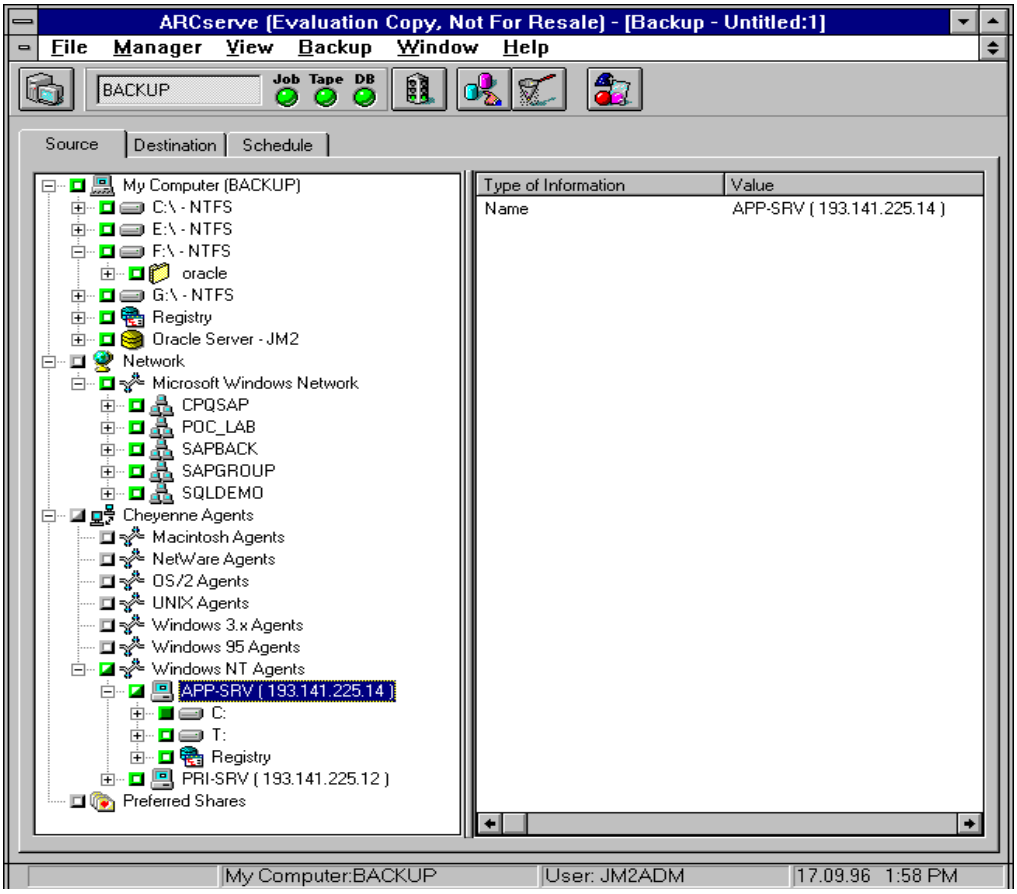



*Figure 3: Backup window*

There are three major groups of backup that are provided by ARCserve for Windows NT.

**The first group** is the local backup (My Computer) where you can select single files, complete disks, the registry, or databases if you have installed any database agent. If you select a complete disk and you have installed the add-on Image Option you can make an image backup of this disk. ARCserve Image Option for Windows NT allows the backup/restore of local hard drives in the image mode. Image Option bypasses the Windows NT file system. Image Option reads/writes data at sector level and also uses asynchronous I/O mechanisms for higher performance.

The R/3 database agent allows you to backup the complete database in online mode including the SAPARCH directory and control files.

ARCserve provides the option to backup the registry of a running Windows NT.

**The second group** is the network backup (Network) that allows you to backup files via an Windows NT share (pull concept). There is also an option to backup the registry of remote servers.

**The third group** is the agent backups (Cheyenne Agents) that allows you to backup data from Macintosh, Netware, OS/2, UNIX, Windows 3.x, Windows 95, and Windows NT clients (push

concept). For this kind of backup you have to install the agent software on the client and configure the new connection on the server.

## Restore

If you choose the restore item, the Restore window is displayed as shown in Figure 4. At this point, you can choose which kind of restore you want to start.


*Figure 4: Restore window*

Each restore job requires a source and a destination. The files selected as your source will always come from a tape. The location selected as your destination will always be a hard drive.

ARCserve provides you with four methods for selecting the data you want to restore (the source) which are:

- Restore by Tree
- Restore by Tape
- Restore by Query
- Restore by Tape Media

The first three methods use information logged in ARCserve's database, while the fourth method does not. In addition, if you have purchased separately the Image Backup Option, Restore by Image will also be available. You also have several methods for selecting a destination to restore the data to the machine.

**The Restore by Tree**view allows you restore a specific directory or drive. This view displays a machine tree of files and directories that were backed up with ARCserve as shown in Figure 5. It is also possible to restore individual files from an Image Backup.


*Figure 5: Restore by Tree*

First of all the **Restore by Tape**allows you to select the tape, then the session, and finally, the files and directories you want to restore. This source view is useful if you know the tape that holds the data you want to restore, but you are not sure of the right session it is in.

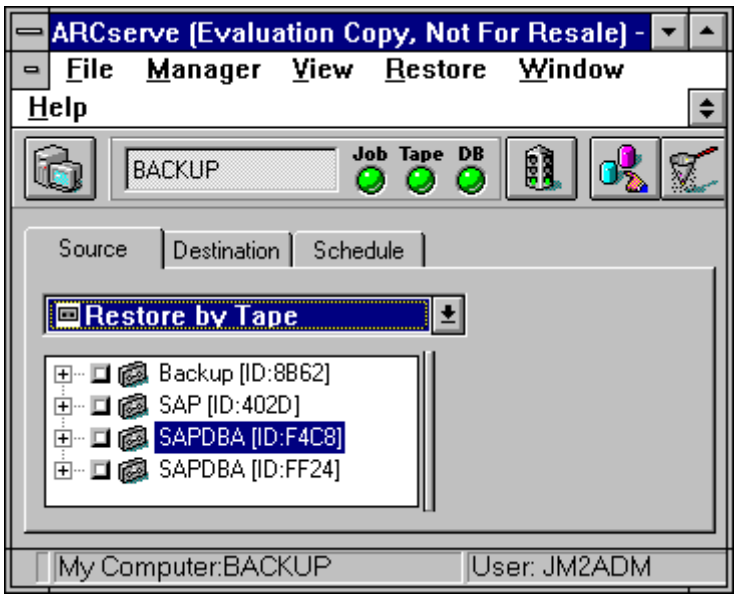



*Figure 6: Restore by Tape*

The **Restore by Query** source is used to restore files when you already know the name of the file or directory you want to restore, but you do not know the machine it was backed up from or the tape(s) it was backed up to. This view also uses the ARCserve database. As long as the file and directory information is logged in the database, you can effectively use this view to select files to restore.

The **Restore by Tape Media** allows you to restore complete sessions on a tape to a tape device. All files in this session are restored to the destination, unless filters are added to the job. This source is either useful in case information from your ARCserve database is unavailable, or in case you try to recover your network after a disaster.

Image mode restore ('**Restore by Image**' mode in ARCserve Restore Manager) overwrites the target volume data.

## ARCserve Tape Label Handling

The ARCserve tape label handling is done by the different tools. The first one is the **Device Manager**.

If you have more than one tape device connected to your Windows NT machine, ARCserve lets you separate them into two or more "groups". Establishing tape groups is a key component of ARCserve's flexibility and efficiency.

The tape groups enable you to perform the following options:

- parallel streaming - you can have several operations occurring simultaneously, one at each tape group configured for your system.
- automated tape spanning - if, during a backup session, the tape becomes filled, ARCserve automatically spans to another tape in another device within the same tape group.

By default, ARCserve is installed with each tape device assigned to its own group. ARCserve finds identical tape drives during the installation, placing them automatically in the same group. Later, you can use the Device Manager to regroup your devices. As you can have up to seven tape devices connected to each SCSI bus in your machine, you can have up to seven tape groups per SCSI board.

There is only one rule when assigning tape devices to the same group; the devices in the group must be identical. That means they must be the same make and model.

The Device Manager is also used for formatting tapes. By formatting a tape you can specify a tape name, which represents together with the tape ID (4 digits chosen by ARCserve) a kind of tape label.

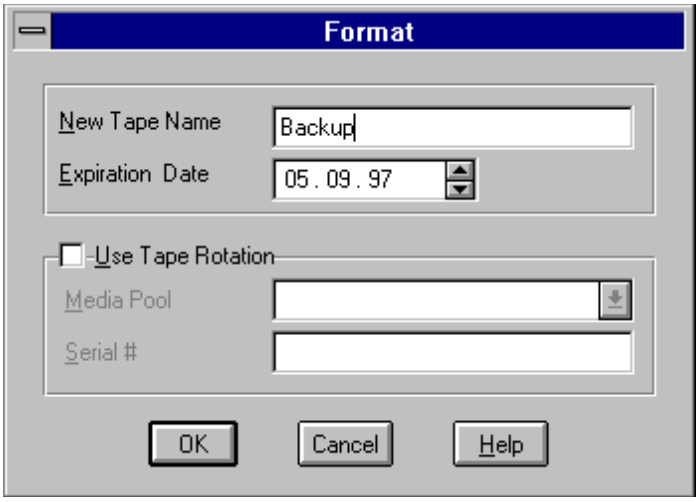



*Figure 7: Format window*

The second tool is the**Media Pool Management**utility.

A media pool is a collection of media managed as a unit. Tape rotation or grandfather-father-son (GFS) methods of backup are based on media pools. Each media pool is assigned a name and the media is organized according to serial numbers. The serial numbers assigned are permanent and if you are using a device with a bar code reader, the bar code labels will be used for the serial number of the media. The media pools are organized by the range of serial numbers of the media they contain and are divided into two sets, the Save Set and the Scratch Set.

The set of media containing important data that can not be overwritten is called the Save Set. Once the media has passed several criteria these will be recycled and re-used. The media from the Save Set, that has met several criteria (minimum number of media to save and retention period) and therefore can be re-used and overwritten, is placed in the Scratch Set.

Each time a media is written to, it moves from the Scratch Set to the Save Set. That media will move back to the Scratch Set once the specified criteria have been met.

Media pools apply to every media, regardless of the selected backup type and method. All rotation backup jobs will create their own media pool based on the name entered in the Media Pool Name field of the Schedule dialog box for simple rotation, or the prefix entered in the Media Pool Name Prefix field with GFS enabled. The GFS backup uses three media pools:

- Daily
- Weekly
- Monthly

These three pools are also based on the information entered in the Media Pool Name Prefix field. For example, if you enter ACTG as the Media Pool Name Prefix for an GFS backup job, the Daily media pool name would be ACTG_DLY.

For a simple (single media pool) rotation, you specify the complete name for the media pool.

## ARCserve Engine Administrator

In the ARCserve Windows NT group, you can find the ARCserve Engine Administrator. With the Engine Administrator you are able to start and stop the different ARCserve engines (Job, Tape, and Database Engine). In this applet, you can also see the status and some more data of these engines. Normally you do not need this utility because you can start and stop the engines with the ARCserve Manager and the Windows NT Service Manager.

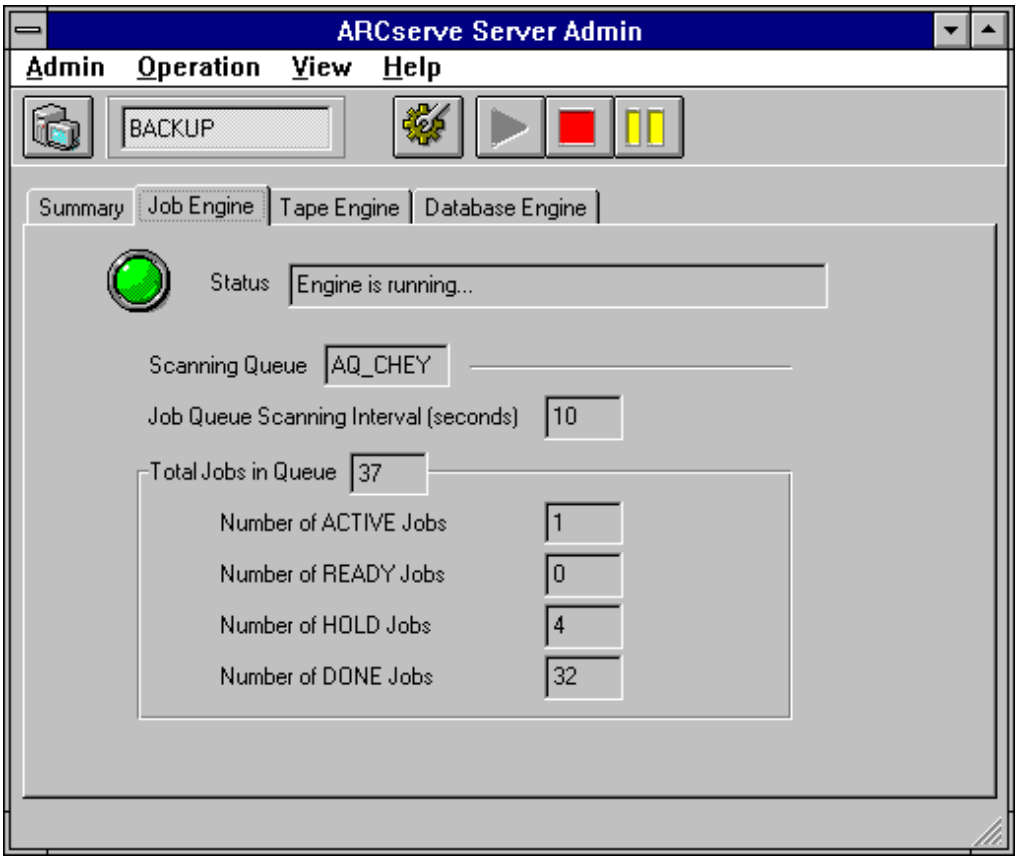



*Figure 8: ARCserve Server Admin*

## ARCSERVE RAID ENGINE

The ARCserve RAID Engine is generating out of a group of physical tape drives one or more logical tape drives applying one of the RAID algorithms that are well known from hard disk arrays. Currently there is support for RAID0 (striping) and RAID5 (distributed data guarding). Support for RAID1 (mirroring) is planned for the next release of the RAID option.

You can only group the same kind of tape devices to a logical tape drive. It is not possible to mix different drives like DLT-tapes with DAT-tapes. But you can define a group of DLT-tapes and a group of DAT-tapes. The current implementation of the RAID engine allows for up to 8 physical tape drives belonging to one logical tape drive. For performance reasons, you should never connect more than 2 DLT drives to 1 SCSI controller. So in the test environment, Compaq used up to 4x "32-Bit Fast-Wide SCSI-2/P Controllers" for the 8 DLT drives test scenario.

You can choose between different RAID levels that are the same as in a disk environment.

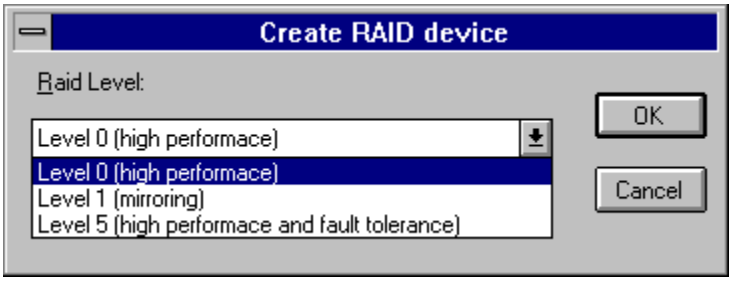



*Figure 9: ARCserve RAID options*

### Tape Array Functionality

ARCserve provides the capability to combine multiple physical tape drives into one physical RAID array. Data is distributed equally over all tapes of the RAID system. As this increases the probability of failure (if one tape of the RAID system is damaged, the whole backup is lost), additional mechanisms for data safety are included in the RAID technology. There are three RAID levels:

- RAID 0

  RAID 0 only distributes data over all tapes of the RAID system. It does not provide any features for error correction but provides a higher data throughput than single devices. 100% of the tape net capacity can be used.

- RAID 1

  RAID 1 uses the mirror technique to reduce the probability of data loss in case of a damaged tape. Data is written on two tapes in parallel. For a RAID1 tape array at least two tape devices are needed. 50% of the net capacity can be used for the backup. RAID 1 has not been available in the tested version of ARCserve.

- RAID 5

  RAID 5 generates checksums for the data to be backed up and distributes data as well as checksums over all tapes of the RAID system. If one tape is damaged, data can be restored from the remaining tapes. This mechanism needs less tapes than RAID 1. A RAID 5 array consists of at least three tape drives. It needs one additional tape, i.e. net capacity plus one tape.

The tested ARCserve version supported RAID0 and RAID5 tape arrays. They can be configured with the *ARCserve RAID Option Setup*program as shown in Figure 10.

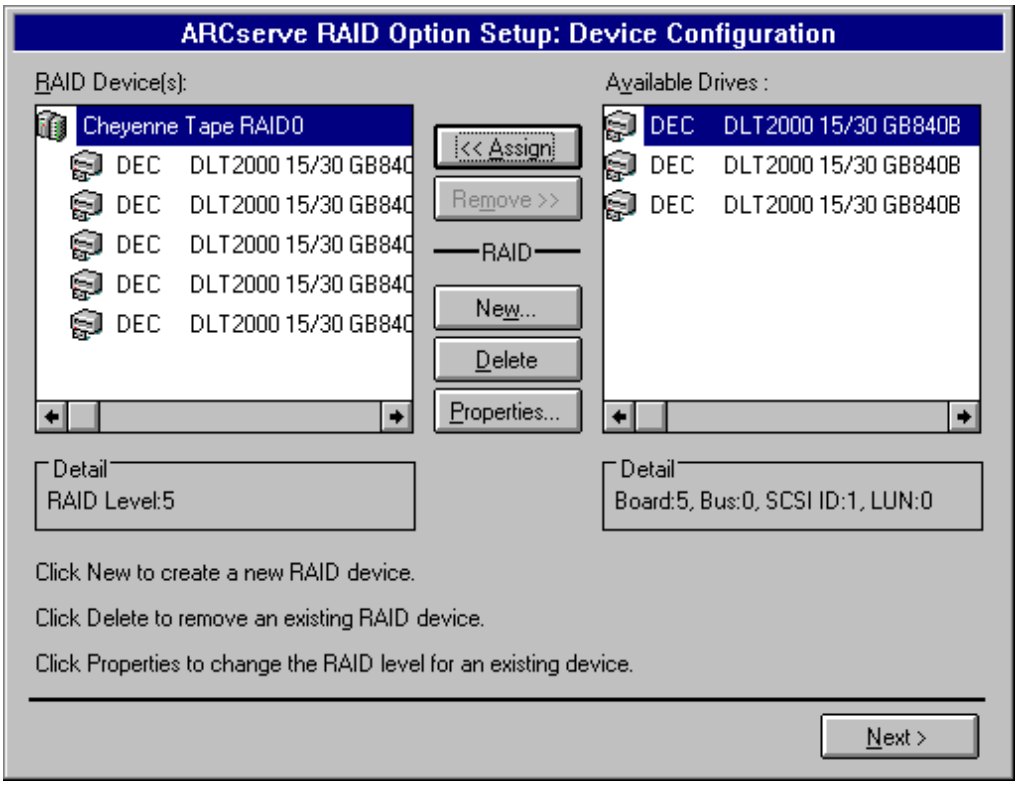



*Figure 10: ARCserve RAID Option Setup*

## COMPRESSION TESTS

The following sections describe the compression tests.

### Capacity of DLT Cartridges

Compaq determined the capacity of a 15 gigabyte DLT cartridge. The capacity was calculated by writing data in no-compression mode to the tape until the „end of tape“ error occurred. The following data was found:

- DLT tape 15 gigabyte

### Compression Factor of an Initial R/3 System

In this test, an initial R/3 system was used as it is created right after the installation of the CD-ROM. The only deviation to this was the import of the benchmark client 900 that had been used for the online scenarios. This resulted in a total size of the database of 4.0 gigabytes. For software compression, Compaq used the compress command that comes with the R/3 software.

As there was no direct way to determine the hardware compression factor, this factor was calculated by writing hardware-compressed data so many times to the tape until the „end of tape“ error occurred.

| | SW compression factor | HW compression factor DLT | HW compression factor DAT |
|---|---|---|---|
| Datafiles of an initial R/3 system with Client900 | 1 : 5.02 | 1 : 4.92 | 1 : 4.36 |

*Figure 11: Compression factors*

Of course the compression factors of individual tablespaces of the R/3 database are different and depend on the fill rate and the type of data that is stored in a specific datafile. In order to get a better feeling for this effect the compression factor for individual tablespaces was determined.

| Tablespace | SW compression factor | HW compression factor DLT |
|---|---|---|
| PSAPSOURCED | 1 : 2.00 | 1 : 2.24 |
| PSAPLOADD | 1 : 2.80 | 1 : 2.97 |
| PSAPBTABD | 1 : 22.37 | 1 : 13.92 |

*Figure 12: Compression factors of SAP R/3 tablespaces*

## Compression Factor of a Productive R/3 System

It is clear that productive R/3 systems can have a lower compression factor than our initial R/3 system because tablespaces are more filled and the nature of data might be different.

In addition, we had the opportunity to determine the compression factor of a productive system with a 18 gigabyte database, using the command "brbackup -k only". Depending on the installed processing power this can easily become an overnight operation and unfortunately had to be stopped in our case before completion.

However, Compaq can compare the results gained up to the present:

| | **SW compression factor** |
|---|---|
| Tablespaces PSAPBTABD .. PSAPSOURCED of 18 GB database of a **productive R/3 system** | 1 : 3.63 |
| Tablespaces PSAPBTABD .. PSAPSOURCED of our **initial R/3 system** with Client 900 | 1 : 4.12 |

*Figure 13: Compression factors of a compete R/3 oracle database*

As expected, the compression factor of the test system was slightly better (about 10% ) than the compression factor of a database in a large productive system. By talking with some SAP basis consultants, Compaq believes that typically a factor of 1:3 could be used as a conservative estimate. This would mean that 1 DLT cartridge can hold 15 gigabyte * 3 = 45 gigabyte of data, as they are typically found in a R/3 system.

## Summary

It has been realized that the hardware compression factor is about the same as the software compression factor, at least for small compression rates up to 1:3. This shows that SAP's assumption hardware compression equals software compression is valid and their mechanism can be used in the native mode via *cpio* for our tape devices.

Nevertheless it is important to understand what compression rates can be expected. As shown a rate of 1:3 should be a good conservative estimate for a typical R/3 system. This means that a 15 gigabyte DLT cartridge can hold 45 gigabyte of R/3 data. Should a customer decide to employ 2 DLT drives in parallel for performance reasons, they could do an unattended backup of a 90 gigabyte database. So in a lot of cases, a tape library might not be needed as quickly as it initially appears.

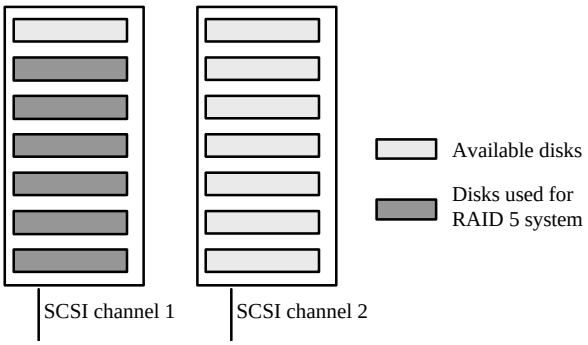
In general, you want to do a backup using a hardware compression mechanism. This helps to reduce the demand for CPU power that is especially needed in online scenarios. Therefore all ARCserve testing has been done only with hardware compression.

## PERFORMANCE OF THE DISK SUBSYSTEM

The maximum performance with which a backup or restore job can be done is among other factors determined by the performance of the disk subsystem. In order to understand this influence on the overall ARCserve performance, Compaq did some isolated disk performance tests with different disk subsystem configurations. Compaq used the Completion port I/O test utility provided with the Compaq Resource Kit for Windows NT. Basically, 2 configurations were tested. In one case, Compaq just operated an increasing number of disk drives on 1 SCSI channel of the SMART-2 controller. In the other case, Compaq distributed an increasing number of disk drives equally over the 2 SCSI channels of the SMART-2 controller. As RAID5 is a very cost effective fault tolerance mechanism, Compaq started out with RAID5 configurations. However as naturally write accesses to a RAID5 volume always carry the burden of the additional read and write access for the parity generation, Compaq also looked at a few RAID1 configurations.

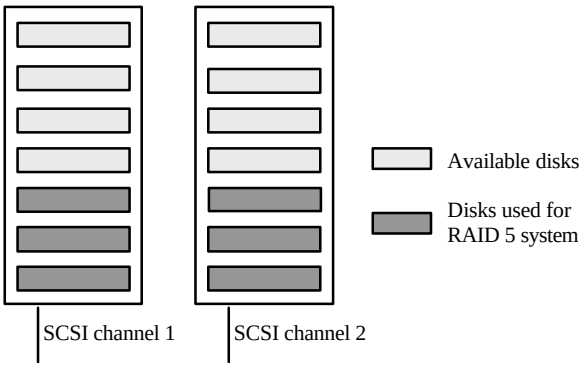
The following diagram depicts more details of the 1 and 2 SCSI channel configuration with the example of a 6 disks configuration.

- 6 * 4,3 GByte disks
- SMART-2 controller
- 6 disks connected to one SCSI channel




In the tests with two SCSI channels, Compaq distributed the disks equally to the two disk cabinets.

- 6 * 4,3 GByte disks
- SMART-2 Controller
- 3 disks at SCSI channel 1, 3 disks at SCSI channel 2




Compaq did tests from three disks, which means the minimum for a RAID 5 configuration was up to ten disks.

| RAID 5 disk configuration | Read performance in GB/h | Write performance in GB/h |
|---|---|---|
| 3 x 4.3 GB disks on 1 SCSI channel | 45 | 12 |
| 3 x 4.3 GB disks on 2 SCSI channels | 51 | 12 |
| 4 x 4.3 GB disks on 1 SCSI channel | 46 | 15 |
| 4 x 4.3 GB disks on 2 SCSI channels | 73 | 15 |
| 5 x 4.3 GB disks on 1 SCSI channel | 48 | 16 |
| 5 x 4.3 GB disks on 2 SCSI channels | 72 | 17 |
| 6 x 4.3 GB disks on 1 SCSI channel | 49 | 17 |
| 6 x 4.3 GB disks on 2 SCSI channels | 83 | 17 |
| 7 x 4.3 GB disks on 2 SCSI channels | 81 | 18 |
| 8 x 4.3 GB disks on 2 SCSI channels | 91 | 19 |
| 9 x 4.3 GB disks on 2 SCSI channels | 86 | 19 |
| 10 x 4.3 GB disks on 2 SCSI channels | 94 | 19 |

*Figure 14: Disk subsystem performance of RAID 5 configurations*

To get the maximum performance, Compaq also did some tests with RAID 0 and RAID 1 configurations. It was found out, that in order to obtain the best write performance, you have to set the Stripe Factor of the Compaq SMART Array controller to 32. For RAID 5 configurations the default number is already 32. For RAID 0 and RAID 1 configurations the default value is 256. To change the Stripe Factor of the Compaq SMART-2 Array controller, the Compaq utility CONFIG.EXE was used. Figure 15 shows the maximum numbers optimized for the write performance.

| RAID0, RAID1disk configuration Stripe Factor 32 | Read performance in GB/h | Write performance in GB/h |
|---|---|---|
| 12 x 4.3 GB RAID 0 | 90 | 32 |
| 14 x 4.3 GB RAID 0 | 99 | 33 |
| 12 x 4.3 GB RAID 1 | 63 | 26 |
| 14 x 4.3 GB RAID 1 | 74 | 26 |
| 7 x 4.3 GB RAID 0 on 1 SCSI channel | 50 | 27 |

*Figure 15: Disk subsystem performance of RAID 0 and RAID 1 configurations*

As you see in Figure 15, the best write performance that is important for the restore process is 33 GB/h with 14 disks in a RAID 0 configuration. For SAP systems, the fault tolerance is of high significance. The fastest fault tolerance configuration which can be implemented is a RAID 1 configuration with 14 disks. With the RAID 1 configuration, Compaq got a read rate of 73 GB/h and a write rate of 26 GB/h. The last two numbers show that the overhead in the write process of a RAID 1 configuration is not very high (26 GB/h vs. 27 GB/h).

There is also a feature to change the cache settings of the Compaq SMART2 Array controller. For all these tests, the SMART2 Array controller cache was set to 50% read and 50% write. Changing the SMART-2 cache configuration did not improve the disk performance in the particular test environment, as Figure 16 shows:

| Cache configuration (10 x 4 GB disks on 2 SCSIs) | Read performance in GB/h | Write performance in GB/h |
|---|---|---|
| 50% read, 50% write | 934 | 19 |
| 0% read, 100% write | 93 | 19 |
| 100% read, 0% write | 94 | 13 |

*Figure 16: Comparison of different cache configurations*

If not stated differently, Compaq used the following disk subsystem configurations as a result of these test results. If highest restore rates possible are required the only (expensive) solution then would be to utilize a mirrored disk subsystem for the volume(s) carrying the database files.

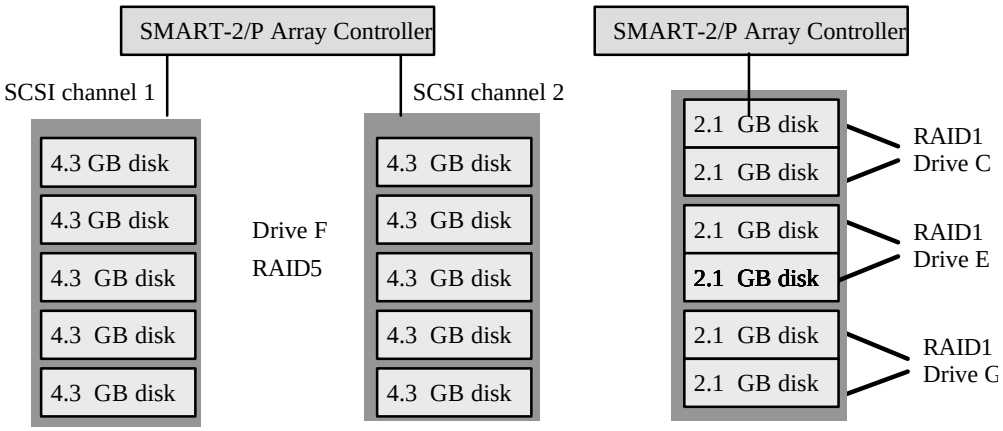



*Figure 17:Disk configuration*

All drives are formatted with NTFS, block size 4 Kbytes.

Drive C: NT operating system and page file

Drive D: CD-ROM

Drive E: SAP R/3 and Oracle executables, SAPARCH directory

Drive F: Database Data

Drive G: Online Redo Logs

## DLT configuration

DLT tapes : 8 x Compaq 15/30 DLT tape firmware 840B

For performance reasons Compaq never connected more than two DLT tape drives to one SCSI Controller.

## PCI configuration

The assignment of PCI controllers to PCI slots was chosen very carefully in order to get the maximum performance out of the 2 PCI buses of the ProLiant 5000. There is an oversimplified rule which says that controllers among which a lot of I/O is expected to occur should be grouped on one PCI bus and I/O traffic across the 2 PCI busses should be avoided.

There is a White Paper titled "Configuring the Compaq ProLiant 5000 Server for Peak Performance" available on the Webthat can provide you with more details

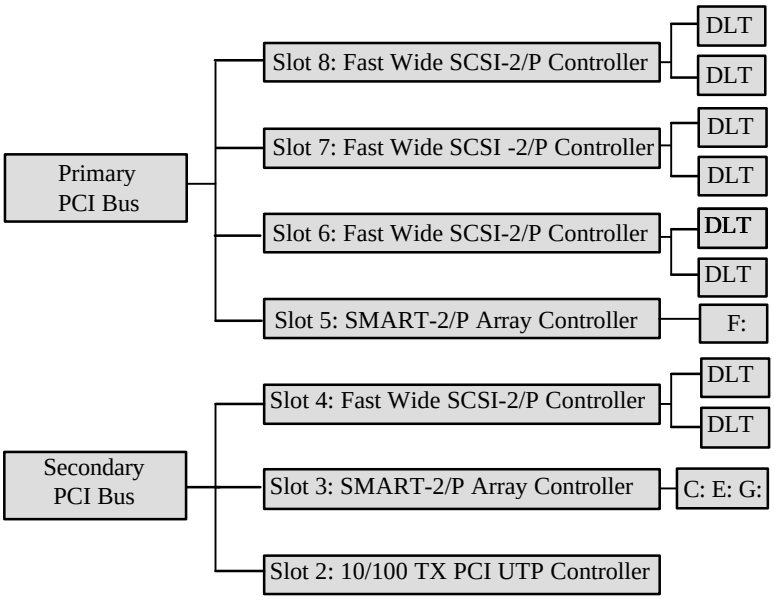
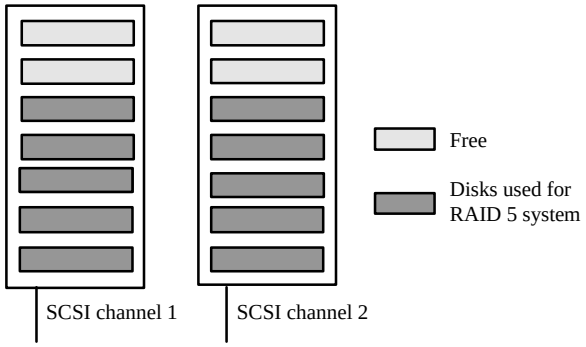



*Figure 18: Controller configuration*

## ARCSERVE BACKUP

As already described in the ARCserve functionality section, you have different options to do a backup. With ARCserve you are able to make off-line and online backups. The off-line backup types are backup on Windows NT file system level and backup with the IMAGE option, which means that you backup complete logical drives without using the Windows NT File system. For all the following backups, Compaq used an SAP R/3 Oracle database with the SAP IDES system (which is an SAP system that already contains data for training purposes) and the SAP standard benchmark 900 client. The total database size was about 16 gigabytes. This database was located on a RAID 5 disk array that had the following layout.

- 10 * 4,3 GByte disks
- SMART-2 Controller
- 5 disks at SCSI channel 1,
  5 disks at SCSI channel 2




### Backup on Windows NT File System Level

In this backup mode, you get a window where you can select from single files up to all drives on your computer shown in the upper part of Figure 18.

For the backup on Windows NT file system level, Compaq tested the performance of several tape array configurations. It always did a full backup of all the database files of our R/3 system. To get an impression if there is any performance difference between only one tape connected to a SCSI controller, Compaq did some test with only using 1 tape per SCSI controller.

In the tests, the following numbers were received:

| Number of tapes / Number of SCSI-Controllers | Backup performance in GB/h with RAID 0 | Backup performance in GB/h with RAID 5 |
|---|---|---|
| 1 Tape / 1 Controller | 10 | not possible |
| 2 Tapes / 1 Controller | 14 | not possible |
| 2 Tapes / 2 Controllers | 19 | not possible |
| 3 Tapes / 2 Controllers | 21 | 13 |
| 3 Tapes / 3 Controllers | 28 | 19 |
| 4 Tapes / 2 Controllers | 27 | 20 |
| 4 Tapes / 4 Controllers | 37 | 27 |
| 6 Tapes / 3 Controllers | 39 | 33 |
| 8 Tapes / 4 Controllers | 39 | 38 |

*Figure 19: Performance of backup on NT file system level*

From these tests, Compaq derived two results.

First, the backup performance is depending on the number of tapes connected to one SCSI controller. As you can see there is a big difference if you connect only one or more tapes to a SCSI Controller. The RAID 0 backup with 4 tapes connected to 4 controllers is about 10 GB/h faster as the 4 tapes connected to 2 controllers. Never connect more than 2 DLT drives to 1 SCSI controller because of performance reasons.

Second, the performance of a RAID 5 tape configuration is worse than that of a RAID 0 configuration. The worse performance of the RAID 5 configuration is caused by the fact that the parity information needed for a restore with one tape missing has to be calculated and then written on the tape. That is why you only need 2 tapes / 2 controllers with RAID 0 to get the same performance as for 3 tapes / 3 controllers with RAID5.

## Backup Using the Image Option

The ARCserve Image Option for Windows NT allows the backup and restore of local hard drives in the image mode. This mechanism bypasses the Windows NT file system. Image Option reads/writes data at a sector level and also uses asynchronous I/O mechanisms for highest performance.

The image option is set in*Backup* menu by choosing*Source Context Menu -> Use Image Option…*:

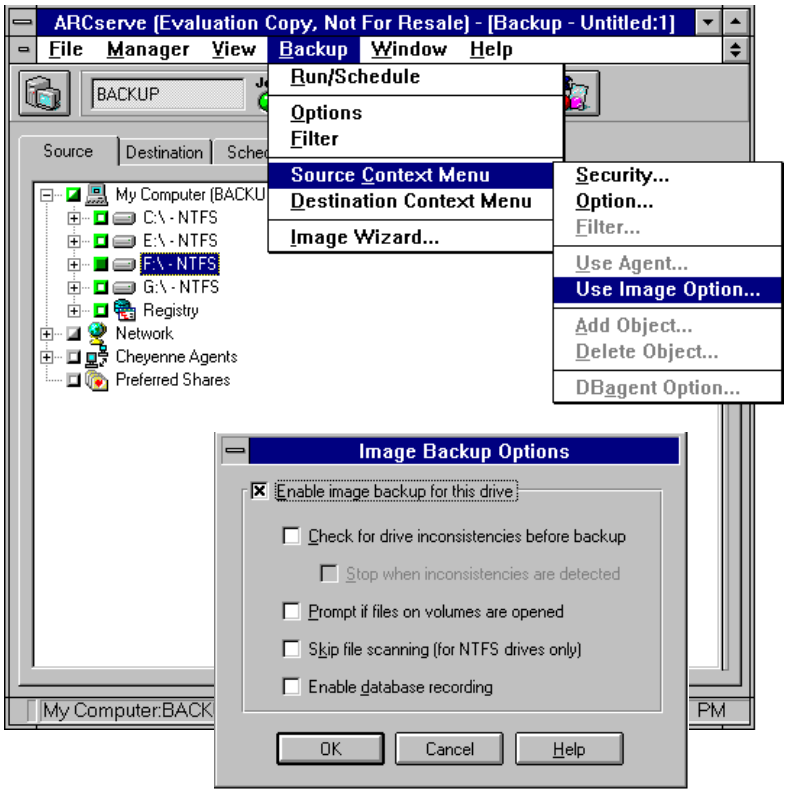



*Figure 20: ARCserve Image Option*

Compaq saw the following Image Option performance results:

| Number of tapes / Number of SCSI-Controllers | Backup performance in GB/h with RAID 0 | Backup performance in GB/h with RAID 5 |
|---|---|---|
| 1 Tape / 1 Controller | 9 | not possible |
| 2 Tapes / 1 Controller | 14 | not possible |
| 2 Tapes / 2 Controllers | 19 | not possible |
| 3 Tapes / 2 Controllers | 21 | 14 |
| 3 Tapes / 3 Controllers | 28 | 18 |
| 4 Tapes / 2 Controllers | 26 | 20 |
| 4 Tape / 4 Controllers | 37 | 27 |
| 6 Tapes / 3 Controllers | 40 | 34 |
| 8 Tapes / 4 Controllers | 53 | 46 |

*Figure 21: Performance of Image Option backups*

The results of the Image Option backup almost correspond to those of the regular backup via the NTFS file system. There is a slower backup rate in the RAID 5 configuration which is caused by additional parity data. There is no gain of performance compared to the regular backup up to the 6 tapes on 3 controllers configuration. Only the 8 tapes on 4 controllers configuration is higher than the number of the normal backup. There you can see the advantage of the Image option over an NTFS file system backup.

## Online Backup Using ARCserve R/3 Agent for Oracle

ARCserve provides an R/3 database agent for Oracle and SQL Server. In this test scenario, Compaq determined the backup and restore performance of the ARCserve R/3 database agent for Oracle. Compaq only did some online backups, as the off-line backup performance is covered with the NTFS file system and image backup.

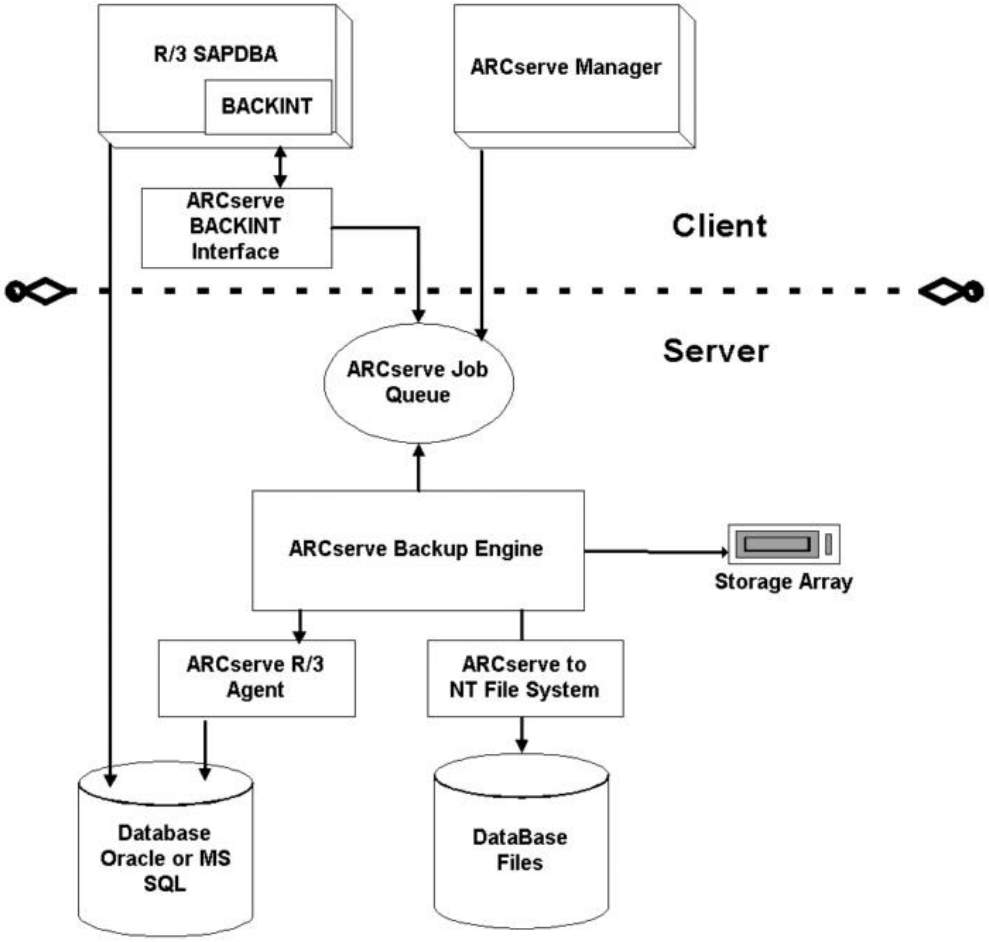



*Figure 22: ARCserve architecture*

The purpose of the online backup tests via ARCserve database agent is to understand how the R/3 load, generated by active R/3 users, affects the performance of the backup, and how the responsiveness of the R/3 system is reduced by the backup activity.

The active R/3 users were simulated by using the standard SAP benchmark environment in version 3.0D. Out of several benchmark modules the Financial module (FI) was chosen to generate the system activity. It might happen, that particular customer installations will observe a heavier load caused by their active R/3 users and that a lower online backup performance is experienced. As each R/3 system is different in terms of configuration and customization, it is impossible to come up with general guidelines. The FI benchmark load has been chosen to establish some point of reference. The absolute number of users is not really important. However, the CPU utilization and the average response time, that reflects the load situation the system is in, are of more significance.

The “average R/3 dialog response time“ is a value indicating how long the R/3 system needs on average to handle a dialog transaction started by a user. Typically a value of up to 2 seconds ( for FI 1 second) is accepted by most companies.

The backup was made by using the ARCserve R/3 database agent for the whole database including all data and control files.

Please note that the performance numbers of the tests delivered by ARCserve are not totally correct. ARCserve opens a new backup session for each tablespace that is in the Oracle database. The time between two sessions in not added to the total backup time. In the test case, the time to be added to the backup was about 5-6 minutes. If you include this time the results diminish.

For example, the measured throughput of **52** GB/h with 8 tapes decreases to about **39** GB/h including the 5-6 minutes overhead. The **20** GB/h of the 3 tapes RAID 0 configuration decrease to **18** GB/h real backup performance. The time not included in the total backup time depends on the number of sessions which is equal to the number of database tablespaces.

## Online Test without FI benchmark users

| Number of Tapes / Number of SCSI-Controllers | Average data [GB/h] RAID 0 | Average CPU load [%] | Average data [GB/h] RAID 5 | Average CPU load [%] |
|---|---|---|---|---|
| 3 Tapes / 2 Controllers | 20 | 15 | 13 | 15 |
| 4 Tapes / 2 Controllers | 27 | 20 | 20 | 19 |
| 4 Tapes / 4 Controllers | 36 | 25 | 27 | 25 |
| 6 Tapes / 3 Controllers | 39 | 33 | 33 | 26 |
| 8 Tapes / 4 Controllers | 52 | 42 | 45 | 38 |

*Figure 23: Online backup with no system load*

## Online Test with 40 FI benchmark users = 30% CPU load

| Number of Tapes / Number of SCSI-Controllers | Average data [GB/h] RAID 0 | Average CPU load [%] | Average data [GB/h] RAID 5 | Average CPU load [%] |
|---|---|---|---|---|
| 3 Tapes / 2 Controllers | 19 | 49 | 13 | 48 |
| 4 Tapes / 2 Controllers | 24 | 53 | 19 | 50 |
| 4 Tapes / 4 Controllers | 31 | 60 | 22 | 57 |
| 6 Tapes / 3 Controllers | 33 | 62 | 28 | 57 |
| 8 Tapes / 4 Controllers | 43 | 65 | 35 | 63 |

*Figure 24: Online backup with 30% system load*

## Online Test with 62 FI benchmark users = 50% CPU load

| Number of Tapes / Number of SCSI-Controllers | Average data [GB/h] RAID 0 | Average CPU load [%] | Average data [GB/h] RAID 5 | Average CPU load [%] |
|---|---|---|---|---|
| 3 Tapes / 2 Controllers | 16 | 65 | 12 | 65 |
| 4 Tapes / 2 Controllers | 19 | 68 | 15 | 67 |
| 4 Tapes / 4 Controllers | 24 | 72 | 18 | 72 |
| 6 Tapes / 3 Controllers | 24 | 73 | 22 | 73 |
| 8 Tapes / 4 Controllers | 32 | 76 | 24 | 76 |

*Figure 25: Online backup with 50% system load*

## Online Test with 85 FI benchmark users = 70% CPU load

| Number of Tapes / Number of SCSI-Controllers | Average data [GB/h] RAID 0 | Average CPU load [%] | Average data [GB/h] RAID 5 | Average CPU load [%] |
|---|---|---|---|---|
| 3 Tapes / 2 Controllers | 12 | 78 | 8 | 79 |
| 4 Tapes / 2 Controllers | 14 | 82 | 11 | 82 |
| 4 Tapes / 4 Controllers | 17 | 85 | 14 | 85 |
| 6 Tapes / 3 Controllers | 19 | 86 | 16 | 87 |
| 8 Tapes / 4 Controllers | 20 | 88 | 18 | 88 |

*Figure 26: Online backup with 70% system load*

As you can see the backup performance slows down if the load of SAP R/3 increases. In case of no system load, you almost get the backup rates of the file backup on NTFS file system level shown in Figure 26. With 30 percent R/3 system load caused by 40 FI users the rates are lower but still acceptable. With 50 and 70 percent R/3 system load the performance gets worse and you almost have no gain by using more tapes.

For an online backup the influence of the running backup on the performance of the R/3 system is of importance. To see how the R/3 performance develops during a backup we ran some benchmarks while backing up the R/3 system to 4 and 8 tapes. Compaq used the SAP standard benchmark of the module FI:

| Tape configuration | 62 FI Benchmark users | 85 FI Benchmark users |
|---|---|---|
| No backup | 171 ms | 178 ms |
| 4 Tapes RAID 0 | 174 ms | 428 ms |
| 8 Tapes RAID 0 | 183 ms | 451 ms |

*Figure 27: R/3 response times during the backup*

All these numbers came from our test scenario. There is no guarantee that the same results are obtained in a customer system. The customer transactions may be completely different from those in the FI benchmark and therefore the system load can be different. Because of this, the R/3 response time during backup may be different, too.

## Online Backup Using the R/3 SAPDBA

Online and off-line R/3 backups are also possible using the SAPDBA program that comes with the R/3 and Oracle software.

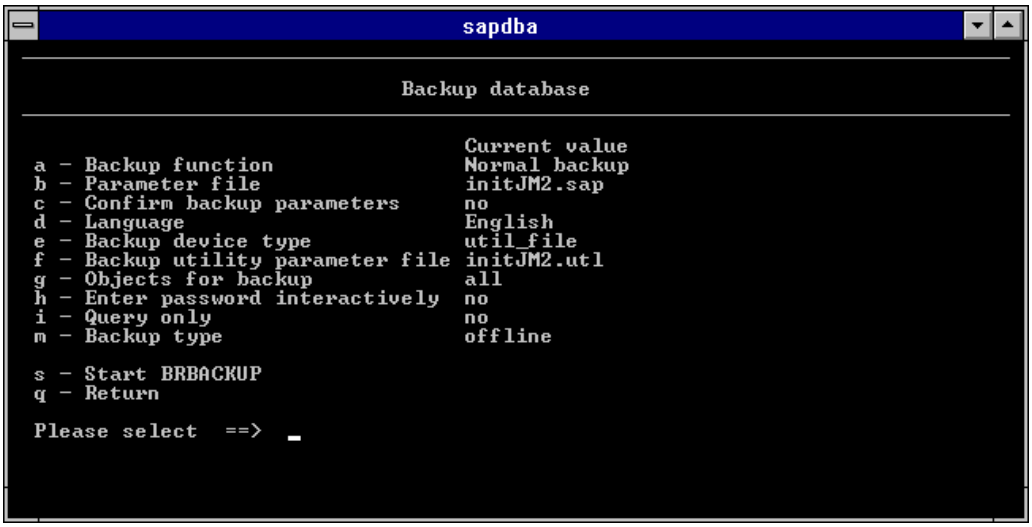



*Figure 28: Backup using the R/3 SAPDBA*

The SAPDBA program ispreconfigured to use the native *cpio* program that is delivered with the R/3 system for writing to and reading from tape. As this program is rather slow especially when using multiple tapes in parallel, SAP offers the possibility to connect an external backup program using the so-called *backint* interface.

SAPDBA uses the R/3 *brbackup* and *brarchive* programs to backup the Oracle datafiles and the archive logs. The connection to ARCserve is implemented in the *backint* interface that is delivered by Cheyenne. *backint* submits a regular file system job into the ARCserve job queue and ARCserve just does a normal backup. Using this mechanism the R/3 Agent for Oracle is not involved.

SAP certification of the Cheyenne backinit interface is pending.

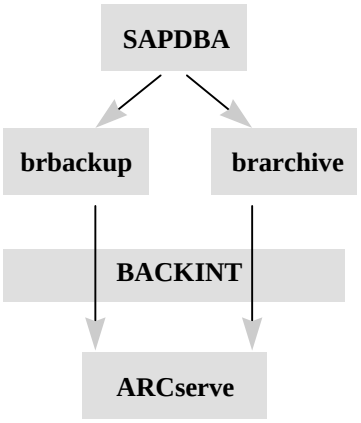



*Figure 29: Backint interface*

Compaq only did some online backups, as the off-line backup performance is covered with the Windows NT file system and image backup.

The performance of the SAPDBA backups is similar to the performance of the NTFS file system backup. There is only a small overhead for the SAPDBA administrational tasks (e.g. starting and stopping of the database if necessary, backing up internal protocol files) and the *backint* call. This overhead is depending on different factors as the database size or the kind of backup (online or off-line).

As the off-line backup performance is covered with the Windows NT file system and image backup and the online backup performance is covered with the online ARCserve Database Agent performance tests, Compaq only tested the backint functionality that worked without errors.

In contrast to the R/3 Agent backup where each tablespace is stored in a separate session, the backup using SAPDBA and *backint* is done in one session.

## NETWORK BACKUPS

There are two methods of performing network backups.

- Pull method

  Any machine in the Microsoft network can be backed up by simply choosing the shared drives in the backup window. Backup is initiated by the ARCserve server that pulls the data from the client using a share.

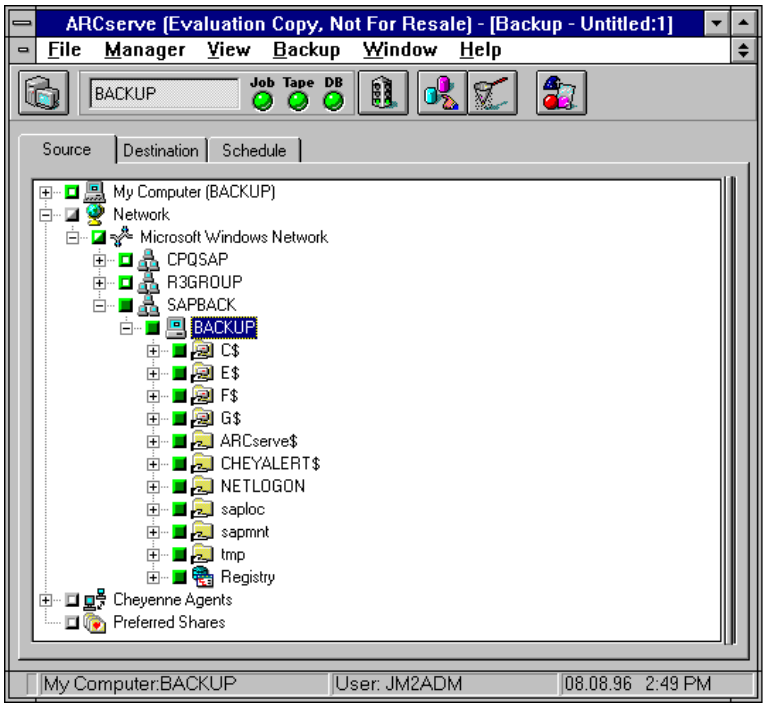



*Figure 30: ARCserve network backup*

- Push method

  Backup of a remote Windows NT machine is also possible by using the ARCserve Windows NT agent that utilizes the Push Agent technology to accomplish, backup, restore, and compare jobs. Here backup is initiated by the ARCserve Windows NT agent and data are pushed to the ARCserve server holding the backup devices.

## Pull Agent

The pull method is a backup over Microsoft network shares. You can select all drives or simple files which are shared by Windows NT or another LAN Manager Server like Windows 95 or Windows forWorkgroups 3.11. It is also possible to backup a registry over the network with this method.

For pull method backups you don’t have to install any additional software on the client. The ARCserve user only needs sufficient privileges to access the shares. For our network benchmarks, Compaq used a 100Mbit Ethernet network with twoProLiants over a 100BASE T repeater with no other machines connected to the LAN.

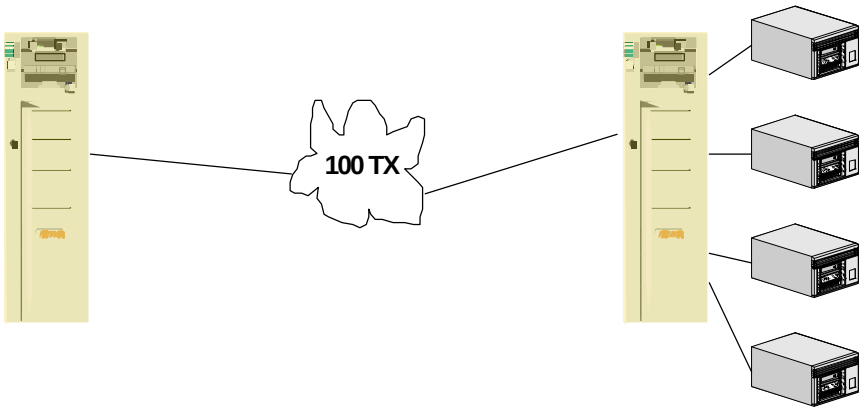



*Figure 31: Network layout*

The source machine is a ProLiant 4500 with a RAID 5 disk array containing the data. The backup host is the ProLiant 5000 which has already been used for the local backup tests.

Compaq optimized the network throughput by changing the TCP Window size parameter in the registry from the default value 8760 to 17520. The performance gain for our test environment was about 15%. Be careful with tuning that parameter because it depends on the kind of network and other hardware you use.

Compaq saw the following network backup results:

| Number of Tapes / Number of SCSI-Controllers | Average data [GB/h] |
|---|---|
| 1 Tape / 1 Controller | 10 |
| 2 Tapes / 1 Controller | 13 |
| 3 Tapes / 2 Controllers | 17 |
| 4 Tapes / 4 Controllers | 17 |
| 8 Tapes / 4 Controllers | 17 |

*Figure 32: Performance of network backups*

As you can see from Figure 32, the maximum backup rate of about 17 GB/h was reached with 3 tapes. Adding more tape devices didn't improve the network backup performance.

To guarantee that the bottleneck was not the disk subsystem of the source machine (Compaq ProLiant 4500), Compaq measured its read performance. The read rate was about 73 GB/h, which is quite enough for the tests. As the backup rate with one or two tapes nearly corresponds to the local backup rates and the read performance of the source disk subsystem is large enough, the backup rate should increase with a higher number of tapes.

As it did not, the network had to be the bottleneck. To prove this we did some network performance tests. Compaq used a small program that generated point to point transfer on a TCP/IP connection by transferring about 250 megabytes located in RAM. The average throughput was about 24 GB/h. As expected this value is higher than the ARCserve network throughput because with the test program Compaq only had data in memory that were directly put on the network. There was no disk overhead.

So if the disk and tape hardware is fast enough the network is the bottleneck in backing up data over the wire. Until the maximum network throughput is reached, you get the same performance for network and for local backups.

### Push Agent

The second kind of network backup tested was the backup through an ARCserve agent. ARCserve delivers the already mentioned agents for Windows NT, Windows 95, Windows for Workgroups, UNIX, Macintosh, and some other platforms.

In the ARCserve evaluation, Compaq only tested the agent for Windows NT. Compaq used the same test configuration as described in the Pull Agent section of this white paper. Compaq saw a backup performance of 21 GB/h and a restore performance of 16 GB/h. Here again the network is the bottleneck.

In a 10 Mbit network the throughput will be worse than the backup rate we measured because the network is slower.

## ARCSERVE RESTORE

ARCserve provides you with four methods of selecting the data you want to restore:

- Restore by Tree
- Restore by Tape
- Restore by Query
- Restore by Image

Using the Restore by Tree, Tape, and Query the selected items are restored file by file. Only the Restore by Image uses another method which is bypassing the Windows NT file system.

In the restore tests, Compaq found out that there are three parameters which influence the restore performance. The first is the number of tapes used for the backup and restore. The restore rate will not be higher as the backup rate with the same tape configuration. The second parameter is the write performance of the disk configuration you are using. The third one is the behavior and the overhead of the ARCserve software.

In the following section of this white paper, you see different tables which show the influence of these parameters on different hardware configurations.

### Restore of an Windows NT File Backup

In the test environment, Compaq used a RAID 5 disk array containing 10x4.3 GB disks. As you can see from Figure 33, the write performance of this disk configuration is 19.3 GB/h. The maximum restore rate is expected to be less than 19.3 GB/h as there is also some ARCserve overhead.

| RAID 0 configuration of 3 tapes on 2 controllers | Performance in GB/h |
|---|---|
| Backup | 20 |
| Restore | 19 |

*Figure 33: Restore performance of RAID 0*

Compaq used this small configuration (regarding the number of tapes) to get an impression of the difference between backup and restore performance. The numbers of Figure 33 show that you can restore with nearly the backup speed if the performance of the disk subsystem is larger than the backup rate.

Compaq also did some tests with a missing tape in a RAID 5 tape configuration to determine if a damaged tape has any influence on the read performance of the RAID tape array.

| RAID 5 configuration of 3 tapes on 2 controllers | Performance in GB/h |
|---|---|
| Backup on 3 Tapes | 14 |
| Restore from 3 Tapes | 12 |
| Restore from 2 Tapes on 2 Controllers | 19 |
| Restore from 2 Tapes on 1 Controller | 12 |

*Figure 34: Restore performance of RAID 5 with a damaged tape*

As you can see there is almost no difference between the restore from three tapes configured as a RAID 5 array and the restore with one damaged or missing tape if the 2 remaining tapes are connected to one SCSI controller. So obviously calculating data from the RAID checksums is faster than reading data from tape, i.e. the calculation doesn't lead to additional overhead.

If the remaining tapes are connected to 2 controllers the restore is even faster. You can verify this behavior by comparing the restore results to the backup results of Figure 35. (Remember that in the 3 tape configuration backup and restore performance are nearly the same.). The restore performance of 3 tapes connected to 2 controllers corresponds to the backup performance of a RAID5 array consisting of 3 tapes on 2 controllers. The restore performance of only 2 tapes on 2 controllers corresponds to the backup performance of a RAID 0 array consisting of 2 tapes on 2 controllers.

| RAID configuration of 8 tapes | Restore performance with 8 tapes in GB/h | Restore performance with 7 tapes in GB/h |
|---|---|---|
| RAID0 | 19 | not possible |
| RAID5 | 19 | 19 |

*Figure 35: Restore performance of 8 tapes*

The numbers of Figure 35 show that the maximum restore rate in the test configuration is 19 GB/h. Here the write performance of the RAID 5 disk array is the bottleneck.

To get higher restore rates tests with a RAID 0 and a RAID 1 disk configuration were set up:

| Disk configuration | Restore Rate [GB/h] | Write Performance Disk Subsystem [GB/h] |
|---|---|---|
| 10 Disks RAID 5 | 19 | 19 |
| 10 Disks RAID 0 | 25 | 31 |
| 14 Disks RAID 5 | 19 | 20 |
| 14 Disks RAID 1 | 25 | 26 |
| 14 Disks RAID 0 | 25 | 33 |

*Figure 36: Restore performance using different disk subsystem configurations*

In Figure 36, you can see that using RAID 0 and RAID 1 disk subsystem configurations the maximum restore rate is limited to 24.6 GB/h. With a RAID 0 disk array of 14 disks, the write performance of the disk subsystem which is 33 GB/h is no longer the bottleneck.

The problem in achieving higher restore rates is that ARCserve allocates as much memory as the size of the file to be restored, in maximum 512 megabytes. If the file is larger than 512 megabytes, the restore performance gets worse due to memory allocation problems. As the test configuration containstablespaces that are bigger than 1gigabytye, Compaq got these performance problems.

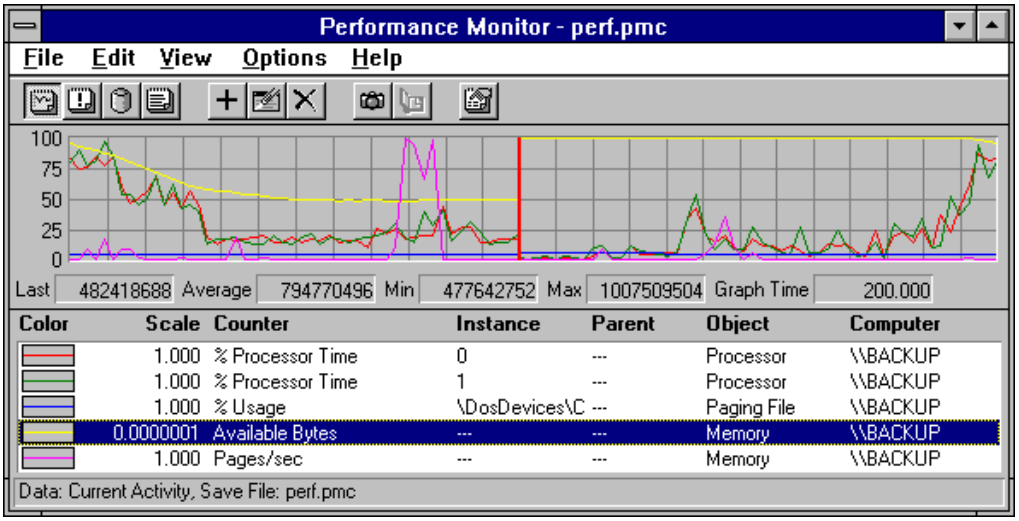



*Figure 37: Available memory during restore of PSAPSTABD (2 files of 1.2 GB)*

If only small files are restored you get restore rates which are nearly the same as the backup rates. Normally only the disk write rate is the bottleneck.

According to Cheyenne the problem is solved with Windows NT 4.0. Cheyenne is also developing a fix for Windows NT 3.51.

## Restore of an Image Backup

The only restore type different from the restore of an Windows NT file backup is the image restore. In order to perform an image restore the target of the restore has to be free from access of other programs or services like SAPSID_00. After the restore on a partition which is bigger than the backup partition, you can only use the size of the backed up one.

| Disk configuration | Restore Rate [GB/h] | Write Performance Disk Subsystem [GB/h] |
|---|---|---|
| 14 Disks RAID 0 / 8 Tapes | 35 | 33 |
| 10 Disks RAID 5 / 4 Tapes | 19 | 20 |
| 10 Disks RAID 5 / 2 Tapes | 12 | 20 |

*Figure 38: Restore of an Image Backup*

As you can see in Figure 38, the disk subsystem is the bottleneck using the image restore. The image backup is not allocating memory like the normal restore process. With image restore you nearly get the number as in the backup.

Note that the restore rate for 14 disks is larger than the measured write performance of the disk subsystem. This is because the two values were generated by different programs (ARCserve and the Completion Port I/O Test Utility).

There is the possibility to restore partial files from an image backup. The performance is the same as the restore of a file backup.

## Restore of an Online R/3 Database Agent Backup

The restore of an online backup has the same performance as the Windows NT file restore (see section, *Restore of an Windows NT File Backup*).

But there is one big difference: the ARCserve R/3 agent is writing every tablespace in a separate session during backup and therefore reading every tablespace in a separate session during restore. After each session the restore process is rewinding the tape. In a complete restore, it takes quite a while to reach the end of the tape. In this case, about one hour had to be added to the net restore time. The additional rewind time depends on the number of tablespaces.

After you have restored the datafiles and the off-line redologs the user has to do some actions to get the database in a consistent state.

- Copy the controlfile from the database agent directory to the original locations
- Startup database in mount status
- Recover database until cancel using backup controlfile
- Alter database open resetlogs

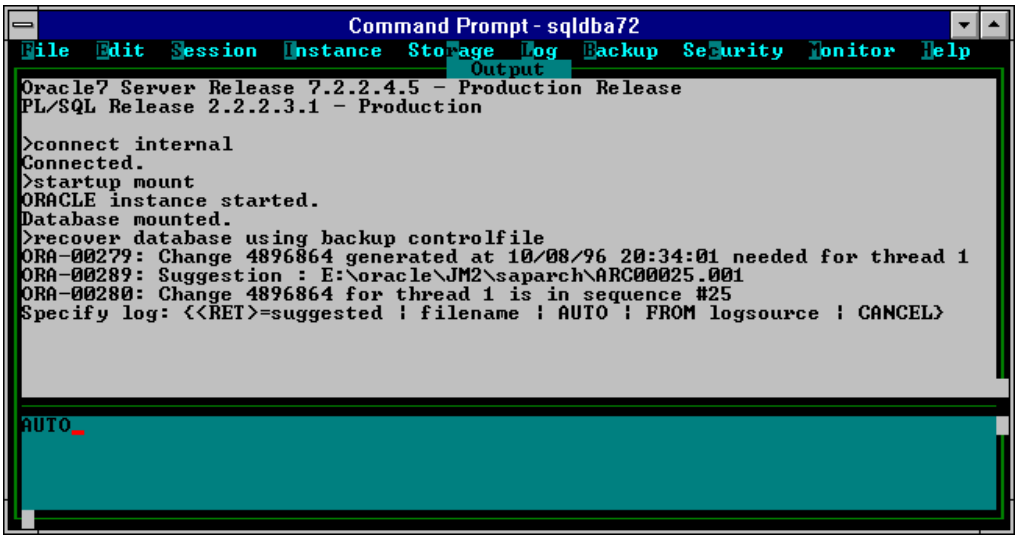



*Figure 39: Recovery of the Oracle database*

See the Oracle documentation for more detailed information.

## Restore of an SAPDBA Backup

Restore of the R/3 system is also possible using the SAPDBA program that comes with the R/3 and Oracle software.

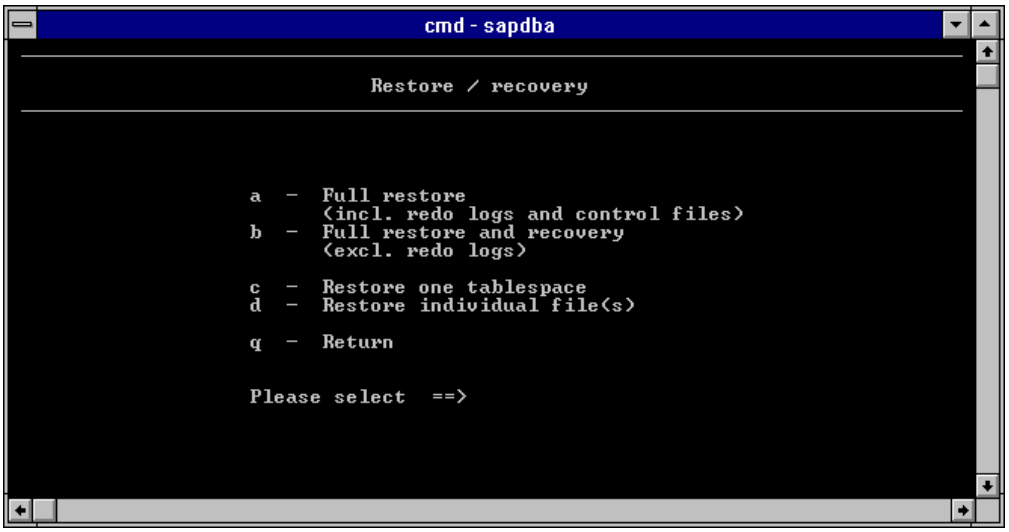



*Figure 40: Restore using the R/3 SAPDBA*

SAPDBA calls the R/3*brrestore* program. The connection to ARCserve is implemented in the *backint* interface as described before in the SAPDBA backup section of this white paper.

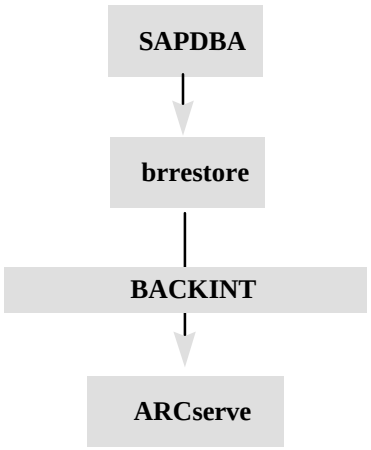



*Figure 41: Backint interface*

The restore performance is similar to the restore performance of Windows NT files. There is a small constant overhead for SAPDBA administration tasks and the *backint* call. A maximum restore performance of 19 B/h was possible using 8 tapes.

To evaluate the *backint* functionality, Compaq tested the restore of single tablespaces as well as the restore of a complete R/3 database.

## SUMMARY

ARCserve provides different methods of backing up and restoring Windows NT and SAP R/3 data. Compaq tested the functionality of :

- backup and restore on Windows NT file system level
- backup and restore with the Image Option, bypassing the Windows NT file system
- integration into R/3 using the R/3 Agent for Oracle
- integration into R/3 using thebackint interface together with the SAPDBA

All the different backup and restore methods worked fine. All the different backup and restore methods worked fine. With the next version of the ARCserve Database Agent, it will even be possible to backup the R/3 database in one session that will further improve the restore performance. The next version of the ARCserve Database Agent will be available in the first quarter of 1997. In the case of restore, you loose a lot time by changing between the sessions.

In general with the right tape configuration ARCserve delivers excellent backup and restore rates. Compaq achieved the following backup rates:

- 39GB/h for a backup on Windows NT file system level
- between 46GB/h and 53GB/h (depending on the type of tape RAID array) using the ARCserve Image Option
- between 20GB/h and 43 GB/h for an online R/3 backup (depending on the R/3 load)

The restore rate was only limited by the write performance of the disk subsystem. The maximum restore rate was between 19GB/h and 25GB/h depending on the type of the disk RAID array. The restore of very large files (>1GB) where some memory allocation problems occurred should be improved.

As the backup and restore performance is heavily depending on the hardware configuration you have to configure the PCI and the disk subsystem very carefully to avoid the hardware of becoming the bottleneck in backup and restore. Therefore this White Paper contains some recommendations for the disk subsystem, DLT and PCI configuration.

In total ARCserve is a really good backup solution because it is providing a lot of features like the RAID and the Image Option. The product can be used for small backups with only one DLT up to complete online backups of big databases with at 8 DLT devices configured to a RAID array.

# APPENDIX

## List of All Tablespaces

```
************************************************************

09.10.96 12:27 --- List of all tablespaces / fragmentation:
The values of total space, allocated space and largest free space area are in
KBytes.

TABLESPACE    Total Allocated %-Alloc. Files Free areas Largest
-------------------------------------------------------------------
PSAPBTABD   3063808   1692136    55      2       1      1371656
PSAPBTABI   2197504   1199760    55      2       2       997640
PSAPCLUD     245760    238240    97      1       1         7512
PSAPCLUI      33792     28424    84      1       1         5360
PSAPDDICD     61440     41024    67      1       1        20408
PSAPDDICI     33792     14088    42      1       1        19696
PSAPDOCUD    102400     67616    66      1       1        34776
PSAPDOCUI     20480     11480    56      1       1         8992
PSAPEL30DD   839992    657400    78      2       2       111880
PSAPEL30DI    40960     25056    61      1       1        15896
PSAPES30DD  2055376   1654048    80      2       2       399008
PSAPES30DI   616352    491624    80      2       2       118192
PSAPLOADD     70656      4504     6      1       1        66144
PSAPLOADI     41984      6080    14      1       1        35896
PSAPPOOLD    857296    552008    64      2       2       197832
PSAPPOOLI    841728    371456    44      2       2       420496
PSAPPROTD    292864    254536    87      1       1        38320
PSAPPROTI     29696     26336    89      1       1         3352
PSAPROLL     204800     75920    37      1      22        42552
PSAPSOURCED   67584     19280    29      1       1        48296
PSAPSOURCEI   14336      2808    20      1       1        11520
PSAPSTABD   2401896   1398848    58      2       2       900664
PSAPSTABI   1344512   1046552    78      2       7       297568
PSAPTEMP     167936         0     0      1       1       167928
PSAPUSER1D     5120      2128    42      1       1         2984
PSAPUSER1I     5120        32     1      1       1         5080
SYSTEM       153600     72896    47      1       2        75496

Total number of files in database: 40 including 4 redo log files



TABLESPACE File-Id Filename                                        Size in K
-------------------------------------------------------------------------
PSAPBTABD     4    f:\oracle\jm2\sapdata1\btabd_1\btabd.data1    1531904
             28    f:\oracle\JM2\sapdata1\btabd_2\btabd.data2    1531904
PSAPBTABI     7    f:\oracle\jm2\sapdata2\btabi_1\btabi.data1    1098752
             29    f:\oracle\JM2\sapdata2\btabi_2\btabi.data2    1098752
PSAPCLUD      9    f:\oracle\jm2\sapdata2\clud_1\clud.data1       245760
PSAPCLUI     12    f:\oracle\jm2\sapdata3\clui_1\clui.data1        33792
PSAPDDICD     5    f:\oracle\jm2\sapdata1\ddicd_1\ddicd.data1      61440
PSAPDDICI    24    f:\oracle\jm2\sapdata5\ddici_1\ddici.data1      33792
PSAPDOCUD    22    f:\oracle\jm2\sapdata5\docud_1\docud.data1     102400
PSAPDOCUI    13    f:\oracle\jm2\sapdata3\docui_1\docui.data1      20480
PSAPEL30DD   19    f:\oracle\jm2\sapdata4\el30dd_1\el30dd.data1   646144
             32    f:\oracle\JM2\sapdata4\el30dd_2\el30dd.data2   193848
PSAPEL30DI   25    f:\oracle\jm2\sapdata5\el30di_1\el30di.data1    40960
PSAPES30DD   27    f:\oracle\JM2\sapdata6\es30dd_2\es30dd.data2   474320
             36    f:\oracle\JM2\sapdata6\es30dd_1\es30dd.data1  1581056
PSAPES30DI   26    f:\oracle\jm2\sapdata5\es30di_1\es30di.data1   474112
             33    f:\oracle\JM2\sapdata5\es30di_2\es30di.data2   142240
PSAPLOADD    17    f:\oracle\jm2\sapdata4\loadd_1\loadd.data1      70656
PSAPLOADI    11    f:\oracle\jm2\sapdata3\loadi_1\loadi.data1      41984
PSAPPOOLD    23    f:\oracle\jm2\sapdata5\poold_1\poold.data1     659456
             34    f:\oracle\JM2\sapdata5\poold_2\poold.data2     197840
PSAPPOOLI     6    f:\oracle\jm2\sapdata1\pooli_1\pooli.data1     420864
             30    f:\oracle\JM2\sapdata1\pooli_2\pooli.data2     420864
```

```
PSAPPROTD    16    f:\oracle\jm2\sapdata4\protd_1\protd.data1     292864
PSAPPROTI    15    f:\oracle\jm2\sapdata3\proti_1\proti.data1      29696
PSAPROLL      3    f:\oracle\JM2\sapdata1\roll_1\roll.data1       204800
PSAPSOURCED  10    f:\oracle\jm2\sapdata2\sourced_1\sourced.data1  67584
PSAPSOURCEI  18    f:\oracle\jm2\sapdata4\sourcei_1\sourcei.data1  14336
PSAPSTABD    14    f:\oracle\jm2\sapdata3\stabd_1\stabd.data1    1501184
             31    f:\oracle\JM2\sapdata3\stabd_2\stabd.data2     900712
PSAPSTABI    21    f:\oracle\jm2\sapdata5\stabi_1\stabi.data1    1034240
             35    f:\oracle\JM2\sapdata5\stabi_2\stabi.data2     310272
PSAPTEMP      2    f:\oracle\JM2\sapdata1\temp_1\temp.data1       167936
PSAPUSER1D   20    f:\oracle\jm2\sapdata4\user1d_1\user1d.data1      5120
PSAPUSER1I    8    f:\oracle\jm2\sapdata2\user1i_1\user1i.data1      5120
SYSTEM        1    f:\oracle\JM2\sapdata1\system_1\system.data1   153600
```

## ARCserve Parameter File for backint

```
#############################################################################
# This is the parameter file of BACKINT for ARCserve containing parameters that #
# determine the backup procedure.                                           #
# BACKINT reads this file and submits a job to the ARCserve queue for execution.#
# Instructions for filling out each line start with a pound sign (#) and precede#
# the actual information line which the user needs to fill in.              #
#############################################################################
# Tape Name that ARCserve should use for the backup (e.g. tape0, tape1,.., or '*')
DESTTAPE=*
# Group Name that ARCserve should use for the backup (e.g. GROUP0, GROUP1,.., or '*')
DESTGROUP=*
```