WHITE PAPER

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Compaq Computer
Corporation

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COMPAQ

SAP R/3 on the Compaq ProLiant Platform

SAP R/3 is an integrated business application and is the successor to the mainframe-based R/2 product. R/3 was first available in July 1992 but was confined to the UNIX environment. In October 1993, SAP announced the future availability of SAP R/3 on the Microsoft Windows NT platform and the product was launched at the CeBIT fair in Hannover in March 1994.

This document provides a technical overview of the Compaq SAP R/3 platform, with a targeted audience of Compaq pre-sales and support personnel, SAP partner organizations, and technical departments in customer organizations. The document is not intended to be an installation guide for the system, but should provide all the technical information necessary to plan an installation effectively and to supplement the skills of a Certified R/3 Installer.

Complementary documents are the iXOS certification report and the SAP R/3 installation guide. A benchmarking environment has now been established at the Compaq Competence Centers in Munich and Houston. As well as providing information for marketing and system sizing, this environment will be used for generating technical documentation (optimal disk layouts, backup strategies, tuning, and so on), performing Proof of Concepts for customers, and integration testing.

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NOTICE

The information in this publication is subject to change without notice.

SAP R/3 on the Compaq ProLiant Platform

THE COMPAQ-SAP PARTNERSHIP

The International Compaq SAP Competence Center

Compaq and SAP have established an International Competence Center (ICC) at the SAP HQ in Walldorf, Germany. The ICC has dedicated resources as part of the SAP support infrastructure and will be active in joint engineering projects.

Key activities carried out at the ICC are:

- SAP second-level hotline support

- Joint engineering development projects with SAP

- Post-sales critical customer support

- Provision of early watch services

- System sizing

- Development of support tools

- Customer briefings at Walldorf

- Marketing

- Event support

Regional Compaq SAP Competence Centers

In addition to the International Compaq Competence Center, Compaq has established regional Competence Centers:

Regional Responsibility	Location
Europe, Middle East, and Africa	Munich, Germany
North America	Houston, USA
Japan	Tokyo, Japan
Asia Pacific	Singapore

Key activities carried out at these centers are:

- Pre-sales support to subsidiaries and partners

- Pre-sales critical customer support

- Major account briefings

- Platform certification

- Benchmarking

- System sizing methodology and sizing service

- Platform specific engineering projects, such as developing backup/restore solutions

- Development of Lotus Notes-based project management tools

- Publication of White Papers

- Marketing

- Event support

CERTIFICATION OF SAP R/3

Process

SAP produces a single version of R/3 for Windows NT. This version runs on all Intel-based Windows NT hardware platforms. No additional software build is necessary to run R/3 on Intel Windows NT platform, unlike UNIX, where each vendor platform requires a separate compilation of the R/3 executables. This is not the case for Windows NT systems using other processor architectures. However, for each hardware platform R/3 is released on the same date and has the same functionality.

SAP does not support all Windows NT hardware platforms (of which there are hundreds). To test the ability of a particular hardware platform to support R/3, SAP introduced a certification procedure. This certification is carried out by a partly owned partner of SAP, iXOS Software GmbH, who established the "Competence Center for SAP R/3 on Windows NT" (R/3 NTC). The certification procedure checks that each platform is technically sound and performs well with R/3, as well as having the necessary service and support infrastructure in place to support R/3 implementations.

Each platform certification relates to the following:

- A major R/3 version (for example, 2.1 or 2.2)

- A Windows NT version (for example, 3.1 or 3.5)

- A database version (for example, Oracle 7.0, Oracle 7.1, Adabas 3.12, SQL Server 6.0)

- A hardware architecture (for example, Compaq ProLiant)

As an example, the Compaq Proliant has been certified for R/3 release 2.2, Oracle release 7.1 and Windows NT 3.5. Compaq ProLiant is certified as a *system family*. This means that product line enhancements like ProLiant 4500 **do not** need separate certification.

There is only one common release schedule for all supported platforms. This means that the Windows NT version of R/3 ships at the same time as the UNIX version. The certification process for all Windows NT platforms can sometimes take up to three or four weeks. A customer may use a non-certified version of the system. However SAP may not give timely support for such a non-certified system so that certainly for productive systems only certified versions should be used.

Only number releases of R/3 require certification, for example, 2.1, 2.2, or 3.0. Alphabetical releases (correctional stages) such as 2.2b, 2.2c or 2.2d do not require additional certification. A customer can go productive with these releases as soon as they are made available by SAP.

Currently Certified Platforms

The SAP release schedule for R/3 on Windows NT version is the same as for UNIX versions:

R/3	NT	Database	Availability
Release 2.1 J	3.5	Oracle 7.1.3.3.6	today
Release 2.2 E	3.5	ADABAS-6.1.1.13	today
Release 2.2 F	3.51	Oracle 7.1.3.3.6	today
	3.51	ADABAS-D 6.1	in the process of certification
	3.51	SQL Server 6.0	in the process of certification
Release 3.0B	3.51	Oracle 7.1	planned for 4Q/95
	3.51	ADABAS-D 6.1	
	3.51	SQL Server 6.0	

In the Compaq ProLiant Family of Servers, the EMEA Competence Center recommends that the ProLiant 1500 not be offered for productive environments due to the limited scalability in memory (maximum 208 Megabytes) and system processors. With a clear notification of these limitations, the system can be offered to customers as a test or training system.

SAP Logo Partner Program

The SAP R/3 Logo Partner program encourages other companies to provide marketing, consulting, and service activities related to SAP R/3. Many different types of companies are Logo Partners, for example, large consulting companies or small service providers. The R/3 Logo Partner agreements are valid for two years. SAP reviews these agreements regularly to ensure quality of services and high customer satisfaction.

As part of the Logo Partner program, SAP offers the following:

- Free SAP R/3 demo licenses

- Dedicated second-level support

- Special education programs

- Common marketing events

- Regular SAP R/3 partner meetings

- Access to SAP internal systems

- Cooperation in development projects

- Project support through the SAP partner services

In return, the Logo Partners have an obligation to build up expertise in multiple areas (Business Process Re-engineering - BPR, R/3 base system, application modules, and so on) to assist customers implement and deploy SAP R/3 solutions. The Logo Partners do not sell SAP R/3. They cooperate with the SAP sales force.

Global SAP R/3 Logo Partners operate in all regions where SAP operates and have the infrastructure required to support international R/3 customers. The following list contains some of these Logo Partners:

- Andersen Consulting

- BSO Origin

- CAP GEMINI

- Coopers & Lybrand

- Deloitte & Touche Tohmatsu

- Ernst & Young

- I • C • S

- KPMG

- Price Waterhouse

- EDS

National SAP R/3 Logo Partners operate predominantly within one country.

SAP R/3 SYSTEM ARCHITECTURE

Overview

R/3 supports a three-level client/server architecture. Depending on the configuration of the complete R/3 system, the three major software components described below could all run on one physical machine or on several physical machines:

- All database transactions are handled by the *Database Server.* Currently, there can only be one physical machine running the *Database Server* software component.

- The *Application Server* (AS) processes the input within the SAP R/3 work processes. Because all parts of the R/3 software except the kernel are written in ABAP/4, an interpretative 4GL developed by SAP, the application server is very processor intensive. To increase processing power, several physical machines can be added to the R/3 system that run the *Application Server* software component.

- The *Presentation Server* (PS) supplies the user interface to the R/3 application. These are primarily Windows 3.xx based, but Windows NT, OSF/Motif (X11), OS/2 Presentation Manager, and Macintosh are also supported. Nearly 90 percent of the R/3 front-ends are Windows based. The presentation server can also provide graphical analysis of application data.

If the Database Server and Application Server are running on the same physical machine, the system is referred to as a *Central System.* It is possible to separate the database and application server across different systems. In fact, a single database server can support several application servers. This is known as a *Distributed System* (DS). In all cases, the network interconnection between the R/3 components is made over the TCP/IP protocol.

The performance of an SAP system is very much dependent upon the Application Server component. Typically, there is a 4:1 ratio between the work done by the Application Servers and that done in the Database Server. In a distributed environment, if all servers were similarly configured, there would be one Database Server and four Application Servers.

The SAP R/3 Application Services

The SAP R/3 system is a "true" client/server system. This means that a user logged on to the SAP R/3 system implicitly uses processes from all the servers in the network. The specific process available on the server and the extent of the process depends on the configuration of the SAP R/3 system.

Process	Description
Dialog Process	Interactive transactions of the SAP R/3 system.
Batch Processes	The SAP R/3 system contains a complete job-scheduling system. This service is also used to put long running queries into background. Batch processes are basically the same entity as a Dialog Process, but do not accept user input. In fact, the system can be configured to convert Dialog Processes between batch work and on-line work during different periods of the day.
Update Processes	All database changes, adding a sales order for example, are done asynchronously to the dialog process.
Enqueue Processes	SAP implements its own database lock manager, known as the Enqueue Process. Only two Enqueue processes can be started and must be run on the same server in a Distributed System.
Spool Processes	The SAP R/3 system contains a comprehensive spooling system. To print spool orders, Spool Processes are required.
Message Server	Manages communication between the work process, within a server and between separate servers. Only one message server exists per installation of R/3. With R/3 Version 3.0, the message server also handles the load balancing of user logons across application servers, allocating new logons to the least active system.

When R/3 is started each server can run a different group of workprocesses, depending upon its role. In a central server configuration all processes run on the same server. In a distributed environment processes can be distributed between servers, although in most cases all processes but the dialog process run on the central server.

SYSTEM CONFIGURATION

R/3 is a very intensive application, requiring considerable memory, processor capacity, and disk resources. This section presents some guidelines in configuring Compaq ProLiant systems to host the R/3 application. Example system configurations are provided for minimal and development systems, together with advice on the disk layout for larger production systems. These are not intended to be specific guidelines for the sizing of productive systems. More details can be obtained from the Competence Centers.

System Performance and Benchmarking

Benchmarking Methodology

SAP has defined a standard set of benchmarks for the different application modules (SD, FI, MM, PP, HR). These benchmarks are available to all hardware partners to enable them to provide competitive performance analysis, together with system capacity planning. The benchmark suite also provides a very valuable means to place a substantial load on a system during testing of new hardware and software components.

Benchmarking is an open process in which all of the SAP hardware partners participate. The benchmarks are controlled by SAP but run by the individual companies. This process is overseen by the "SAP Benchmarking Council," an informal grouping of SAP and the hardware partners. This council monitors the benchmarking activity and provides standards for reporting the results, which must be verified by SAP prior to publication.

The benchmark consists of a number of script files which simulate the actions of a typical user in each of the modules and a predefined SAP client database which contains simulated company data against which the benchmark is run.

After a standard installation of the R/3 system and import of the predefined company data, the script files are executed on a benchmark driver system. Currently, this system must be a UNIX workstation. However, a Windows NT version is currently under development. Each script file simulates the entries made by a user in the SAPGUI frontend software, executing a variety of SAP transactions consisting of one or more screen changes or dialogue steps (DS). This process employs the playback mechanism in the SAPGUI application allowing keystrokes to be saved and replayed against the frontend software. This means that for each benchmark user simulated a separate SAPGUI process must be run.

After each dialog step there is a 10-second pause called the *think time*. SAP has experienced that an average user performs a dialog step every 30 seconds. Therefore, the load imposed by a single script file represents roughly three active users (when taking the system response time into account, this ratio is more accurately specified as 2.67, and for planning purposes we generally apply a factor of 2.5).

Once a script file performs all its SAP transactions, it repeats these steps in a loop. The repetition time may be defined when commencing the benchmark. Typically, a benchmark simulating a specified number of users (and therefore the same number of SAPGUI processes) must be run for a period of one hour to generate statistically significant results.

After each run, performance data is retrieved from the SAP system and collected on the benchmark driver system. Then the next run is performed with an increased number of users. The benchmark result is defined as the number of benchmark users supported by the system in the given application module, with an average dialog process response time of two seconds.

This figure should be viewed as a measure of the absolute performance capability and is primarily intended to enable comparisons between different hardware platforms. This figure should never be used as part of the capacity planning process. For system sizing, a further criterion is applied:

The number of benchmark users supported by the system in the given application module, with an average dialog process response time of less than two seconds and processor utilization on the database server of no more than 60 percent.

This extra constraint allows for the fact that systems experience peak loading and that background processes, such as print spooling and batch jobs, are always present. On a well-balanced hardware architecture, such as the Compaq ProLiant, two-second response times only occur with the system processor utilization at 100 percent. Generally, the response time experienced in a system at 60-percent utilization is below one second.

The response time definition is based upon the dialog process. A real user experiences a longer response time due to delays imposed by the network and performance of the workstation used. If both these components are correctly specified, the increased time should not be a problem.

Although benchmarks are available for the majority of the SAP modules, the figure most often communicated is the number of SD benchmark users supported. This has replaced the earlier use of FI users. The SD application is one of the most complex in the R/3 suite and provides the best single representation of a mixed group of users accessing different modules.

Publication of Results

The result of the benchmarks may be communicated in two different ways:

1. Number of benchmark users in a given module.

2. The number of SAPs supported by the system.

Method 1 is only valid when communicated together with a mean response time and mean processor utilization.

Method 2 is a measure of total system throughput and enables results from different SAP module benchmarks to be compared. SAP has defined a conversion factor per benchmark to generate this common throughput-based result. The prime conversion factor is based on the benchmark module SD, and 100 SAPs are defined as: "Updating 2,000 business operations per hour in the SAP application benchmark SD. In this time, 6,000 dialog steps are executed." While it is valuable, this figure is rarely published. Generally, the simpler user figure is given.

Interpretation

As mentioned above, the intent of benchmarks is to provide a means of comparing systems. It is not possible to guarantee a real user response time using the benchmark suite, because the performance impact of customizing, database size, batch loads, and specific system configuration cannot be included.

With two given results you can establish a comparison as follows:

Example 1 - SAPs

System A: 200 SAPs

System B: 300 SAPs

Interpretation: System B is able to handle 50 percent more dialogue steps than System A in the same amount of time.

It does *not* mean:

System B is faster than System A; System B could have more but slower processors than System A, resulting in a poorer mean response time but higher throughput.

Example 2 - SD Users

System A: 300 SD benchmark users

System B: 400 SD benchmark users

This result provides very little information.

System A: 300 SD benchmark users, 1 second MRT/DS

System B: 400 SD benchmark users, 1.5 second MRT/DS

This provides at least a part of the information needed. System B is handling 30 percent more users with a 50 percent longer mean response time per dialogue step.

System A: 300 SD benchmark users, 1 second MRT/DS, 95-percent mean processor utilization

System B: 400 SD benchmark users, 1.5 seconds MRT/DS, 65-percent mean processor utilization

This is the complete information and shows that System B is definitely more powerful than System A, because B can sustain the response time for even *more* users or while executing background batch jobs. System A shows severe response time degradation when adding additional load.

Central System Performance

The application scales very well with the number of processors, up to and including the maximum of four:

	Maximum Number of Active Users in SD Module		Maximum Number of Active Users in FI Module	
Processor Utilization	60%	100%	60%	100%
1 x 100-MHz Pentium Processor	23	38	63	63
2 x 100-MHz Pentium Processors	43	68	133	175
4 x 100-MHz Pentium Processors	83	113	175	268
4 x 133-MHz Pentium Processors	110	163		

NOTE: With the 133-MHz boards we saw an excellent performance improvement, in the range of 30 to 40 percent. The reason is not only the higher clock speed but also the improved cache design.

SAP recommends designing systems for average processor loads that are close to 60 percent. However, the 100-percent figure indicates the potential for handling peak loading during exceptional circumstances. The 60-percent figure **must** be used for the system sizing process.

The maximum number of users supported by a given configuration will be reduced if batch jobs are being run at the same time as user access. Also, only a properly designed system can achieve high throughput. When there is a disk or memory bottleneck, additional processors never result in more throughput.

Distributed System Performance

Once user requirements exceed the performance of a central server configuration, it is necessary to split the database and application components across separate systems. The performance of such a system is very dependent upon the components used at all levels of the system. However, the database server always provides the ultimate performance bottleneck. Recent benchmarks, utilizing the Oracle database, have demonstrated the following performance capabilities of the Compaq ProLiant platform:

	Maximum Number of Active SD Users Supported per server	
Processor Utilization	60%	80%
Database Server		
4 x 100-MHz Pentium	450	550
Application Servers		
2 x 100-MHz Pentium		63
4 x 100-MHz Pentium		116

These results support the observation that there is approximately a 4:1 ratio between the workload on an application server and that on a database server. In this case, with all components at 80-percent utilization, the database server can support 4.75 times the number of users that can be supported on an identically configured application server. The latest results can be retrieved from the Compaq SAP Competence Center by mailing to cpqsap@bangate.compaq.com.

System Sizing Methodology

To perform a successful sizing, the customer must provide information concerning the planned installation. A questionnaire for gathering this information is available from your local subsidiary, Regional Competence Center, or the International Competence Center.

The required information falls into two categories:

- First, we must know the peak number of users accessing the system in each of the different SAP modules, for example, Financials, Materials Management, Sales and Distribution, and so on. These must be further divided into active and in-active but logged-on users. This differentiation is important. Even if a logged-on user is not working, and therefore not creating any processor load, the system still reserves memory for that connection. The definition of an active user is one who submits a screen change in SAPGUI every 30 seconds, viewed by SAP as the average work rate experienced on customer sites. This information is used to size the number and type of processors and the amount of memory required.

- Secondly, information is needed about the transactions and data volumes on the system. This information is specific to each of the SAP modules and requires a detailed understanding of the business processes being implemented. This information is used to size the database.

We very **strongly recommend** that customer sizing information be gathered by a knowledgeable SAP consultant. In particular, small errors in the disk sizing questionnaire might lead to large errors in the amount of disk space predicted for storing the database tables.

If the sizing questionnaire is correctly filled in, sizing an R/3 system should not take more than a few hours. However, these questionnaires are often incomplete or produce unrealistic configurations due to errors in answering the questions. From our experience we suggest allowing a minimum of **2 weeks** from the point of submitting the questionnaire to completion of a system proposal. In fact, for larger systems this might take even longer.

Processor Sizing

The processor configuration of an R/3 system is determined from the number of **active** users accessing the system in each of the R/3 modules. This number is determined by converting the number of users in each module to *normalized SD users* (referred to as SD's), using a series of weighting factors between the average loads generated by typical users in each of the modules. An FI user is assigned a weighting of 1 and all other user types are scaled against this factor.

Once the number of SD's is calculated this value may be compared with the maximum number of SD users supported on each of our processor platforms. These values have been derived from benchmarking. In many cases the performance requirement can be met by more than one system configuration. For example, a 45-SD central server configuration could be supported by four 66-MHz, three 90-MHz, or two 100-Mhz processors. In this case we recommend configuring the system with the minimum number of processors possible to allow for future increases in user numbers or transaction load.

If the system load exceeds the number of SD's supported by a central server configuration, then a distributed system must be proposed. The database server may be sized by comparing the SD figure with the benchmarks, once again selecting a processor configuration which minimizes the number of processors. Selecting the number and type of application servers is more difficult, because there are many different options available depending on the type of processor selected. The precise configuration will depend very much upon the needs of the customer and the availability of components. We recommend applying the following rules:

- A minimum of two application servers should be proposed.

- A maximum of seven application servers should be proposed.

If the number of users in a distributed system exceeds 100, then it must be made clear to the customer that they must invest in FDDI technology (or other similar bandwidth technology) to connect the servers together.

Memory Sizing

R/3 is a very memory-intensive application, requiring large amounts of memory to run efficiently. Memory is sized according to rules established by SAP. For each type of system, a fixed amount of memory is specified plus a component depending upon the number and type of users. A minimum of 192 Megabytes should be configured for a productive system. However, even this amount only supports about 20 users.

The amount of memory needed by SAP, will not, however, exceed the maximum capacity of the Compaq ProLiant 4500. Limits are currently always imposed by processor performance requirements before the amount of memory needed for a system exceeds one Gigabyte. This will be re-evaluated with the introduction of the next generation of Intel processor technology, the "P6".

Disk Sizing

Detailed disk-sizing guidelines are available for Oracle. Contact a Competence Center before sizing the disks for a system with an Adabas database.

Database/Central Server

The disks on a Central Server or a Database Server in a distributed environment are sized in the same manner. The disk storage *must* be divided into a minimum of three separate volumes, to ensure the integrity of the database:

Volume	Minimum Size	Contents	Size
1	2 GB	NT Operating System	200 MB
		Operating System Page File	2 x Memory
		On-line Oracle Redo Logs	200 MB
2	2 GB	SAP R/3 Executables	200 MB
		SAP R/3 Logs	250 MB
		Oracle Database Executables	200 MB
		Archived Oracle Redo Logs	Depends on Users
3+	6 GB	Oracle Database Table Spaces	Both calculated by SAP disk sizing tool
		Oracle Database Reorganization Space	

Volume 1

This volume includes the operating system, on-line Oracle redo logs and page file. SAP recommends that the page file be three times physical memory. However, this is based upon the UNIX environment. Windows NT does not use as much page space, and paging activity greatly reduces system performance. Sizing the page file at two times physical memory allows for all operational environments. If the page file needed exceeds this value, then a memory upgrade is needed to ensure acceptable system performance.

Volume 2

This volume includes the SAP and Oracle executables, space for the SAP system log files, and space for the archived Oracle redo logs. The first three components may be sized easily. However, the amount of space for the archived redo logs presents a problem in sizing. These logs are continually created as users access the database, the rate of creation varying according to the level of activity.

The amount of space needed depends upon two factors, the rate of growth and the rate at which the customer backs them up to tape and deletes them. Experience with existing customers indicates that an average user generates approximately one Megabyte per hour. Thus, to calculate the space requirement we must multiply this growth rate by the number of users and by the interval between the backup and deletion process.

Volume 3+

The amount of space needed by the database is calculated using a Windows-based tool provided by SAP, called *R/3 Configuration.* This tool is periodically updated to account for changes in the R/3 modules. This tool only supports the Oracle database. It is not currently possible to accurately size any other databases.

The information needed to size the database accurately is very extensive and requires considerable knowledge to complete. The database section in the sizing questionnaire compiled by Compaq from the sizing tool has 19 pages of questions. Only those questions concerning modules used by the customer must be completed. However, this is still a complex task and we very strongly recommend that this be filled out with the assistance of a qualified SAP consultant. Mistakes in completion can lead to very large errors in the amount of disk provided.

Once the sizing data is collected, it must be input into the database sizing tool. The tool then predicts the total amount of disk space needed by the system, including the amount of space needed for the basis system. Because this is intended to size a UNIX system, the result predicted by the tool must be further processed to obtain the amount of space needed for only the database tables and re-organization. The following procedure should be adopted:

1. Set all values, except for the number of languages in the BC component to 0.

2. Add the size of the largest predicted table space for database re-organization. This value may be obtained from the sizing tool by activating the database distribution display (See Help in the R/3 Configuration tool).

Application Server

An application server only needs a single volume, typically a RAID 1 mirror set comprising two disks. This volume must allow space for the operating system (200 Megabytes), SAP executables (200 Megabytes), SAP log files (250 Megabytes), and operating system swap space (2 times the system memory).

Sizing Tools and Support

A number of tools exist to help in the sizing process. Compaq has developed an internal memory and processor sizing tool complementing the SAP developed R/3 Configuration tool for sizing the database. In addition, there is a Lotus Notes database, "SAP R/3 Sizing Requests" available to help manage the sizing process. This may be used to manage sizing requests made locally or to submit sizing requests to a Compaq SAP R/3 Competence Center for processing by the engineers there.

All systems with greater than 200 active users must be referred to a Regional Competence Center for sizing.

Disk Configuration

The R/3 system consumes large amounts of disk space. For example, SAP recommends a minimum of 6.5 Gigabytes for the executables, database, and database redo log files. However, a production system uses far more than this, and it is quite common for end-user systems to have in excess of 10 Gigabytes for the database alone. Therefore, pay great attention to the disk layout for reasons of performance and resilience.

If the system is not being used in production, lower levels of fault tolerance may be considered. For the sake of consistency between systems, reserve the D: drive for the CD-ROM. We recommend that all volumes are NTFS, for reliability and file naming consistency. Although using FAT for the operating system does allow the option to boot with a DOS diskette and make repairs, the backup and restore technology for NT is sufficient to recover a damaged Operating System partition.

For ease of maintenance, use only one type of drive in production systems and provide on-line spares. In development or demonstration systems this restriction could be eased but it is not recommended unless cost is a major issue.

Oracle Database

For safety reasons it is essential that a minimum of three logical disk volumes be used, separating the on-line redo logs, archived redo logs, and database files. The following is typical for a productive environment:

Volume	Disks	RAID level	Drive letter	Size [GB]	Contents
1	2 x 2 GB	1	C:	1.8	Windows NT, NT pagefile
			E:	0.2	Oracle on-line redo logs
2	2 x 2 GB*	1	F:	2	SAP R/3 executables, Oracle executables, Oracle Archive Log Files
3	4 x 2 GB#	5	G:	6+	Oracle tablespaces, database reorganization space

* Depending on the system activity, the necessary space for the Archive Log Files can be considerably larger.

The actual size of the database depends very much on the specific customer requirements and can be much larger.

Consider the location of the on-line redo logs very carefully, because these are written to every time a database update is made and could cause considerable performance problems if badly placed. R/3 mirrors the redo logs in software, storing the mirrored logs by default in the same volume as the database. Remove this mirroring after installing the system to avoid too great a load on the database volume. Hardware mirroring of Logical Drive 1, using the Compaq SMART SCSI Array Controller, is more reliable and faster.

Adabas-D Database

In addition to the generic guidelines for Compaq ProLiant Servers running SAP R/3, there are some changes to consider when the DBMS is ADABAS/D from Software AG.

Volume	Disks	RAID level	Drive letter	Size [GB]	Contents
1	2 x 2 GB	1	C:	1	Windows NT, NT pagefile
			E:	1	ADABAS/D log devspace
2	2 x 2 GB	1	F:	2	SAP R/3 executables, ADABAS/D executables, ADABAS/D log archive destination
3	3 x 2 GB+	5	G:	4+	ADABAS/D sysdevspace, datadevspace(s)

ADABAS/D allows the creation of *database containers* up to the maximum Windows NT file size. Adabas then uses these containers to store tablespaces and dynamically allocates extra storage as needed, removing the need for database re-organizations. Therefore, it is not necessary to make a detailed plan of the database file layout.

Adabas-D Database

The disk layout for R/3 systems based on SQL Server will be covered in the next revision of this White Paper.

Networking

As a client/server application, R/3 makes considerable demands on network resources. Two types of network connections must clearly be distinguished:

- *Database Server to Application Servers*. It is **not** recommended to set up configurations where Database and Application servers are distributed across a wide area network, because of bandwidth limitations with current networking technology.

- *Application Server to Presentation Servers*

In the case where a single computer fulfills the functions of Database Server and Application Server, only the network between Application Server and Presentation Server must be considered.

SAP Requirements

Only TCP/IP networks are supported by SAP, and communications occur via TCP/IP sockets.

The network(s) across which R/3 is implemented and run must fulfill *boundary conditions*:

- Response time less than two seconds (maximum system response time allowed at the end-user's workstation)

- Maximum 50-percent load (to allow peaks, and considering the real network throughput)

Measurements done by SAP on development systems have determined *the network load of an R/3 system*:

- Between Application and Presentation Servers: 1 Kbyte per screen change (with 3.7 screens average per transaction) - 3.7 Kbyte / Transaction

- Between Database and Application Servers: 20 Kbyte per screen change (with 3.7 screens average per transaction) - 74 Kbyte / Transaction

- Between Database Server and Printer: approximately 2 Kbyte / Page

This highlights the dramatic difference between the communication medium needed between database and application servers versus the load between the application server and workstation clients. Subsequently, in the case of a distributed system, take great care to ensure that sufficiently high bandwidth is available between the servers.

LAN Considerations

Between Database Server and Application Server

The communication between database server and application server is very intense, requiring at least a dedicated Ethernet segment, and most likely the use of FDDI 100-Megabyte per second optical networking. Use of FDDI between application and database servers is recommended by SAP for systems with more than 100 active users.

Where a customer has not already chosen an FDDI vendor, we strongly recommend the use of SysKonnect equipment. This solution has been thoroughly tested in our laboratory and provides a reliable service.

Between Application Server and Presentation Server

Traffic between the workstation client and Application Server is 20 times lower than the traffic between Database Server and Application Server. The theoretical maximum number of clients supported by a single Ethernet segment is in the thousands, well above the practical limits for current hub technology.

In the case of a local implementation with a high number of users, partition the users across multiple segments, connected to each other using FDDI technology.

WAN Considerations

Network bandwidth between Application Servers and clients, however, does become an issue when the clients are separated from the application servers by a Wide Area Network. The following formula may be used to calculate the bandwidth requirement for connecting a remote group of workstations to an Application Server:

$$T \text{ (kbit/s)} = 0.5 * N / U$$

where: T = necessary line capacity (kbit/s)

   N = Number of users

   U = Required line utilization (should be no more than 0.3 (30%))

The following table shows the maximum number of active users that should be supported for the specified bandwidths:

Bandwidth Kbaud	Maximum Number of Active Users
4.8	0
9.6	5
64	34

Ideal utilization of the line would be 70 percent. However, SAP advises planning for a maximum of 30 percent, thereby allowing for peak workloads. This advice is based upon experience with existing customer installations.

As mentioned above, the partition of Database Server and Application Server(s) across a WAN is not supported because sufficiently high bandwidth WAN services are not available.

Support Requirements

Provide all R/3 systems with an X.25 or ISDN WAN connections for the following support services:

- On-Line Software Service (OSS), which provides a mechanism to escalate technical problems directly to the SAP post-sales support team, as well as access to software updates, and technical documentation.

- SAP Early Watch, which provides a regular preventive system performance analysis service directly from SAP.

Every Customer site **must** have a WAN connection established to SAP **before** the installation is performed, as a requirement for the support contract with SAP. This is the only means for SAP and Compaq to operate appropriate remote support. Frequent on-site support can be very costly for the customer.

General Hardware Configuration Issues

These guidelines are made recognizing that a productive SAP system is always viewed by the customer as mission critical. In some cases loss of the system for more than two or three days could result in the failure of the company supported by the system.

General

- Base distributed SAP systems upon rack-mountable components.

- Redundant Power Supply models should be proposed.

- Include a UPS unless the customer has separate provision for protection from power loss.

- Encourage the customer to purchase a second development system in accordance with SAP's own recommendation. This system could also be used as a back-up in the event of failure of the productive system. It is also common for customers to run a third test system for evaluation of new releases. The main benefit of this system is that testing does not interfere with development. An SAP license permits installation of up to three systems for production, development, and testing.

Processors

- Propose the processor model that minimizes the number of processors in the system unit.

Disks

- All disk volumes should be RAID 1 or RAID 5.

- Include one on-line spare drive per SMART Controller on central or database servers.

Backup Technology

- Except for small (database, eight Gigabytes or less) or development systems, propose DLT tape technology. Although the 4-/16-Gigabyte TurboDAT autoloader offers high capacity, the backup rate is too low.

Communications and Networking

- If a distributed system is to be installed, FDDI or equivalent must be used to network the servers if the number of users exceeds 100.

- The customer must install an X.25 capable TCP/IP router. This must be a separate unit to the server, do not install router technology in servers running the R/3 application.

- A modem must be installed in the server to allow remote Compaq Insight Manager access for technical support.

Operating System

Versions Supported

The following table lists the versions of NT supported with the indicated R/3 versions, together with the necessary software updates from Microsoft and Compaq. The version of NT used must be certified for use with the specific R/3 version. Therefore, these guidelines must be followed to obtain support from SAP. Furthermore, only the **Compaq SmartStart version of NT with English Language** is certified for use with R/3.

NT 3.1 Advanced Server	
SAP Versions Supported	All 2.1 versions up to but not including 2.1J - Oracle
	All 2.2 versions up to but not including 2.2D - Oracle
SSD level	1.05b
Service Pack Level	3
NT 3.5 Server	
SAP Versions Supported	All 2.1 versions from 2.1J onwards - Oracle
	All 2.2 versions from 2.2D onwards - Oracle
	All **Adabas** versions
SSD level	1.15a
Service Pack Level	Service Pack 2

Newer versions of the SSD or Service Pack should not be applied without first referencing a Competence Center.

When installing Windows NT 3.5, select the Workgroup Server option. Making an SAP server a domain server or a member of a domain can cause a number of problems:

- Domain Servers keep monitoring the network and subsequently use processor and memory resources for this task.

- If an SAP system is a member of a domain, but the Domain Server has failed, it will not be possible to start up the R/3 application.

Recommended Modifications to the Certified NT Installation

After installing Windows NT on the server, together with the appropriate SSD and service pack (if required), a number of other tasks must be completed, some of which can substantially improve system performance:

- Make sure that no screen saver is running. Screen savers unnecessarily take up a lot of processor resources.

- Ensure that the system name and TCP/IP address are included in the hosts file. If the system is in a distributed installation, ensure that the names and addresses of all systems are included, for both the user access network and inter-server network.

- Ensure that the DNS hostname is entered correctly.

  In the Control Panel, select *Network -> TCP/IP Protocol -> Configure -> DNS -> Hostname*, and ensure that the hostname has the same case as the Windows NT system name.

- Select the correct memory model.

  In the control panel, select *Network -> Server-Configure -> Set* to "Maximize for Network Applications"

- Start the disk performance monitor.

  Execute the **diskperf -y** command in a DOS window.

Example Systems

Following are a number of example systems. These are presented to provide an idea of the hardware components that need to be included in an R/3 system. The examples given are based upon the requirements for supporting the Oracle database. Adabas-D systems are configured very similarly. However, check page 18 for advice concerning the specific disk layout.

> **Do not use these systems to make proposals to customers. Each and every R/3 system must be carefully sized and configured to meet the individual needs of a specific customer implementation.**

An Appendix also lists a number of other system configurations of varying sizes. These systems are included on the Lotus Notes based SAP Infoline and are available to partners and customers of SAP as examples of Compaq configurations for SAP R/3.

Minimum Configuration

This represents the smallest possible configuration needed to run R/3. It is *possible* to create a smaller system. However, no guarantee of performance could be given. This example is designed *purely for evaluation or demonstration purposes*. Such a system **must** not be used in a productive environment because it includes no fault tolerance and has insufficient memory to support more than a few users carrying out simple investigative tasks.

System	ProLiant 4500 5/100 - 1 x 100-MHz Pentium Processor
Memory	128 MB RAM
Disk Drives	5 x 2 GB
Disk Volumes:	2 GB for Windows NT 3.5 and Oracle On-line Redo Logs
	2 GB for SAP/Oracle Executables, and Oracle Archived Redo Logs
	6 GB for Oracle Database Table Spaces
Other	15″ Monitor

Development System

This system has been designed to support a development team of up to 20 in any R/3 module, with provision for a 12-Gigabyte database. Because development is often a time-critical process, the system has a high level of fault tolerance. The database size has been chosen to provide an example configuration only.

SAP strongly recommends that customers run a development/test system in parallel with a production system to avoid any impact from development problems upon the working environment. In fact, the SAP license makes a provision for the customer to install up to three separate instances for development, test, and production. In this case the database size should be the same as that on the production system. A test system is particularly valuable during upgrades to R/3 as the upgrade procedure can be tested against the production database prior to the upgrade of the main system.

System	ProLiant 4500 5/100 RPS - 2 x 100-MHz Pentium Processors
Memory	256 MB RAM
Hard Disks	11 x 2 GB
Disk Volumes:	2 GB (RAID 1) for Windows NT 3.5 and Oracle On-line Redo Logs
	2 GB (RAID 1) for SAP/Oracle Executables, and Oracle Archived Redo Logs
	12 GB (RAID 5) for Oracle Database Table Spaces
Other	15" Monitor, 10-/20-GB DLT Tape Drive, Redundant Power Supplies, and UPS Support

Production System - Central Server Configuration

This is an example of a production system supporting approximately 80 users in a central server configuration, that is, with the database server and application server combined into the same system. The system has built-in fault tolerance to ensure a high degree of availability consistent with a production environment.

System	ProLiant 4500R 5/100 RPS - 3 x 100-MHz Pentium Processors
Memory	320 MB RAM
Hard Disks	4 x 2 GB ; 6 x 4 GB
Disk Volumes:	2 GB (RAID 1) for Windows NT 3.5 and Oracle On-line Redo Logs
	2 GB (RAID 1) for SAP/Oracle Executables, and Oracle Archived Redo Logs
	16 GB (RAID 5) for Oracle Database Table Spaces
On-line Spares:	1 x 4 GB
Other	15" Monitor, 10-/20-GB DLT Tape Drive, Redundant Power Supplies, UPS Support, Modem, and X.25 TCP/IP Router

Production System - Distributed Server Configuration

This is an example of a system designed to support approximately 200 users in a distributed server environment. The system has built-in fault tolerance to ensure a high degree of availability consistent with a production environment. Note that the size of the second disk volume has been increased from two Gigabytes to four Gigabytes. This accounts for the fact that the large number of users supported in this configuration generate a large number of archived redo logs during a typical working day.

Database Server	
System	ProLiant 4500R 5/100 RPS - 2 x 100-MHz Pentium Processors
Memory	320 MB RAM
Hard Disks	17 x 4 GB
Disk Volumes:	4 GB (RAID 1) for Windows NT 3.5 and Oracle On-line Redo Logs
	4 GB (RAID 1) for SAP/Oracle Executables, and Oracle Archived Redo Logs
	40 GB (RAID 5) for Oracle Database Table Spaces
On-line Spares:	2 x 4 GB
Application Servers (x3)	
System	ProLiant 4500R 5/100 RPS - 2 x 100-MHz Pentium Processors
Memory	320 MB RAM
Hard Disks	2 x 2 GB
Disk Volumes:	2 GB (RAID 1) for Windows NT 3.5 and SAP Executables
Other	15" Monitor, 2 x 10-/20-GB DLT Tape Drive, Redundant Power Supplies,
	UPS Support, Modem, and X.25 TCP/IP Router. This system will also need an FDDI concentrator and NICs to support the high level of traffic between the database server and application servers.

System Installation Guidelines

This section provides an overview of the R/3 installation process. Installing R/3 is a complex and time-consuming process that should only be undertaken by SAP Certified Installers. The discussion presented here is *not* a guide to installing, but is intended to highlight the process and to provide some specific Compaq guidance about topics not covered in the R/3 Installation Guide.

SAP R/3 Installation Training

Training is discussed in more detail later in this document. However, customer installations of R/3 must be carried out by an SAP R/3 Certified Installer. SAP require Certified Installer status for the installer, and they reserve the right **not** to support the system if this requirement is not met. This is not true for demonstration systems or test systems, which are used at trade shows or internally within Compaq.

If a Windows NT Certified Installer is not available in the country in which the system is to be installed, contact the local Competence Center for advice. Even if a Windows NT Certified Installer is available on site, support may be needed during the installation from a Compaq Systems Engineer knowledgeable in Windows NT and R/3. This individual, while not necessarily a Certified Installer, must have carried out at least two R/3 installations within Compaq prior to providing this support.

Planning for an Installation

An SAP R/3 installation follows a set pattern:

1. System sizing and design.

2. Delivery of hardware and software.

3. Hardware build.

4. Network Integration.

5. Operating system installation and system configuration.

6. SAP R/3 and Database Installation.

7. Language Import and other post-installation R/3 configuration tasks.

8. Connection of a printer and successful printing from R/3.

9. Installation of remote support capability (X.25/ISDN SAP Early Watch Service and modem for remote Compaq Insight Manager Support.

10. Create an Inspect file and send to International Competence Center

11. Create a new emergency repair disk.

12. Test the on-line backup capabilities of SAPDBA and carry out a complete off-line backup of the system.

13. Installation of client software on workstations.

In all installations the above tasks must take place and must be planned. Ideally, a project plan should be established with the customer or installation partner to ensure that all components come together for the installation. To assist in this planning task, we present the following checklist which must be completed prior to beginning the installation of R/3:

- The complete hardware order should have been delivered. Ideally, this should be thoroughly tested by the reseller prior to delivery. Any hardware component failure during installation could cost the project considerable time, plus requiring the rescheduling of the installation consultant.

- The hardware partner should build the system to a predefined specification at the installation site. The correct firmware revision diskettes should have been applied to the system. Note that it is quite common to complete the R/3 installation and following customization at an SAP partner prior to delivery of the system to the customer.

- Network connections for the server(s) and clients should be in place. If the system is distributed, a high-bandwidth network for application to database server communication should have been installed (FDDI is the current recommendation).

- The customer should have the latest SmartStart kit and Compaq SSD.

- The customer should have the SAP R/3 installation kit. This is *essential* to ensure that the customer possesses a valid SAP license.

- All relevant installation notes must have been obtained from SAP. Generally, SAP releases a number of technical notes containing sometimes critical information without which the installation may fail.

- A printer capable of being connected to Windows NT should be available, either directly connected to the R/3 system or as a network resource.

- The customer must have a working X.25 link to test the connection to the SAP Early Watch service. If there are problems following the installation, this connection may be vital to diagnosing the problem.

- One or more client workstations should be available to test the LAN connection to the R/3 application server(s).

Central System

In the following table is a brief description of the different activities that **must** take place during an R/3 installation and the amount of time that should be allowed for each activity.

	Task	Description	Knowledge Required	Time
1	Hardware Configuration	Using EISA Configuration tool, select the correct disk volumes, RAID levels, and so on.	Utilities Hardware	15 mins
2	WindowsNT Installation	Installation of Windows NT Server from Compaq SmartStart	SmartStart Windows NT	1 hour
3	Windows NT Upgrade	Application of SSD and Service Pack if appropriate	Windows NT	15 mins
4	Windows NT Configuration	Configure Windows NT for SAP. Create and format disk partitions, modify network settings, modify system settings, etc.	Windows NT	30 mins
5	Compaq Insight Manager Installation	Install and test Insight Manager on the system. Configure the system modem for remote Insight Manager access from Compaq.	CIM Windows NT	15 mins
6	Install database	Load the database executables from the SAP provided CD	Oracle	15 mins
7	Install SAP Executables	Load the SAP executables	SAP	15 mins
8	Import the database	Edit the SAPFS.INF file to define the correct tablespaces for the installation and start the import process.	Database Oracle/ Adabas	5* hours
9	Load the ABAP/4 programs	Import process-dependent ABAP/4 programs	SAP	1 hour
10	Install local front-end software	Install the SAPGUI software on the Windows NT server.	Windows NT	15 mins
11	Install the SAP license	Obtain the license data from the system and fax to SAP. Once verified by SAP, a license key will be returned and must be installed. This will take a little time, but does not interfere with the rest of the installation. A four-week temporary license is activated when R/3 is installed.		15 mins
12	Start the system	Start the database and R/3. Then run some basic transactions to test the system	SAP	30 mins
13	Printer Installation	Define the printer to R/3. This task is important because the installation guide finishes at this point and the instructions for the rest of the installation must be printed from the R/3 system.	Windows NT SAP	15 mins

continued

14	Transport and Correction	Setting up transport and correction facilities in R/3.	SAP	15 mins
15	Client Copy	Copying client 001 (company definition) to create a client in the system for the customer to use.	SAP	1 hour
16	Setting up the link to SAP	Setting up and testing the WAN link to SAP to enable remote support and Early Watch.	Windows NT SAP	30 mins
17	Language Import	If a language other than German or English is needed they, must be imported from CD.	SAP	5 hours
18	Checking database administration tools	Test the functionality of BRBACKUP and BRARCHIVE utilities.	SAP	1 hour
19	Create Inspect File	Create an Inspect file for the system to record the precise hardware configuration at the installation stage. This should then be sent to the International Competence Center for filing.	Hardware Utilities	15 mins
20	Create Emergency Repair Disk	Create a new emergency repair disk.	Windows NT	5 mins
21	Complete System Backup	Make an off-line backup of the complete system, including, Windows NT executables and database	Windows NT	4 hours

* The time given for the database import depends upon the version used. Typically, Oracle needs approximately five to six hours, while Adabas takes one to two hours.

The times given in the table are approximate and vary from system to system, depending upon the processor type, memory, disk layout, and any changes that might be required, due to the R/3 version used.

Excluding the language import, a complete R/3 installation typically takes two days. However, allow for an additional day in case of problems during the installation. For example, if the database import fails, an extra day will almost certainly be needed. All steps up to and including starting the database import should be completed on the first day. The database import should be allowed to proceed overnight. If a language other than German or English must be imported, then one additional day per imported language is necessary.

R/3 is only properly installed when the following has occurred:

1. SAP R/3 starts up.

2. The customer has access to R/3 (front-end on R/3 server).

3. The customer has made a printout from within R/3.

4. A client workstation can access R/3.

5. Access to SAP Early Watch is enabled.

6. Backup has been successfully tested.

Distributed Systems

Database Server

The installation process for a database server is identical to that outlined above for a central system. The database server is installed with the complete set of R/3 executables, and to enable an easy upgrade process these are mounted across the network by the application servers.

For performance reasons it is often necessary to modify the R/3 profile to change the number and type of processes running on the database server:

- Unless users log on directly to the database server, it is unnecessary to run more than one Dialog process, because the only direct access to the database server should be by the system administrator. It is possible to run without Dialog. However, in that case it would not be possible to directly access the database server through the SAP application.

- Similarly, only one Dialog must run on the database server to support administrative access.

- Spool processes should be removed; these are normally handled by the application servers.

- The Enqueue processes should be retained on the database server. Only one server in the system may run Enqueue processes and unless processor utilization is very high (see below). These are best placed on the database server.

In the case where performance is critical, all SAP application processes may be removed from the database server and distributed to application servers. In this case, the database server only runs the RDBMS software and transport facilities (for example, Oracle SQLNET). The drawback of this solution is that the application server running the Enqueue process becomes a second single point of failure because only one Enqueue server may be deployed. Generally, this server also becomes the bottleneck in the system and should be configured as the highest performance application server in the system. If such a configuration is needed, detailed capacity planning, beyond the normal sizing process, is needed and the local Compaq SAP R/3 Competence Center must be involved.

Note that redistributing the SAP work processes only improves system performance if the performance bottleneck results from high processor loads. If performance is poor but processor utilization is low, then further analysis of other components, such as the disk subsystem, memory or network is required.

Application Servers

During the Application Server installation process a number of important tasks, not mentioned in the installation manual, must be carried out:

- Before installing the operating system on the application servers, decide upon a common disk drive partitioning for all application servers. It is also strongly recommended that the same drive letter be used on the application servers for the instance files as was used for the central files.

- Enter the IP address and hostname of the database server in the "hosts" file of each application server. Ensure that this is the address of the high-bandwidth network segment dedicated to transport between the servers. Check this connection by executing the **ping** command.

- When running on Oracle 7.1, SQLNET 1.1 (TCP/IP client) is required. Check the registry key for the national language support of ORACLE (HKEY_LOCAL_MACHINE, Software, ORACLE, NLS_LANG). The value should be "AMERICAN_AMERICA.US7ASCII". Any other value might lead to strange effects within the SAP application, because the sort order is different.

The base implementation is installed very easily using the SAP R3INST tool. After calling R3INST from the CD, a local copy is created. When next running the tool from the desktop, first select *connect to existing sapconf-host* and enter the name of the database server. Then select *new server* and then *application server.* Enter drive letters for each directory by selecting the according lines and pressing the drive letter. Start the setup by selecting *Do-it.*

The following activities run automatically:

- Creating the local directory structure

- Creating the SAPLOC share

- Creating the profiles on the database server

- Creating the SAP start profile on the database server

- Creating the SAP instance profile (<SID>_D00) on the database server

- Creating the SAP service

- Starting the SAP service

- Creating an icon for the SAP service manager <SID>_D00

This process is the same for all application servers. However, the common files created during the installation of the first application server will NOT be overwritten.

The default installation instance for an application server only provides support for running Dialog processes. If other processes, such as Update, are needed the default profile must be modified. By default, the application servers all use the same profile, stored on a shared disk on the database server. If all the application servers are to run the same processes, then only this file must be modified. This can cause problems, because a customer may have machines with different capabilities (amount of processors, memory size).

Defining Different SAP Profiles for Individual Application Servers

To have different SAP profiles per application server, some changes are needed in the default installation procedure. There are two approaches to running different SAP instances per application server.

Locally Stored SAP Profile

Checking the startup command for the SAP service in the registry shows that it starts an executable stored on the central system (share SAPMNT) using a profile which is also stored on the central system (share SAPMNT) and named START_D00. Copying this and the instance profile (<SID>_D00) to a local directory (share SAPLOC on the application server) provides the opportunity to make modifications independent to the other application servers.

To make SAP R/3 aware of the new profile, change the command executed during the SAP service startup. Change the name of the centrally stored profile to the one which is now local and edit the new START_D00 file. This file should now enable the SAP dispatcher to be started using the locally stored instance profile <SID>_D00. This can be done by specifying the new profile in the dispatcher startup command line. To ease this process, add a NOTEPAD icon per profile to the SAP administrator's workspace.

Using Different Instance Numbers

This method, involving the use of different system numbers per application server, allows the profiles to be maintained on a central system. Because the R3INST tool does not offer ability to change the instance number ('00'), the SAP_D00 service must be removed and a new one installed, SAP_D??.

Copy the files START_D00 to START_D?? and <SID>_D00 to <SID>_D??. Make sure that all corresponding SAP entries in the SERVICES file (<WINNT_ROOT>\system32\drivers\etc\services) on the central and application server are added for the new instance numbers.

Upgrading SAP R/3 Systems

Upgrading from one version of R/3 to another is even more complex than carrying out a new installation, because the customer data inside the system must be very carefully protected. This task should only be attempted by an SAP R/3 Basis Consultant, although Compaq could be called upon to provide technical support. The key activity that must take place prior to an upgrade is a complete off-line system backup of all components. This backup should be verified to ensure that a restore of the original environment can be made in the event that the upgrade fails. The upgrade process is irreversible; it is not possible to downgrade an SAP system.

BACKUP AND RESTORE OF R/3 SYSTEMS

Backup and Restore is dealt with in a separate White Paper. Here we will only provide a summary of the results.

The probability of a problem occurring that requires a restore from tape is greatly reduced by the presence of RAID and the extensive use of redo logs within the Oracle database. In fact, given the reliability of modern hard disks and the use of RAID techniques, only major catastrophes such as fire are likely to lead to the necessity of restoring data from tape.

On this basis all disks connected to an R/3 system should be either mirrored or in a RAID 5 array. When designing a system give considerable thought to the backup strategy that the customer will employ and the technology necessary to support that strategy. R/3 databases are often very large, varying from 6 to 100 Gigabytes in productive systems. For this reason we suggest the use of fast DLT drives in preference to DAT. However, for the larger systems this would necessitate many tape changes during an installation. The TurboDAT autoloader is an option, but with an online backup rate of only 1.5 Gigabytes per hour, backup of a large system takes an unreasonably long time.

There are three basic elements in the SAP environment that must be effectively backed up: the operating system, the SAP executables, and the database.

Operating System Backup and Restore

Presently, there is no direct support within Windows NT for disaster recovery of the operating system. With other operating systems it is possible to use bootable media such as tapes, diskettes, or CD-ROM's to boot a simple memory resident version of the operating system supporting the tape devices. There is no such capability in Windows NT.

For this reason it is strongly recommended that the operating system be mirrored in any production installation. Backup of the operating system can be made using the standard Windows NT tool. After any change to the configuration of a Windows NT system a new back up should be made. Ensure that the registry is correctly backed up by any utility used.

To restore a damaged operating system, it is first necessary to perform a standard Windows NT installation. This enables access to the Windows NT backup tool and the ability to restore the operating system from tape over the newly installed version.

Executables Backup and Restore

These components change very rarely. A backup using the standard Windows NT backup utility or third-party software need only be made after a change was made to one of the configuration files or an SAP upgrade was carried out.

Database Backup and Restore

This section details backup and restore from the perspective of the R/3 application. The discussion always assumes that the instance of the operating system is either running or was successfully recovered.

First, the differences between off-line and on-line backup are outlined. The remainder of the section then focuses on the R/3 tool, SAPDBA, and presents its features and capabilities.

Off-line Backup

File-level backup can be performed with any Windows NT-based tape backup software. Examples are Microsoft NTBACKUP, Arcada BackupExec, Hicomp HIBACK/NT and Cheyenne ArcServe. These tools work well as long as no open files or on-line databases need to be handled. If a backup of a running database is required, some additional provisions are necessary to make sure that transactional changes that are processed against the database while the backup is taking place does not result in a non-consistent backup image.

File-level backup of the R/3 application is only suitable if the business operation can tolerate an R/3 system shutdown while the backup is taking place. In this case the choice of the backup software is determined by criteria such as performance, features, supported devices, price, and so on. However, even for R/3-off-line backups, the R/3 utility SAPDBA is valuable because it also provides tape media administration.

On-line Backup

During an on-line backup the R/3 system is fully operational and the backup is transparent to the users, although there will be a degradation in performance. Because the specifics of the underlying database are important for R/3 on-line backups, each database is covered in its own subsection.

Oracle

Backup with SAPDBA

The R/3 tool SAPDBA is used to create R/3 on-line backups. SAPDBA performs all the necessary actions (like setting tablespaces into the backup mode) which are necessary for consistent on-line backups. SAPDBA can be operated in two different modes; in the so-called native mode or in the so-called backint mode.

- **Native mode** means that SAPDBA uses a utility called CPIO to handle the mechanics of the data transfer to and from the backup media.

- In the **backint mode**, SAPDBA employs a commercial tape software that is coupled via the interface *backint* to handle the data transfer to and from a backup media.

The backint mode should be the preferred mode for R/3 systems with high demands on the backup capabilities, typically found in productive environments. CPIO is a relatively primitive utility for moving data to and from a backup media. Only commercial backup software products ensure that the solution can be expanded and can handle requirements like concurrent device operation, support for additional devices, flexibility in terms of configuration, performance improvements, and so on.

Currently, only the product HIBACK/NT from HICOMP is available for backup in the backint mode. The reason why other software vendors cannot be used lies in the backint interface. Backint is a piece of software that acts as an interface between SAPDBA and the commercial backup software. Backint must have a detailed knowledge of the operation of the underlying backup software. Therefore, it is specific for each backup software product.

Supported Devices

During testing successful backups were achieved with hard disks, the 4 mm DAT tape, and the DLT device as the backup media. So far, the 4 mm DAT Autoloader is not explicitly supported but works in a sequential mode via the rewind off-line command. Our current firmware revision on the Autoloader treats the rewind off-line command in such a way that it selects the next cartridge and continues the backup operation. More work is needed to fully integrate this device with SAPDBA.

For productive systems with high demands on backup capabilities, only DLT devices should be considered. They provide a much better performance (see below), higher capacity per tape, better media reliability, and the life time of the read/write head is about four times longer than the 4 mm DAT devices.

Performance

Detailed performance data from the testing of HIBACK/NT is available upon request from the EMEA Competence Center in Munich. The table below provides a summary of the key results:

	Tape capacity+ based on h/w compression of 2.5	Off-line Backup HIBACK	On-line Backup HIBACK 80% CPU load *	Restore HIBACK
4/16 DAT	10 GB (120m tape)	2.5 GB/h	1.5 GB/h	3.5 GB/h
DLT	25 GB	6.8 GB/h	2.7 GB/h	5.5 GB/h

+ During our testing we saw that typically a hardware compression factor of 2.5 to 3.0 was seen with a standard R/3. The actual compression factors depends on the customer specific situation.

*The on-line load was created using the standard SD benchmark, such that a 2 Pentium/66-MHz system would exhibit a processor load of 70 percent **without** any backup activities.

Restore with SAPDBA

SAPDBA assists the R/3 administrator in recovering a defective database at the level of missing or corrupted files. SAPDBA has the option to check the current state of the database and then, depending on the situation, carry out the necessary steps. This includes locating and restoring files belonging to tablespaces, locating and restoring necessary archive files, and performing a media recovery if necessary. This feature is especially helpful for R/3 administrators who are not (yet) well familiar with the details of the Oracle database.

Another advantage of using SAPDBA for backup and restore lies in the administration of the tape cartridges being used (see below).

Restore via SAPDBA assumes that the instance of the operating system is running and that the R/3 executables environment is available. Typically, the R/3 executables and all the R/3 configuration files do not change. As a result, they are only backed up occasionally using either the native NTBACKUP utility or another third-party tool, when changes such as software upgrades or modifications to the R/3 profile occur.

Tape Media Administration with SAPDBA

SAPDBA has the capability to maintain a record of the tapes being used. Typically, a set of tapes is initialized with a header block containing information about the tape label, how often the tape can be re-used, and how long the tape is logically blocked (number of days) before it can be used again by SAPDBA. When backups are executed, SAPDBA records information such as which tape label a given backup set has been written to. When it comes to restoring data SAPDBA uses this information to request the right tape for restoring the necessary files.

Adabas

For Adabas, SAPDBA is not available. Instead, the utilities XUTIL and XCONTROL from Software AG are used to carry out all database administration tasks, including backup and restore.

Technical Support

Compaq Hardware Support

Hardware support of Compaq R/3 systems should currently be provided through specially selected support partners. The mission-critical nature of R/3 implementations requires rapid response to system failures. Typically, this is characterized by a **four hour** time to repair, although in many cases an even shorter time is necessary. Under no circumstances should customers be permitted to depend upon the standard Compaq three-year warrantee. While providing a cost-effective support solution, this warrantee does not make any commitment to a time of repair.

In critical circumstances where the maximum down time that can be tolerated cannot be guaranteed, consideration should be given to *caching* spare parts at the customer site and training local personnel in basic hardware support.

In a very short time Compaq will be able to offer a worldwide support service. Once in place, this package should be considered to be part of a standard R/3 system sale.

SAP R/3 Support

SAP R/3 Hotline Support

All questions or problems relating to R/3 should be directed to the SAP R/3 Hotline. Depending on the geographic region, this would be for

Region	Hotline Location
Europe	Walldorf
America	Philadelphia
Asia	Singapore
Japan	Tokyo

The hotline will then decide on how to proceed most effectively with the request. This hotline will be staffed by both SAP and Microsoft personnel, enabling them to deal with Windows NT-related issues and SAP issues.

All Compaq Windows NT-related calls that could not be resolved by SAPs first-level hotline will be transferred onto the Compaq International Competence Center. The Competence Center may escalate calls to the R&D teams of Compaq in Houston, Texas if necessary. Furthermore, the escalation and call-tracking systems of both companies, SAP AG and Compaq, are interconnected to enhance problem resolution and case tracking. As soon as the customer accepts a problem solution, the corresponding call is closed. Frequent updates on case-resolution progress depending on case severity levels occur.

R/3 Online Services

SAP provide a number of services directly to the customer. These are accessed via a TCP/IP network connection to SAP and may be achieved using X.25, ISDN, or Frame Relay technologies. They also provide a technical support service via a partner to assist in establishing the connection. This company may be contacted at:

> Schweikert Netzwerktechnik
>
> Robert-Bosch Strasse 30-34
>
> D-69190 Walldorf, Germany
>
> Telephone: +49 6227 34 2959
>
> Fax: +49 6227 64156

We very strongly recommend that all customers take advantage of this service because this is SAPs preferred method for providing software support. It can save a lot of expense; complex problems which could be solved by remote access from SAP may otherwise require the on-site presence on SAP consultant.

The TCP/IP routing technology used to access these services must be approved by SAP to ensure interoperability. As a general guide Cisco routers can be recommended for this function, because they are used by SAP and are relatively low cost (the model 2501 has been tested by Compaq). Avoid direct connection of Windows NT systems to an X.25 network; this connection should always be made via a LAN-attached router.

SAP Online Service System

The Online Service System (OSS) allows SAP customers to access a system directly in Walldorf and provides the following facilities:

- Evaluate SAP problems. OSS provides a database of known SAP problems that can be accessed in order to diagnose a customer problem. This saves the time of formally submitting a support request.

- Inform SAP of new problems and present these problems for processing. This enables the customer to submit problems directly to the SAP problem-management system and also to track the progress of outstanding support requests.

- Submit development requests to SAP. SAP is willing to receive requests for enhancements to the R/3 environment and will review all requests at their SAP Product Planning Committee.

- Exchange experiences with other OSS users via Electronic Mail or receive messages from SAP.

- Electronic registration for training courses and documentation ordering.

Online Troubleshooting

If requested, SAP can directly log onto a customer system and analyze the problem, even to the extent of making the necessary correction. This service is also augmented by a Remote Consulting Service, using remote video conferencing using technologies such as Intel Proshare.

SAP Early Watch

SAP offer a service called Early Watch, enabling SAP in Walldorf to analyze R/3 running on customer systems. Early Watch is a periodic analysis service for R/3 Systems. SAP experts at specially equipped service centers in Walldorf and Foster City, USA, Singapore, and Tokyo carry out regular analyses of important system statistics, compile a diagnostic report, and make recommendations for optimizing system configuration. This makes it possible to recognize system bottlenecks and eliminate them before they lead to problems.

SAP offer the Early Watch Service for an installed R/3 System on an annual basis, with a fixed number of scheduled service dates. This is a fee-based service and is performed twelve times per calendar year at intervals of one month. The Early Watch Service focuses solely on application services and database services.

Compaq Insight Manager

Compaq Insight Manager must be installed on any Compaq SAP R/3 server. This is an SNMP-based computer management utility which enables the remote monitoring of system resources, such as disk quality, memory faults, power supply, and so on. Access to the system can be made through the X.25 connection as well as across the LAN, and even using a modem attached to the server, but it must use the TCP/IP protocol. This utility greatly eases the management of Compaq systems and can provide early warning of impending problems, such as disk or power supply degradation. This can be integrated into network management solutions such as HP OpenView and IBM NetView.

TRAINING REQUIREMENTS

Introduction

Comprehensive training is required for all project-related activities with SAP R/3. This is due to:

- The functional and technological richness of the SAP R/3 environment

- The strict support requirements for this mission-critical application

Two main areas of training are proposed by SAP:

- R/3 Application Training

- R/3 Basis Training

SAP offers a wide range of training courses, covering all aspects of the R/3 application, based in Walldorf. Most of the SAP country offices offer R/3 Training. However, the training available depends heavily upon the availability and capability of local resources.

Need for Training within the Compaq Community

The model used by Compaq is based on a clear distinction between functions, which are fulfilled by separate Partners. Leveraging the work and avoiding conflicts between the Partners clearly shows the following:

- R/3 *Application Training* is required by anyone dealing with the functionality of the applications already loaded in the database; Financials, Sales and Distribution, and so on. Typically, attendees would come from Logo Partners, Consultants, and Customer Project Teams who are dealing with the customization of the base R/3 application. Compaq and its Resellers or Support partners should not need R/3 Application Training.

- R/3 *Basis Training* is aimed at all software and system specialists who need to manage, install or optimize the SAP R/3 implementation on the hardware and network platform. Compaq and its Resellers or Support partners should attend well-defined courses in this area to provide the appropriate level of pre- and post-sales support. This training also must be complemented by the appropriate skills in the Windows NT operating system and RDBMS used.

Application Training

Within the frame of each project, R/3 Application Training requirements depend on the level of involvement with each application. Typically, the Logo Partner Project Team has already attended training prior to engagement with the customer. They determine with the Customer Project Team what training they should attend. This Project Team carries out the Application customization in conjunction with the Logo Partner Project Team.

These individuals are then be the application experts within the customer organization. When the system becomes productive, the end-users of the SAP R/3 will be trained by the core Project Team on the specific procedures and screens to be followed.

Basis Training

Everyone involved with the R/3 Basis system should attend some R/3 Basis training. The amount and type of training to be attended is very much a function of the level of project support expected. In addition, solid expertise in Windows NT, TCP/IP, and the RDBMS used will be required.

Following is a non-exhaustive list of the R/3 Basis Training areas SAP proposes:

- System Architecture and Administration

- Data Dictionary and Structures

- Communication Mechanisms

- Database implementation

- ABAP/4 Language

- Computer Center Management

- Installation workshops

We strongly recommend that anyone involved with the R/3 Basis Software should attend at least the BC010 (R/3 System Architecture) and the BC020 (R/3 System Administration) courses.

Installation Certification

Installing the R/3 software on a system needs a rich combination of hardware, network, operating system, and R/3 skills. For this reason, SAP has put together a strict set of skills an installer must have. Once they have convinced SAP of their competence they then receive a letter of certification and become an "R/3 Certified Installer". To be supported by SAP, an R/3 system at a Customer site **must** be installed by an R/3 Certified Installer.

R/3 Version 2.2

SAP have specified the training program needed:

- Windows NT system administration

- TCP/IP networking

- Database training

- R/3 Basis training

- BC 800 Series R/3 installation training

This represents **six weeks** of training. Certification is obtained by successfully demonstrating R/3 competence to the course trainers. They should then have a very strong background to install and support R/3 installations, and the return on investment for this whole training is rapidly obtained.

R/3 Version 3.0 Onwards

The compulsory nature of the training will be dropped from version 3.0 onwards and will be replaced by a one-day examination. Obtaining a passing mark in this examination will be sufficient to achieve Installation Certification. However, it should be stressed that the competence to install and support R/3 systems will still require the same skills. Attendance of the same set of courses is still very strongly recommended, but not compulsory.

APPENDIX: EXAMPLE PRODUCTION SYSTEM

DO NOT use these examples to make customer proposals on the basis of the total number of users quoted; each and every R/3 system must be sized individually.

	System				
	1	2	3	4	5
SAP R/3 Modules					
AM				20	40
CO		10	10	20	40
FI	30	30	40	40	80
HR			10	10	20
MM		20	30	50	100
PP			10	20	40
SD	10	20	30	40	80
Total Active Users	40	80	130	200	400
Normalized SD Users	20	57	107	170	340
System Configuration	Central	Central	Distributed	Distributed	Distributed
Central/Database Server					
System Unit	4500	4500	4500	4500	4500
Processor Type	100 MHz	100 MHz	100 MHz	100 MHz	100 MHz
Number of processors	1	3	2	2	4
Memory	224 MB	320 MB	192 MB	256 MB	384 MB
Database Space Requirement	10 GB	16 GB	20 GB	32 GB	40 GB
Hard Disks	10 x 2 GB	4 x 2 GB	4 x 2 GB		
		6 x 4 GB	8 x 4 GB	15 x 4 GB	18 x 4 GB
Disk Volumes:					
Volume 1	2 GB (R1)	2 GB (R1)	2 GB (R1)	4 GB (R1)	4 GB (R1)
Volume 2	2 GB (R1)	2 GB (R1)	2 GB (R1)	4 GB (R1)	8 GB (R5)
Volume 3	10 GB (R5)	16 GB (R5)	20 GB (R5)	32 GB (R5)	40 GB (R5)
On-line Spare(s)	1 x 2 GB	1 x 4 GB	2 x 4 GB	2 x 4 GB	2 x 4 GB
Application Servers					
Number			2	3	6
System Unit			4500	4500	4500
Processor Type			100 MHz	100 MHz	100 MHz
Number of processors			2	2	2
Memory			256 MB	256 MB	256 MB
Hard Disks			2 x 2 GB	2 x 2 GB	2 x 2 GB

R1 - Refers to RAID 1

R5 - Refers to RAID 5