

COMPAQ

Performance of Lotus Notes R3 for Microsoft Windows NT on Compaq ProLiant Servers

Compaq TechNote

Includes information on:

- Atomic Task profiling
- Hardware performance comparison
- Performance tuning

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Performance of Lotus Notes R3 for Microsoft Windows NT on Compaq ProLiant Servers

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Compaq and Lotus have worked cooperatively on the testing, analysis, and development of this white paper as part of an aggressive effort to provide our ProLiant and Notes customers with R3 performance information. Our joint efforts will increase as we move forward with R4 Notes. Special effort is anticipated toward the generation of capacity and performance information for all R4 Notes versions which Compaq platforms will support – especially the multi-CPU configurations which enable large-scale Notes deployments.

James Grisby
Notes Product Manager
Lotus Development Corporation

Compaq is very pleased with our relationship with Lotus Development Corporation and the work we have performed together in developing this White Paper. We look forward to our increasing efforts in delivering this type of performance information for Lotus Notes Ver. 4.0. We at Compaq feel that strong cooperative efforts, such as this, benefit our mutual customers by enabling us to deliver useful information such as this White Paper and better integrated solutions, such as Lotus Notes 4.0 on the Compaq Family of Servers.

Philip Reagan
Manager, Applications Engineering
Compaq Systems Division

Chapter 1

About This TechNote

This Compaq TechNote provides the results of a performance analysis conducted by Compaq Engineers on the Lotus Notes Server for NT. The information presented here is based on technical knowledge acquired by Compaq Engineers while testing these products in a closely controlled and monitored environment.

This TechNote is for system integrators and network administrators with a knowledge of Compaq Server products, Lotus Notes, and NT. It is a supplement to the *Compaq Hardware Reference* documentation and the *Lotus Notes 3.3* documentation. The results and conclusions of this TechNote will give you:

- An understanding of how individual Lotus Notes user and server tasks impact overall system performance.
- Suggestions for improving your Lotus Notes Server for NT performance.
- Recommendations for selecting the appropriate server hardware for your Lotus Notes Server for NT.

The chapters in this TechNote contain the following information:

- **Chapter 1 - About This TechNote** provides an introduction to the TechNote with a brief summary of each chapter, general information about the conventions used, and a list of other resources to get more details on particular information.
- **Chapter 2 - Overview** discusses the research methods used, which include the following:
 - Atomic Task Definition
 - Lab Setup
 - Profiling and Load Modeling Tool
 - Data Collection and Recording

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1-2 *About This TechNote*

- **Chapter 3 - Atomic Task Profiling** provides an understanding of the impact of individual tasks or server resources.
 - Profiling Methodology
 - Profile Graphs
 - Atomic Task Profiling conclusions
 - **Chapter 4 - Performance Analysis** incorporates the results of the Atomic Task profiling into recommendations for the selection of appropriate hardware.
 - Hardware performance comparison
 - Tuning considerations
 - Performance conclusions
 - **Appendix A - Multivendor Integration From Compaq** provides information on how to order individual Compaq TechNotes, including pricing information, 1(800) telephone numbers, and a list of the latest TechNotes available.
 - **Glossary** defines server management and related networking terms.
-

Notational Conventions

Table 1-1 lists the conventions this TechNote uses to distinguish elements of text found within this document.

Table 1-1
Notational Conventions

Convention	Use
Keys	Keys on your keyboard appear in boldface.
Keys+Keys	When you see a plus sign (+) between two keys, hold down the first key while you press the second key. For example, "Press the Ctrl+Z keys" means press and hold down the Ctrl key while you press and release the Z key.
<i>screen selections, variables, and new terms</i>	These items always appear in italics.
<i>FILENAMES</i>	Names of files appear in uppercase italics in DOS and in other environments.
COMMANDS, DIRECTORY NAMES, DRIVE NAMES, and PROGRAMS	These items appear in uppercase in DOS and in other environments.
USER INPUT	Information you type exactly as it appears is shown in uppercase.
! IMPORTANT	Presents clarifying or specific points of information.
NOTE:	Presents commentary, sidelights, or interesting points of information.
type	When instructed to type information, do so without pressing the Enter key.
Select item → item → item	Items separated by arrows indicate items you select in a sequence.

Other Resources to Use

You may want to consult the following resources for additional information on obtaining the best possible performance and throughput with Lotus Notes Server for NetWare:

- *Compaq TechNote: Configuring Compaq RAID Technology for Database Servers*, P/N 184206-001.

This TechNote provides general to help determine the best configuration of the Compaq SMART SCSI Array Controller for database server needs. It also contains information on Compaq drive subsystem terminology and RAID.

- Lotus Notes 3.3 documentation.

The Lotus Notes 3.3 documentation set provides a comprehensive set of documents covering installation, reference, and an administrator's guide with detailed information on Lotus Notes 3.3.

- *Optimize the Windows NT of Microsoft Windows NT Resource Kit*

This book can help to determine bottlenecks in networks, servers. Gain an understanding of how various activities affect the performance of computer hardware. Perform capacity planning, to determine your future equipment needs for performance or capacity purpose.

- *Compaq Hardware Reference* documentation.

The *Compaq Hardware Reference* documentation can help isolate a problem to a certain computer component or cable segment. Some network problems occur because of malfunctioning hardware; check the documentation that came with the hardware involved.

- World Wide Web on Internet.

<http://www.compaq.com:81/cgi-bin/present/productinfo/techpubs/techpubs.html>

http://www.yahoo.com/Business_and_Economy/Companies/Computers/Software/Lotus_Development_Corporation/

NOTE: This list is not intended to be all comprehensive of the materials available but access to these materials will be of benefit to the reader.

Chapter 2

Overview

This chapter consists of an overview of the research methodology used, which includes the following:

- Atomic Task Definition
 - Database Server Program
 - Replicator Program
 - Indexer Program
 - Router Program
 - Chronos Program
- Lab Setup
 - Lotus Notes Server
 - Lotus Notes Clients
- Profiling and Load Modeling Tool
- Data Collection and Recording
- Executive Summary

A Lotus Notes Atomic Task can be defined as a fundamental operation initiated either from the Lotus Notes Server (Server Atomic Task), or from the Lotus Notes client (User Atomic Task), which is executed by one of the Lotus Notes Server Programs or a group of clients. For example, one of the User Atomic Tasks is Sending a Mail Message. To illustrate, let's assume that 20 client workstations send a number of messages. In turn, this action causes the Router Program to execute its routine to route mail. As a result, this server activity impacts overall system performance.

The performance investigation of a Lotus Notes Server for Windows NT involves two phases:

- Atomic Task profiling - To understand the impact of individual tasks or server resources.
- Performance analysis - Based on the results of the Atomic Task Profiling, Compaq engineers designed several mixed load scenarios to test various hardware subsystems. They then translated the results into recommendations for the selection of the appropriate hardware.

For the Atomic Task profiling phase, User Atomic Task tests were conducted with a group of 20 workstations. Server Atomic Tasks are shown in the results, but they are workstation independent.

For the performance analysis phase, Tests were conducted with up to 20 workstations and various types of atomic operations in order to emulate real world stress on the specific server subsystem.

Atomic Task Definition

The following is a description of the Atomic Tasks identified for study by Compaq Engineers. Although the list of Atomic Tasks is not exhaustive, it covers the commonly used tasks that you or your systems administrator performs during hours of peak activity. The Atomic Tasks have been identified based upon the interviews with Lotus Notes customers and internal groups who have participated in the world-wide deployment of Lotus Notes at Compaq.

The Lotus Notes Atomic Tasks are organized according to the Lotus Notes Server program that executes the task. The most frequently used Lotus Notes Server programs during peak hours of server activity are the following:

- Database Server
 - Replicator
 - Router
 - Indexer
 - Chronos
-

For a detailed description of Lotus Notes Server Programs, refer to the *Lotus Notes Administrator's Guide*, "Server Commands and Programs."

NOTE: There are other Lotus Notes Server programs that are less frequently used or used at off-peak hours. Since these tasks are not normally active during hours of peak activity, their impact has not been considered for this performance study. Keep in mind, however, that some off-peak tasks can be quite stressful on the system. If they are active during normal hours, you can experience performance degradation.

Database Server Program

The Database Server program covers the following Atomic Tasks:

- Scrolling in a View
- Reading a Document
- Editing a Document
- Expanding or Collapsing a Category
- Detaching a File
- Replicating Workstation to Server
- Rebuilding a View Index
- Executing a Non-Indexed Text Search
- Executing an Indexed Full Text Search

Table 2-1 shows how to use the Atomic Tasks for the Database Server Program from the user interface.

Table 2-1
Use of Atomic Tasks for the Database Server Program

Atomic Task	From the User Interface
Scrolling in a View	Press the Pg Dn key to scroll down. Press the Pg Up key to scroll up.
Reading a Document	Highlight and press the Enter key or highlight and double click the mouse.
Editing a Document	Press the Ctrl+E keys to go into edit mode. Press the Ctrl+S keys to save the document.
Expanding or Collapsing a Category	Press the Plus (+) key to expand a category. Press the Minus (-) key to collapse a category.
Detaching a File	Double click the mouse on the attached file icon.
Replicating Workstation to Server	Highlight the Database icon and select <i>Tools</i> .
Executing a Non-Indexed Text Search	Select <i>Edit</i> .
Executing an Indexed Full Text Search	Select <i>Edit</i> .

Scrolling in a View

Scrolling consists of navigating forward or backward through the documents in the database. This task causes the Database Server to continually position the document cursor in the active view to the desired location. Scrolling assumes that you have opened a view in a Lotus Notes Database.

To scroll from the user interface, press either the **Pg Dn** key or the **Pg Up** key while in the active view to scroll forward or backward by 21 documents.

Reading a Document

Reading consists of opening a document to view its contents. This task causes the Database Server to read the document from the disk or from the cache if the document data is already cached in memory. Reading assumes that you have opened a view in a Lotus Notes Database and that the document cursor is positioned at the document you wish to read.

To read a document from the user interface, highlight a document in the active view and press the **Enter** key or double click the mouse.

Editing a Document

Editing a document consists of reading, modifying, and saving the document contents. This task causes the Database Server to save the document to the disk or disk cache. Editing assumes that you have opened a view in a Lotus Notes Database and that the document cursor is positioned at the document you wish to edit.

To edit and save a document from the user interface, first open the document. Then use the **Ctrl+E** key combination to put the document in edit mode. Finally, use the **Ctrl+S** key combination to save the document after making your edits.

Expanding or Collapsing a Category

Expanding a category shows additional categories or Lotus Notes documents grouped within that category. Collapsing is the inverse operation. This causes the Database Server to continually retrieve the indices of the documents or document categories. Expanding and collapsing categories assumes that you have opened a categorized view in a Lotus Notes Database.

To expand and collapse a category from the user interface, use the Plus (+) key to expand a category and the Minus (-) key to collapse a category.

Detaching a File

Detaching extracts a file attachment from a Lotus Notes Database to a local file on the Lotus Notes client. This task causes the Database Server to retrieve the file attachment from the document to which it is attached and to send the contents over the network to the Lotus Notes client. Detaching a file assumes that you have opened a document with attached files in a Lotus Notes Database.

To detach a file from the user interface, double click on the attached file icon within an opened document to bring up a dialog box for detaching the file. Then follow the directions in the dialog box.

Replicating Workstation to Server

Replication allows you to store copies of a database on multiple Lotus Notes servers and clients and guarantee that they are synchronized. During replication, any new documents from the Lotus Notes client are copied to the Lotus Notes Server's replica copy, and vice-versa. For the first replication and the context of this Atomic Task, the documents will only be copied one way from the client to the server. This Atomic Task assumes that you have a database on the client you wish to replicate to the Lotus Notes Server. It also assumes that you have created a replica stub on the server to receive the new documents.

To replicate from the user interface, highlight the local database icon, then select *Tools*. The *Replicate* dialog box is displayed for selecting the desired server.

Executing a Non-Indexed Text Search

Executing a Non-Indexed Text Search initiates a search in a non-indexed database for documents matching your criteria. This causes the Database Server to look through the documents in the database and collect the ones that match. A non-indexed text search assumes that you have opened a view in a database that has not been full text indexed.

To execute a non-indexed text search from the user interface, select *Edit*. The *Find* dialog box is displayed for specifying your search criteria.

Executing an Indexed Full Text Search

Executing an Indexed Full Text Search initiates a search in an indexed database for documents matching your criteria. This Atomic Task is similar to the previous one, except that the database has been previously full text indexed. An indexed text search assumes that you have opened a view in a database that has been full text indexed.

Replicator Program

The Replicator program covers the following Atomic Tasks:

- Replicating Server to Server (Write)
- Replicating Server to Server (Read)

The server-to-server replication is a process in which changes are pulled from each server's version of a database and can be initiated by either server. Before replication begins, the servers build a list of databases they have in common by checking the Replicate ID on every database. When replication occurs, the initiating server pulls changes from the other server, then give the other server the opportunity to pull changes from it.

Replicating Server to Server (Write)

The Replicator program is used to replicate server to server. Replication has been described earlier in the context of the Database Server (Workstation to Server, and vice-versa). Server to server replication has the same purpose: to synchronize databases between two servers. However, this Atomic Task involves the Replicator, rather than the Database Server. The Replicator is invoked when the Lotus Notes Server pulls documents from another server. For the write replication, the Notes Server under test receives the updates.

This Atomic Task is not invoked via the user interface.

Replicating Server to Server (Read)

This Atomic Task is similar to the previous one, except that during read replication, the Notes Server under test sends the updates. Strictly speaking, this Atomic Task is associated with the Database Server program, rather than the Replicator program. The Replicator is only invoked when the Notes Server pulls documents, not when it sends documents. This Atomic Task is not invoked via the user interface

Indexer Program

The Indexer program covers the Creating a Full Text Index Atomic Task.

The Indexer program is used to create a full text index. This Atomic Task causes the Indexer to build the full text index for the database. A full text index can be created on any database.

To create a full text index from the user interface, select the desired database, then select *Full Text Search*. The *Create Index* dialog box is displayed for creating the index.

NOTE: The Full Text index should not be confused with the view index discussed earlier.

Router Program

The Router program covers the Sending a Mail Message Atomic Task.

The Router program is used to send mail. Sending mail consists of composing a mail message and sending it to the desired recipients. This causes the Router to route the messages to the proper mailboxes. The router gets its input from two databases located on the server: the Mailbox database receives incoming mail from workstations or another server's Router; the Name & Address Book supplies network topology information. In short, the server will perform the following:

- Transfer the mail from server mailbox to another server's mailbox based on connection schedules.
- Deliver the mail from server's mailbox to the recipient's mail file.

This Atomic Task assumes that you have properly configured your clients and the server to handle mail. To send mail from the user interface, select *Mail*, then select *Compose* to compose a new message.

Chronos Program

The Chronos program covers the Executing a Background Macro Atomic Task. Background macro execution uses the Chronos program. Background macro execution consists of executing a background macro on the server on a periodic basis (hourly, in this case). Each hour, Chronos runs through the databases checking to see if it has any macros to execute. Background macro execution assumes you have a database that contains an active hourly background macro.

This Atomic Task is not invoked via the user interface.

Lab Setup

In order to analyze Lotus Notes performance, the following configuration was setup:

- Lotus Notes Server
- Lotus Notes Clients

Lotus Notes Server

The following hardware and software were used for the Lotus Notes Server:

- *Hardware:* Compaq ProLiant 4500 (100-MHz Pentium, 64 megabytes RAM, Compaq SMART Array Controller with five 1-GB drives, Distributed Data Guarding)
- *Operating System:* Windows NT Server 3.51
- *Lotus Notes Server Software:* Version 3.3
- *Network:* Compaq NetFlex/2 controller with 10BaseT, NetBUEI protocol

Lotus Notes Clients

The following hardware and software were used for the Lotus Notes clients:

- *Hardware:* Compaq ProLinea Net1/50 Model 200/E (486SX/50, 16 megabytes RAM)
- *Operating System:* Windows for Workgroup 3.11 with MS-DOS 6.2
- *Lotus Notes Client Software:* Version 3.3
- *Network:* Compaq Ethernet 16E network controller with NetBUEI protocol

Twenty identical clients were configured to generate the load. Figure 2-1 illustrates the network setup. The first client is the control station which responsible to synchronize the test and collect the result.

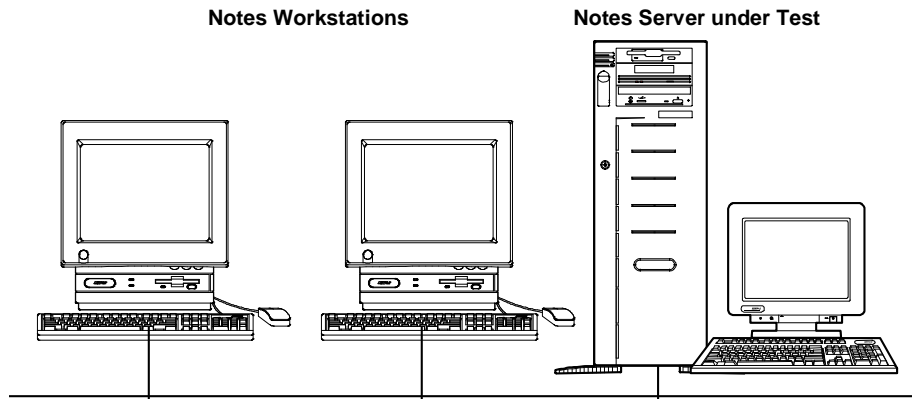


Figure 2-1. Network Setup for Lotus Notes Performance Analysis

Profiling and Load Modeling Tool

At the time of this research, there were no readily available performance monitoring and load generation test tools for Lotus Notes. Therefore, the Compaq Groupware Engineering Team developed a custom tool called the Profiling And Load Modeling (PALM) Tool.

The PALM Tool consists of an editor, a script execution program, and a set of Lotus Notes Atomic Task scripts. The editor was written with Visual Basic 3.0 and the scripts were written using Microsoft Test 2.0.

Visual Basic provides a fast and flexible development environment for Microsoft Windows programs. The resulting editor is a Windows program which is easy for an engineer to use in configuring the script parameters.

Microsoft Test offers several advantages for scripting and script execution. It uses the native Lotus Notes client software to send user commands to the server that generate a real world interaction with the Lotus Notes Server. Also, the language used in Microsoft Test is very similar to Visual Basic which makes it easier to develop an integrated test tool.

The PALM Tool has the following features:

- Synchronizes participating workstations at the start of each test.
- Executes a variety of test scripts in the Lotus Notes environment.
- Records response times from each workstation in a centralized log file. The completion time for a particular test script is referred to as the response time.
- Halts all participating workstations when a test is canceled.
- Distributes PALM Tool updates to each workstation automatically.

The PALM Tool consists of two executable parts:

- PALM Tool Editor - A Visual Basic front end program to create a *MASTER.INI* file that specifies the test script and the test parameters to be used in a given test. Some parameters are as follows:
 - Notes server name
 - Database name
 - View specifier (in the database)
 - Test script name
 - Number of workstations
 - Number of documents in the test (if applicable)
 - Length of the test, measured in one of two ways: number of passes through the data or number of minutes
- PALM Tool Script Executor - A Microsoft Test program to read the test specifications from *MASTER.INI*, execute the appropriate script, measure the completion time, and save the results into a common log file. This log file records the completion time for each participating workstation as well as the test parameters and the date and time that the script was run.

Data Collection and Recording

At the Windows NT server, a Microsoft developed utility called Performance Monitor was used for collecting CPU, disk, and LAN utilization. Performance Monitor has been used in many other test situations involving Windows NT server performance, and Compaq Engineers are very comfortable with its accuracy. Information about the Performance Monitor utility is available in the Optimizing Windows NT of Microsoft Windows NT Resource Kit:

At each Lotus Notes client, the PALM Tool logged the time to complete each task in seconds, those user response time will be used to identify the server bottleneck, performance.

Compaq Engineers considered using the available Lotus Notes Server Statistics, but did not do so for the following reasons:

- The Statistic Log program must run on the server in order to capture statistics. The interaction of this program with the other Lotus Notes Server programs being measured would have skewed our results. It takes about 5% of CPU bandwidth to run the report concurrently.
- The predefined data collection interval is 15 minutes. This interval did not provide the required granularity for our tests, especially since many of them were less than 15 minutes.
- See the Appendix B for an example of Notes Server Statistics Report after replicating ten workstations.

Summary of Results

The following points summarize the results of the research:

- CPU is the most important subsystem, the performance gain is very obvious when upgrading the CPU. This means that the CPU was the most significantly stressed subsystem during execution of the test scripts. Both the disk and the network subsystems were impacted very little by comparison.
-

- Perform CPU intensive tasks during off-peak hours.

Indexing and replication were the most CPU intensive tasks. By rebuilding view indexes, creating full text indexes, and performing server to server replications during off-peak hours, the performance of the Lotus Notes Server for Windows NT will be improved.

- Lotus Notes Server for Windows NT requires large amounts of RAM.

During many simultaneous workstation to server replication progressive tests, the server performance began to degrade after a specific number of workstations were added to run the scripts. The system throughput (disk and LAN) decrease while we adding more workstations. This test strongly suggest the system thrashing occurred. After we doubled server memory from 64 megabytes to 128 megabytes, the bottleneck shift, the performance gain is obvious and system throughput continue to grow when adding more memory. However, the test was performed without any tuning involved, there is no change in the Notes.ini file nor any NOS parameters.

- The recommended Compaq hardware configuration for Lotus Notes Server for Windows NT is:

Compaq ProLiant 4500 with 64 megabytes of RAM and 1 system processor for Notes Server 3.3 users to start with but we will recommend 128 megabytes of RAM for optimal performance.

NOTE: This server offers either a Pentium/100 or a Pentium/133 (optional) CPU as well as the Compaq SMART Controller (standard), which provides the recommended Distributed Data Guarding fault tolerance (RAID5).

NOTE: For details on the research that supports these executive conclusions, see the Performance Analysis chapter later in this TechNote.

Chapter 3

Atomic Task Profiling

The goal of Atomic Task profiling is to identify and measure the impact of User and Server Atomic Tasks on a *Lotus Notes Server for Windows NT*. This information can be used as follows:

- Identification of the stressful Atomic Tasks highlights certain basic administrator options to improve overall system performance.
- Identify the pattern of Lotus Notes applications, find the bottleneck, and recommend optimum performance management.
- These stressful tasks can be used to create a system workload so that hardware can be varied to determine the optimum hardware configuration of a Lotus Notes Server for Windows NT.
- Those identified tasks can be used in combination to stress the server to determine boundary conditions. The boundary condition information can then be used for performance tuning and capacity planning.

Profiling Methodology

The profiling methodology consists of data collection, analysis and recommendation.

Data Collection

Data from each test script was collected in two ways. The response time measured by Microsoft Test was recorded in the centralized log file mentioned earlier. *Performance Monitor* provided the CPU, disk, and LAN utilization on the Windows NT server.

The utilization numbers were then imported into a spreadsheet and were graphed as raw data to revealed the greatest subsystem stress. The raw data graphs of the disk and LAN subsystems were excluded from further analysis because they did not reveal sufficient stress on the server to be of interest. The CPU utility data are discussed in the following sections.

Data Display

The data for each subsystem is summarized in the following figures. The entire set of bar charts is sorted in descending order based on CPU utilization. This is because the CPU is the most stressed subsystem in the server.

In the subsystem graphs, the bars appear in pairs. The first bar in Figures 3-2 through 3-7 reflect the high average of the subsystem utilization resulting from an Atomic Task. The second bar in each group reflects the standard deviation of these high averages which, in turn, illustrates the choppy character of the data. A tall standard deviation bar implies a choppy data set when graphed, and a short standard deviation bar implies a flat data set when graphed. In contrast, choppy data sets contain intervals of lower CPU utilization which means that the CPU is free during that time to perform other tasks.

High Averages

At first, the raw data was summarized in the bar charts by simple averaging. However, this data was then trimmed to reflect the high average of the data. Practically speaking, a high average is a measure of the maximum sustained stress that the server will encounter in a given test. This means that the highest sustained flat portions of the graphs were selected for this relative analysis. In our tests, sustained means more than 30 seconds of activity. The one exception is the Indexed Full Text Search. Since the entire test lasted only about 10 seconds, the high average was computed over a period less than 30 seconds.

Figure 3-1 provides an example of a high average for CPU utilization.

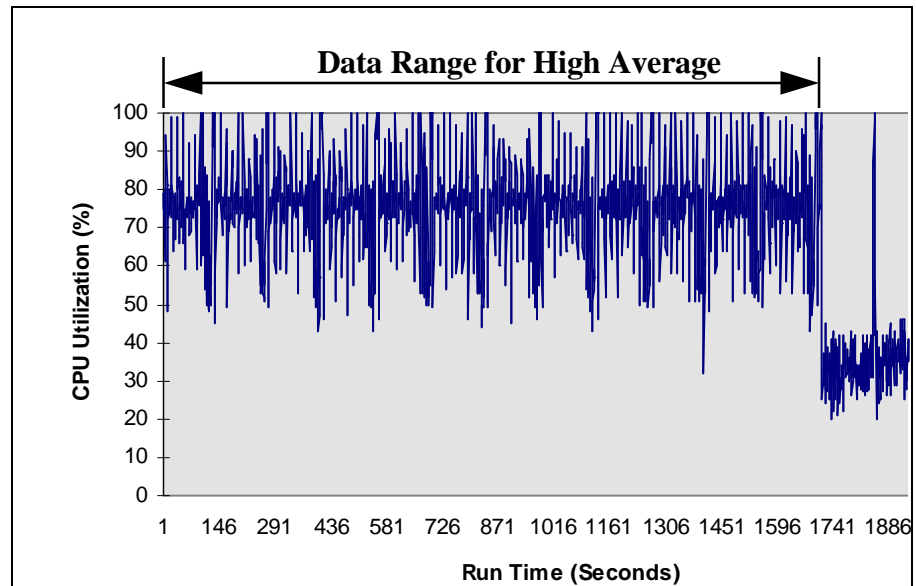


Figure 3-1. CPU Utilization: High Average

High Average Standard Deviations

Since some of the tests produce significant amounts of data fluctuation, a standard deviation for each high average is included as a second bar in each cluster of each graph. This bar provides a visual representation of the data spread. Theoretically, flat data sets with short standard deviation bars are more stressful to a server than are choppy data sets with tall standard deviation bars. This is because a flat data set implies a constant CPU utilization which means that the CPU is not free to multitask as rapidly. In contrast, choppy data sets contain intervals of lower CPU utilization which means that the CPU is free during that time to perform other tasks.

Axis Scales

The axis scales of the raw data graphs have been adjusted to visually reflect the relative impact on the three measured subsystems: CPU, disk, and LAN. In each of the profile bar graphs that follow, tall bars indicate a strong impact on the particular subsystem and short bars indicate a weak impact. The graphs are displayed as follows:

- The CPU utilization was recorded in percentages and varied between 0% and 100%. Hence, the y-axis upper limit is set to 100% for each of the CPU graphs.
- The disk throughput was recorded in bytes per second. Unlike a percentage measurement that has an obvious upper limit of 100%, a realistic disk upper limit is difficult to determine. However, this upper limit directly effects the visual information that is derived from the graphs. Previous disk throughput measurements at Compaq have shown 1,700 kilobytes per second (KBps) to be a reasonable upper limit under similar conditions.

NOTE: Disk throughput depends upon a variety of factors. The upper limit can vary depending upon the hardware and the operating system environment.

- The LAN throughput was also recorded in bytes per second. A realistic upper limit of 70% of the Ethernet theoretical maximum has been selected for display purposes. Hence, 70% of a 10 megabits per second (Mbps) maximum is 7 Mbps which equates to 875 KBps (kilobytes per second). An upper limit of 900 KBps was selected.

Profile Graphs

Three sets of graphs (CPU, Disk, LAN) are displayed in this section to show the relative impact of each of the Atomic Tasks on a specific subsystem. For display purposes, each subsystem graph has been split into two separate graphs which should be viewed as a single chart.

NOTE: The graphs reflect only a single instance of each Atomic Task. Actual loads will vary because multiple instances of User Atomic Tasks can be run simultaneously.

Table 3-1 shows the Atomic Task abbreviations used in the profile graphs.

Table 3-1
Atomic Task Abbreviations

Abbreviations	Atomic Task
Rebld View	Rebuilding a View Index
Create Indx	Creating a Full Text Index
N Indx Srch	Executing a Non-Indexed Text Search
S->S W Repl	Replicating Server to Server - Write
S->S R Repl	Replicating Server to Server - Read
Indx Srch	Executing an Indexed Full Text Search
Expand	Expanding or Collapsing a Category
W->S Repl	Replicating Workstation to Server
Scroll	Scrolling in a View
Mail	Sending a Mail Message
Macro	Executing a Background Macro
Edit	Editing a Document
Detach	Detaching a File
Read	Reading a Document

CPU Utilization

Of the three subsystems analyzed, the CPU utilization was most affected. The three server tasks with the highest impact on the CPU are: Rebuilding a View Index, Creating a Full Text Index, and Executing a Non-Indexed Text Search. The two most CPU-intensive client tasks are Expand and Scrolling. Figures 3-2 and 3-3 show the high averages for CPU utilization. Tables 3-2 shows the percentage for each task.

3-6 Atomic Task Profiling

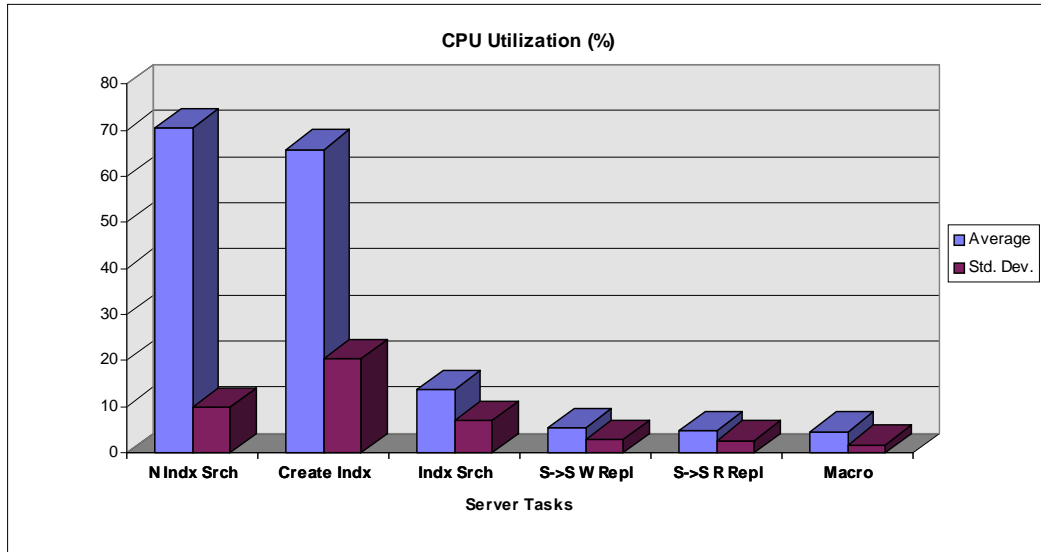


Figure 3-2. CPU Utilization - Part 1

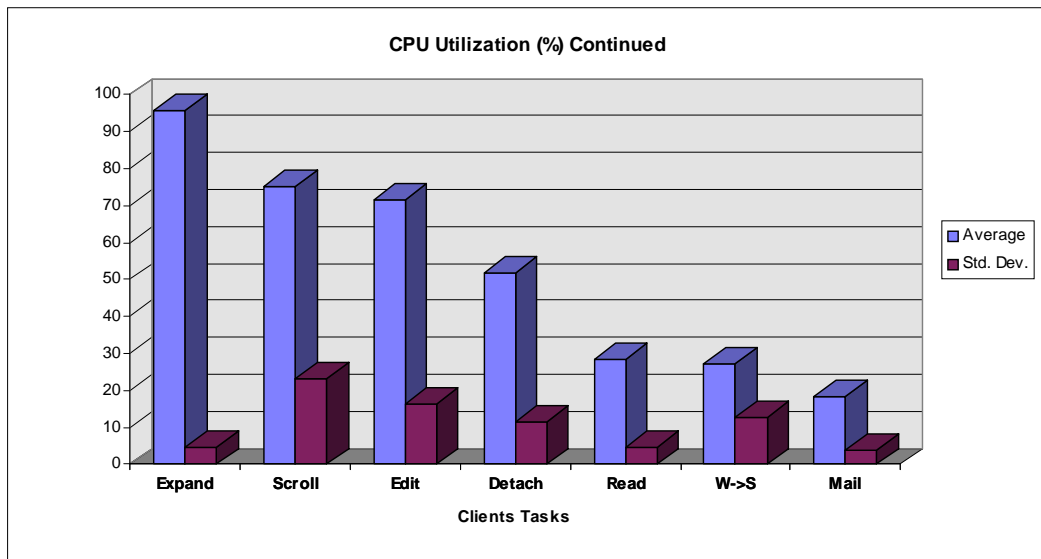


Figure 3-3. CPU Utilization - Part 2

**Table 3-2
CPU Utilization by Task**

	Average (%)	Standard Deviation (%)
Expand	95.68	4.74
Scroll	75.09	23.38
Edit	71.75	16.38
N Indx Srch	70.47	9.97
Create Indx	65.85	20.42
Detach	51.63	11.62
Read	28.57	4.8
W->S Repl	27.07	12.65
Mail	18.38	3.74
Indx Srch	13.72	7
S->S W Repl	5.34	2.97
S->S R Repl	4.85	2.68
Macro	4.6	1.73

Disk Throughput

Disk Throughput is only moderately impacted by a Non-Indexed Full Text Search or replication. All other Atomic Tasks have very little impact on the server disk subsystem. Figures 3-4 and 3-5 show the high averages for disk throughput. Tables 3-3 shows the KBps for each task.

3-8 Atomic Task Profiling

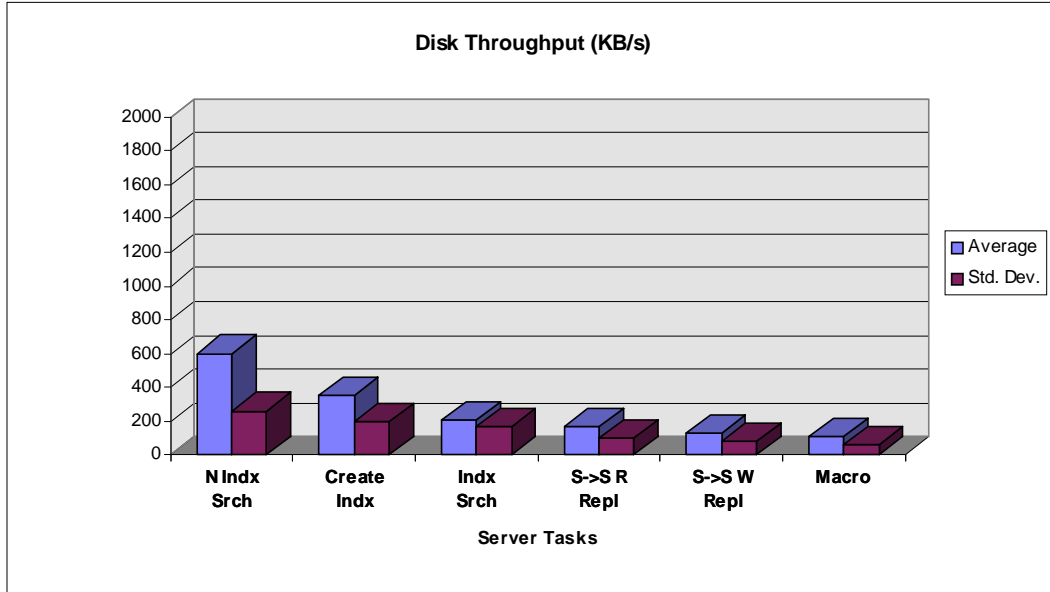


Figure 3-4. Disk Throughput - Part 1

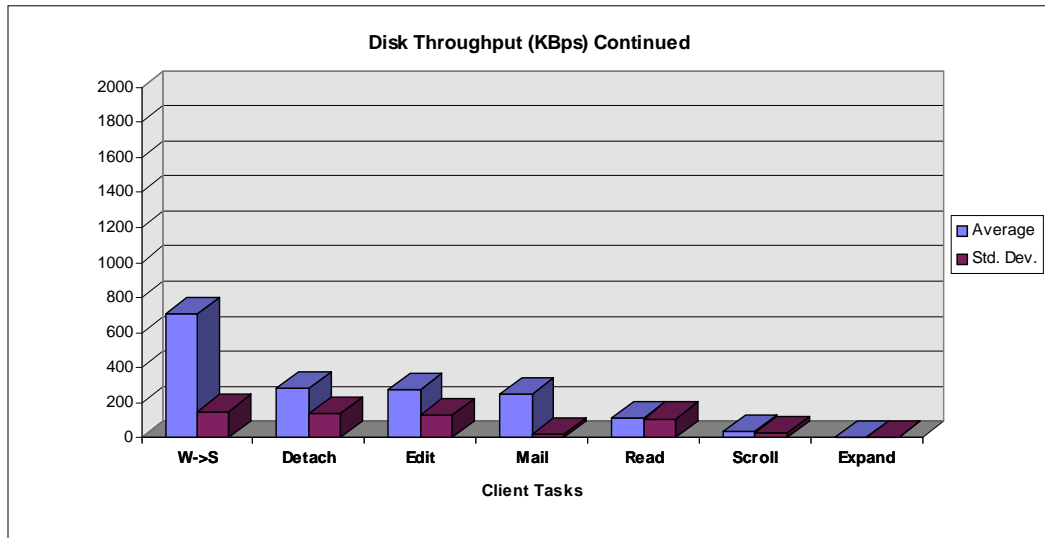


Figure 3-5. Disk Throughput - Part 2

**Table 3-3
Disk Throughput by Task**

	Average (KBps)	Standard Deviation (KBps)
W->S Repl	706.95	152.46
N Indx Srch	601.85	262.09
Create Indx	356.28	200.89
Detach	280.16	136.3
Edit	278.49	130.02
Mail	245.93	24.58
Indx Srch	207.35	169.55
S->S R Repl	169.27	102.77
S->S W Repl	127.34	83.15
Read	113.55	109.96
Macro	107.32	62.28
Scroll	38.37	28.04
Expand	4.44	5.45

LAN Throughput

The server task has very little impact on the LAN throughput due to the client/sever architecture. For example, the client issues a create index command, the server performs the task and only acknowledges the client when the job is done, no excessive network traffic. The client task generates some stress, but those tasks are highly intensified. For example, our "Edit" task actually modify 2000 documents (average size from four to ten pages) in less than 200 seconds. It is an unusually heavy load in the real world. Even so, the impact on the network wire is still not very much relative to the full capacity of the network. The Figures 3-6 and 3-7 show the high averages for LAN throughput. Tables 3-4 shows the KBps for each task.

3-10 Atomic Task Profiling

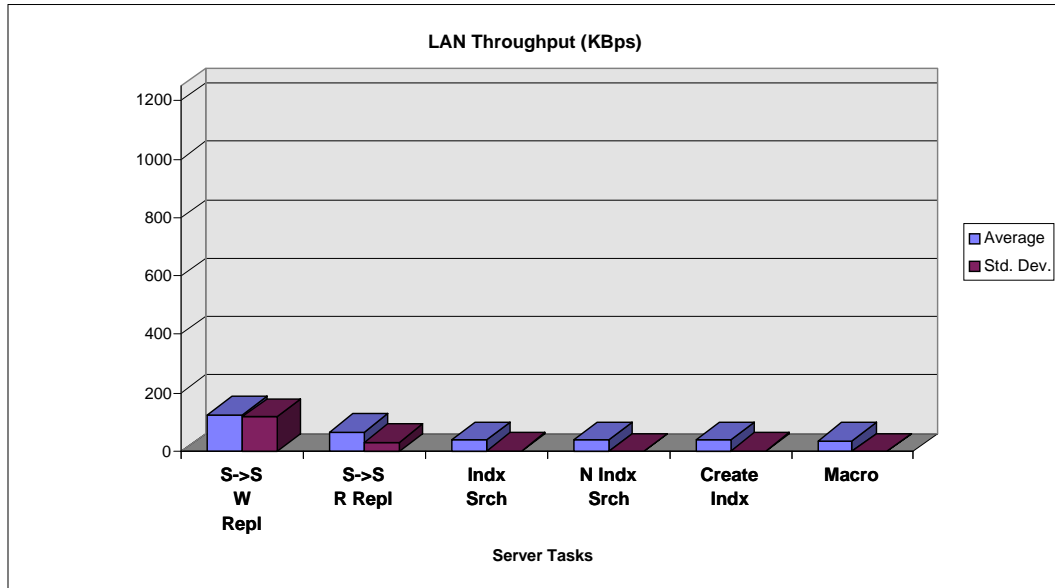


Figure 3-6. LAN Throughput - Part 1

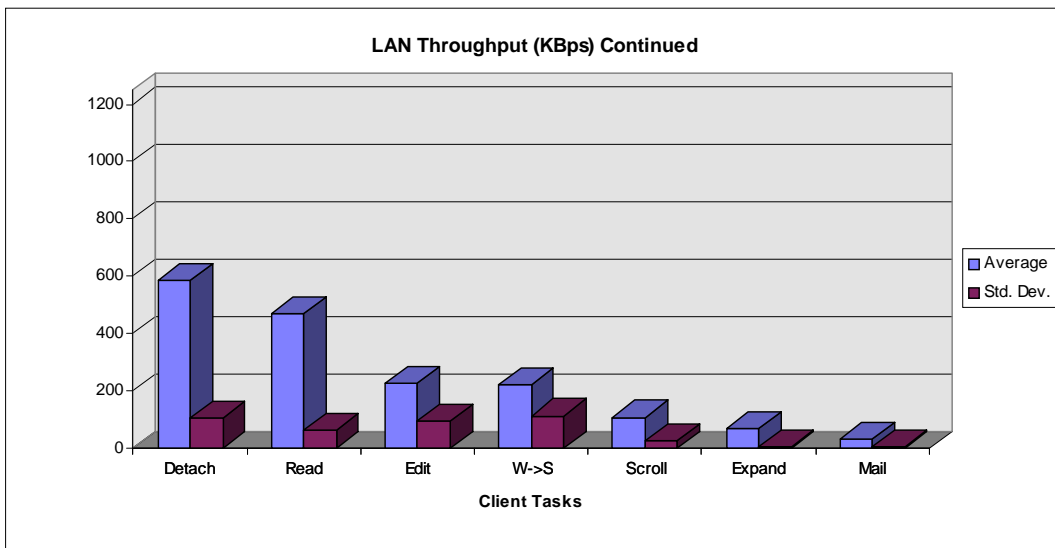


Figure 3-7. LAN Throughput - Part 2

**Table 3-4
LAN Throughput by Task**

	Average (KBps)	Standard Deviation (KBps)
Detach	587.6	105.75
Read	469.41	61.11
Edit	227.68	92.57
W->S Repl	222.1	113.2
S->S W Repl	126.26	117.64
Scroll	107.74	25.43
Expand	66.41	6.36
S->S R Repl	66.4	32.18
Indx Srch	40.15	1.49
N Indx Srch	39.05	0.43
Create Indx	38.97	0.6
Macro	36.55	0.08
Mail	29.97	3.89

Atomic Task Profiling Conclusions

The following sections describe the research and administrator conclusions for Atomic Task Profiling.

Research Conclusions

The following list describes the research conclusions for Atomic Task Profiling.

- Lotus Notes is a highly CPU intensive program. This suggests that the CPU capacity, multi-processor systems, clock speed, and memory caches should be the focal points of further research. The Atomic Tasks that create the greatest stress on the server are:
 - Executing a Non-Indexed Text Search
 - Creating a Full Text Index
- Lotus Notes Server does not significantly stress the disk subsystem in many cases. However, when performing a non-indexed full text search or replication of a large database might stress the disk subsystem very much. Those Atomic Tasks are useful for an analysis to optimize the disk subsystem.
- Lotus Notes Server does not significantly stress the LAN subsystem. Among the server tasks, only the Replicating Server to Server (Read and Write) moderately impacts the LAN subsystem. However, network design as well as Notes domain/logical layout is still very important for those WAN users and enterprise network users.
- Replicating workstation to server is significantly slower than replicating sever to server. Hence, this Atomic Task is useful in investigating workstation hardware configurations and the client impact on system performance. Generally the slower the client, the greater capacity of the server for workstation-oriented Atomic Tasks. Further research on the client performance such as Win95 or protocol performance will be performed in the future.

Administrative Conclusions

The following are the administrative conclusions for Atomic Task Profiling.

- Non-indexed full text search is the most CPU-intensive task, therefore, user should always use indexed databases to avoid this costly operation.
- Create full text indexes during non-peak hours to prevent system delays.

Creating a full text index is the second most stressful Atomic Task. It utilizes 65.85% of the CPU capacity.

Indexed full text searches are very fast compared to non-indexed full text searches. Also, a non-indexed full text search utilizes 70.47% of the CPU capacity. Thus, a 65.85% CPU hit during non-peak hours (Create Index) is much better than a 70.47% CPU hit during peak hours (Non-Indexed Search).

NOTE: The administrator has the option of adjusting the frequency of the full text index updates. The list box under *File* → *Full Text Search* → *Information* contains various options of frequency of index updates. By reducing the frequency, the impact on the CPU during peak hours can be delayed. However, the index will not be current until it is updated.

Chapter 4

Performance Analysis

Performance analysis is an ongoing interactive process that includes:

- Understanding your user requirements
- Monitoring your network load pattern
- Making appropriate modifications to your configuration to achieve optimal use of resources

The term *performance* can be viewed in either of two ways. To a network administrator, performance means effective management of system resources. A system administrator's concerns are with system throughput and utilization. To an end user, however, performance is measured by system response time.

In practice, it is necessary to balance the two perspectives because the results may require certain tradeoffs. For example, lab tests reveal that it is possible to upgrade your system processor to reduce the stress on the CPU subsystem and to provide faster response times. However, with certain disk subsystems, you can only achieve faster response times at the cost of greater stress on the CPU. Your system might be able to accept this additional stress when the CPU utilization is around 60%, but not when the utilization is around 80 to 90%. At high levels of CPU utilization, any additional stress can adversely impact the capacity of your system to handle additional tasks or users.

For the performance analysis investigation, Compaq engineers examined the following areas:

- System Processor (CPU) Performance
- Memory
- Disk Subsystem

The Profiling results clearly show how each Atomic Task uses server resources. For example, rebuilding a view takes 100% of the CPU. So naturally it follows to use this Atomic Task to test CPU performance. As another example, executing non-indexed text search stresses the disk subsystem. It makes sense to use this Atomic Task to test disk performance.

For this phase of testing, the performance analysis included up to 20 clients to stress a specific server subsystem (CPU, Disk, LAN). Compaq engineers conducting the tests varied the components of the subsystem to see the effect. For example, the team used different CPUs to measure rebuilding a view Atomic Task and compare the results.

Hardware Performance Comparison

The following section offers guidelines for obtaining the optimum value and performance from your Compaq server. These guidelines are based on tests designed by Compaq engineers. The tests are based on the analysis of the Atomic Task profiling mentioned earlier in this TechNote.

System Processor (CPU)

In contrast to a resource sharing (file server) environment, a faster processor in a Lotus Notes Server for Windows NT Server yields faster client response times. In a resource sharing environment, the system processor plays a less important role in performance tuning than does the memory, disk, and network interface card. However, for Lotus Notes, the processor is the most important subsystem for high performance.

In order to study how Lotus Notes stresses the CPU, we used tests based on three Atomic Tasks:

- Rebuilding a View. This is the most CPU-intensive Atomic Task since the CPU utilization is fairly constant at 100%.
- Creating a Full Text Index. This Atomic Task is less stressful on the CPU. It stresses the CPU from 63 to 75.6%.
- Non-Indexed Text Search. This Atomic Task is very balanced test. It stresses the CPU up to 80% as well as disk subsystem.

The following results validate the conclusion regarding the importance of the processor. The results also quantify the performance gain you might expect when you upgrade your server to a faster CPU.

NOTE: If you use the 133 MHz Pentium processor in your Lotus Notes Server, be sure to verify that the system ROM in your Compaq ProLiant Server is dated 08/16/95 or later for optimal performance. You can observe the ROM date on your screen when you power up the server. You must also upgrade the System Configuration for EISA and EISA/PCI to V2.28 Rev. A or later.

Rebuilding a View

- The 133-MHz Pentium processor typically provides a 15% faster response time when rebuilding a view index than the 100-MHz Pentium processor.
-

NOTE: Although the clock speed is 33% faster we do not expect to see a 33% faster response time because the 133 MHz still accesses the memory at 66 MHz, while processing internal instructions at 133 MHz. Therefore, there is not a 1 to 1 increase in performance relative to the clock speed.

- The 133-MHz Pentium processor typically provides a 37% faster response time when rebuilding a view index than the 66-MHz Pentium processor.

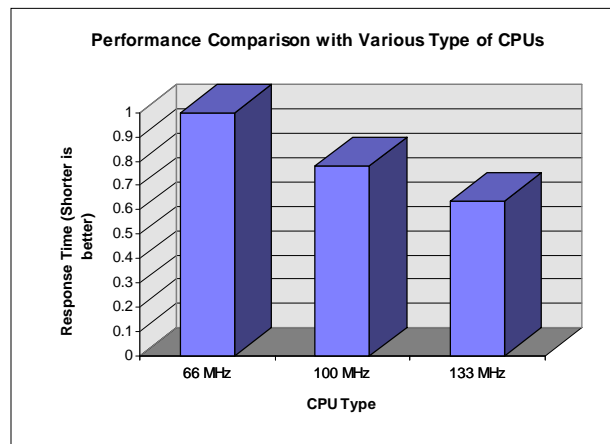


Figure 4-1. Rebuilding a View

Creating a Full Text Index

Figure 4-2 shows that the performance improvements provided by a faster CPU are not just limited to better response time.

- CPU utilization is reduced with faster processors. This increases server capacity.
- Disk throughput is increased with faster processors, even though disk usage is quite light.
- LAN traffic is near zero. This is typical of a client server application where the client makes a request, the server processes it, and only sends the response over the network.

4-4 Performance Analysis

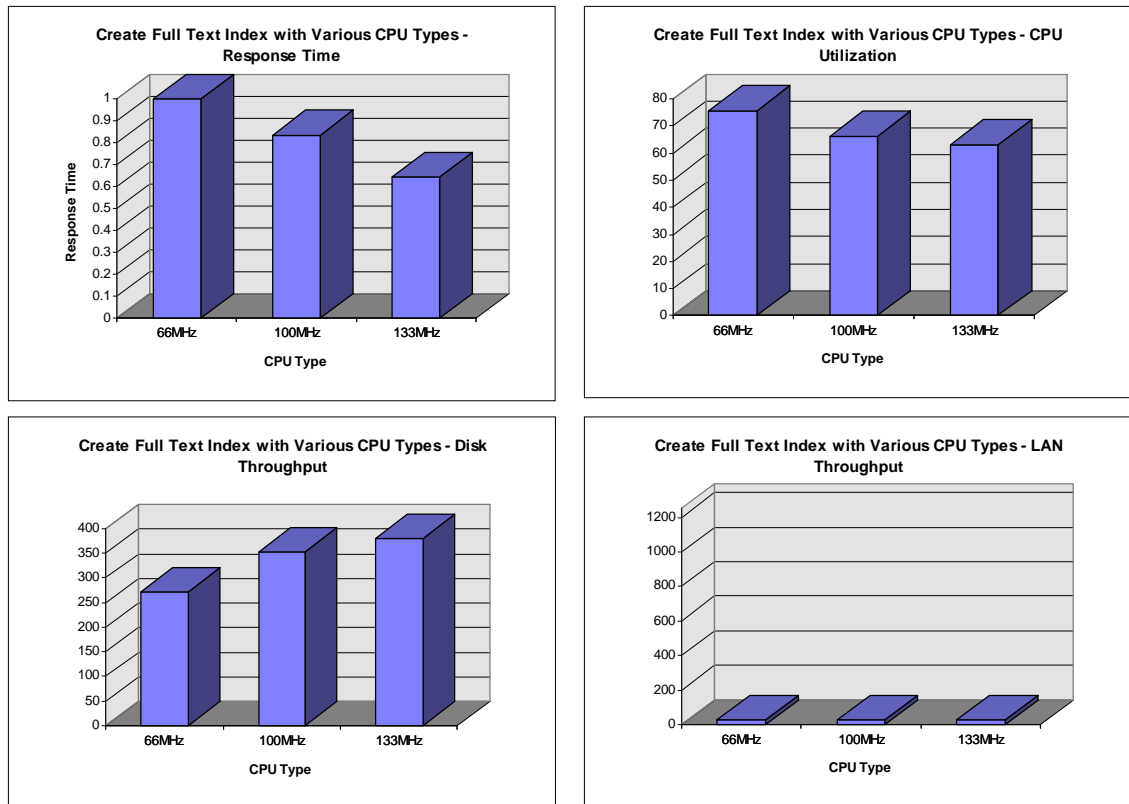


Figure 4-2. Creating a Full Text Index

These results also show how important it is to select the right tool to do performance testing. The test result should cover not only the end user's viewpoint, but also the system administrator's perspective.

Non-Indexed Text Search

Figure 4-3 demonstrates the benefits of a faster processor, which are as follows:

- A faster processor yields better response time.
- A faster processor decreases server stress by reducing CPU utilization.
- The 133-MHz Pentium processor provides 31% faster response time than the 100-MHz Pentium while reducing the CPU utilization by 8%.
- The 133-MHz Pentium processor provides 44% faster response time than the 66-MHz Pentium while reducing the CPU utilization by 16%.

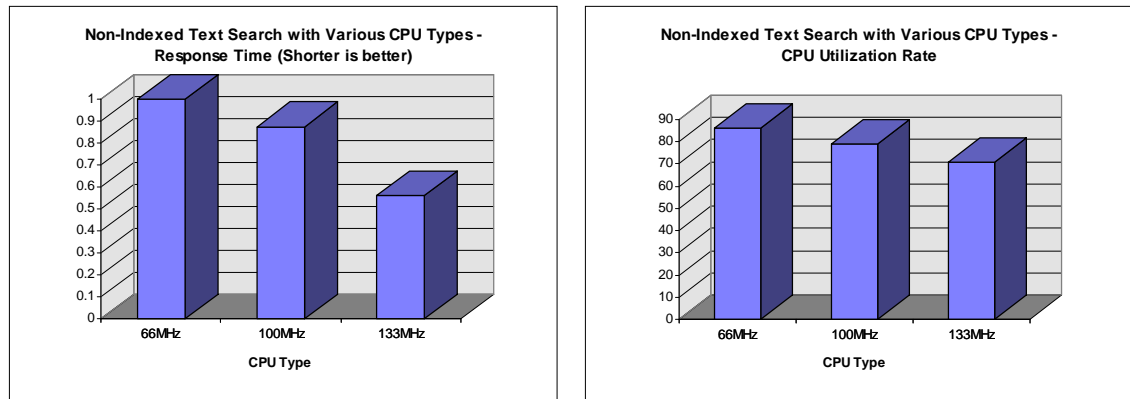


Figure 4-3. Editing a Document

NOTE: Compared to the two previous CPU tests, this Atomic Task represents a more balanced System Resource Utilization (the disk throughput is about 800KB/s). This test demonstrates a response time and CPU utilization change with more intensive I/O tasks.

Transaction Blaster

Compaq has developed a product called the Transaction Blaster, which is a 2 megabyte level 3 memory cache, that can be placed with each 90-MHz or 100-MHz Pentium processor in the Compaq ProLiant. This cache is intended to complement the 512 megabyte high-speed level 2 memory cache that is standard on these processor cards. The purpose of the Transaction Blaster is to improve processor scalability in a ProLiant that is configured with multiple processors. For application environments that are running on multiple processors and are very CPU intensive, the Transaction Blaster improves the overall performance and scalability of the system by reducing the amount of host bus contention between each of the processors.

Internal testing has indicated that the Transaction Blaster does not provide a performance benefit in single processor configurations, such as the Lotus Notes Server for Windows NT Server. There is no host bus contention with only one processor. Therefore, Compaq engineers do not recommend the Transaction Blaster in single processor configurations.

Memory

Figure 4-4 shows that for replication tasks, increasing the memory helps to improve the response time. The gains are slight at low load test because the workload generated on the server by the test is not enough to stress the system. As the workload grows, the performance gain with more memory is very obvious. Compaq engineers expect the performance gains with increased memory to be even more when the system resource is under greater stress.

Compaq engineers recommend that the Lotus Notes Server for Windows NT Server have at least 64 megabytes of RAM. For more stressful tasks, such as concurrent replication, performance improvements can be realized in direct proportion to additional memory. Furthermore, overall performance in the Windows NT Server environment is typically better with more memory. The actual performance gains in the Lotus Notes Server are still qualitative at this point, and more real world tests must be performed before quantifying the actual performance gains.

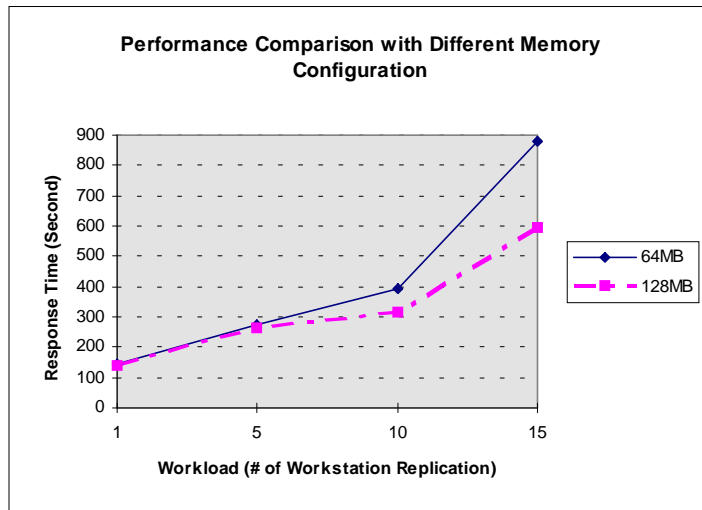


Figure 4-4. Memory Configuration

Disk Subsystem

The analysis of the disk subsystem involves the following factors:

- Number of Drive spindles/striping
- Striping (Hardware versus Software)
- Fault tolerance (Hardware versus Software)
- Controller type (SMART versus Fast-SCSI-2)

Drive Spindles/Striping

If your applications generate significant disk I/O, there will likely be a lot more concurrent use of system services. You can improve the performance of your disk subsystem under load conditions by having your Hardware logical drive span multiple physical drives with striping. This will provide more concurrent disk accesses, thus improving your total system performance.

Table 4-1
Drive Spindle Performance Comparison
Mixed Load

	Response Time (Seconds) Replication	Response Time (Seconds) Edit	Response Time (Seconds) Read
One Drive	282.5	311.33	349.86
7 Drives Hardware Striping (No Fault Tolerance)	223	225.67	289.14

Table 4-1 shows multiple drive spindles can improve the response time up to 38%.

The following table (Table 4-2) indicates a comparable response time between hardware and software striping. Note, however, that hardware striping uses slightly less CPU bandwidth. With more users, it is reasonable to assume that software striping performance will decrease.

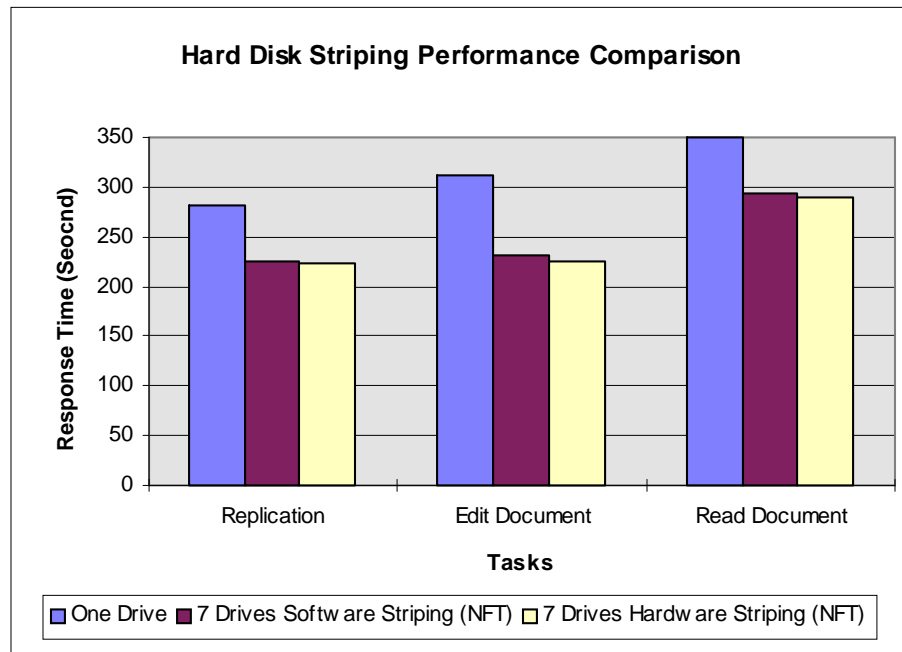


Figure 4-5. Hard Disk Striping

Fault Tolerance

Both duplexing and drive mirroring with Windows NT Server 3.51 uses the “Split seeks” feature [of/and] the controller to enhance performance by alternating read operations between primary and secondary drive arrays. Using both functions, however, takes up additional disk space. By contrast, fault tolerance using data guarding (RAID 4) and distributed data guarding (RAID 5) use up less disk space. Data Guarding/Distributed Data Guarding duplicates the data by using a single parity drive or parity “area” that stores encoded data.

Test results shown in Table 4-2 indicate about 10% degradation with hardware distributed data guarding (RAID 5). Additional results show up to 42% degradation with software distributed data guarding. There is very little system resource penalty for using hardware distributed data guarding. Therefore, Compaq engineers recommend that you use hardware distributed data guarding to protect the data on your Lotus Notes Server, while delivering performance comparable of a non-tolerant system.

Table 4-2
Fault Tolerance Performance Comparison
Mixed Load

	CPU Utilization Rate (%)	Response Time (Seconds) Replication	Response Time (Seconds) Edit	Response Time (Seconds) Read
No Fault Tolerance	64.89	224.75	231.33	292.71
Software Distributed Data Guarding (RAID5)	66.86	310.5	400.5	408.29
Hardware Distributed Data Guarding (RAID5)	61.61	260.25	276.67	318.29

Controller Type

Smart Controllers offer the following performance improvement and feature difference not found with SCSI-2 Controllers.

- Hardware striping and fault tolerance
- Write back cache - Smart Controller has two MB on board cache memory.

In the previous section, we discussed the performance of hardware striping and fault tolerance. Now, let's examine the performance impact of write back cache. The following is the performance comparison with and without write back cache.

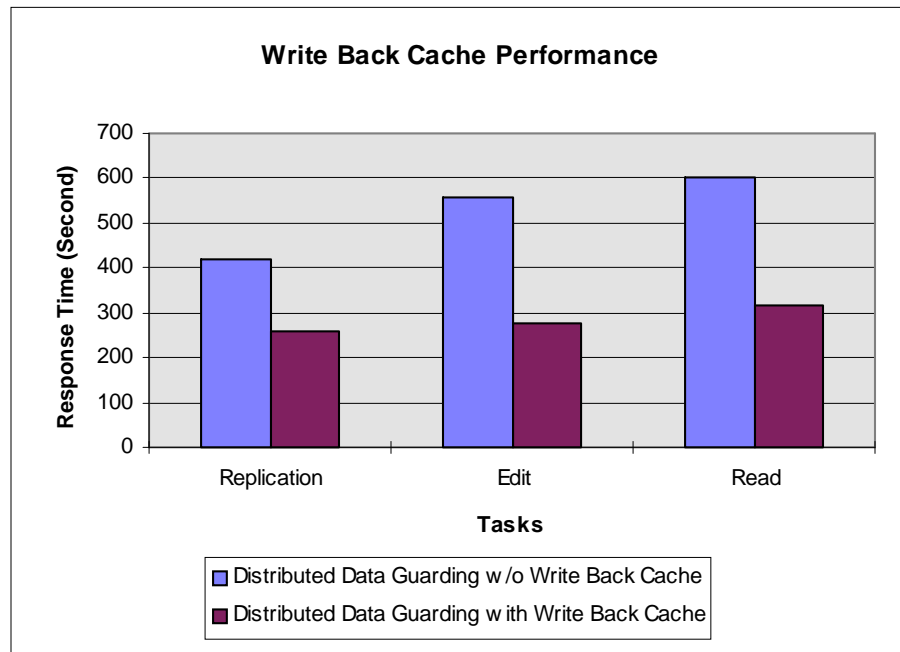


Figure 4-6. Smart Controller Performance

For this test, each of the three simulations were run concurrently. As one would expect without write back cache, tasks involving writes to the disk show reduced performance. It is important to note, however, that read tasks are also affected when write back cache is not available. Read tasks suffer negative performance without write back cache because the system allocates more resources to writing tasks. Based on tests performed in Compaq test labs, Smart Controller is highly recommended for optimal hardware configuration.

Windows NT Server Parameter

Adaptive Algorithms were incorporated in Windows NT Server so that correct values are determined by the system as it runs. The 32-bit address space removed many limitations on memory and the need for users to manually adjust parameters to partition memory. The following test result is the Compaq Performance Benchmark PFCPQ V1.21 for Win32. The disk throughput grows when repeated random read test were performed. It shows that Windows NT Server allocates more memory to accommodate the client request. However, this is only the result of benchmark, not the real world test. You might not see that much performance improvement in the real world due to more concurrent requests and much more data swap in and out the Windows NT Server cache memory.

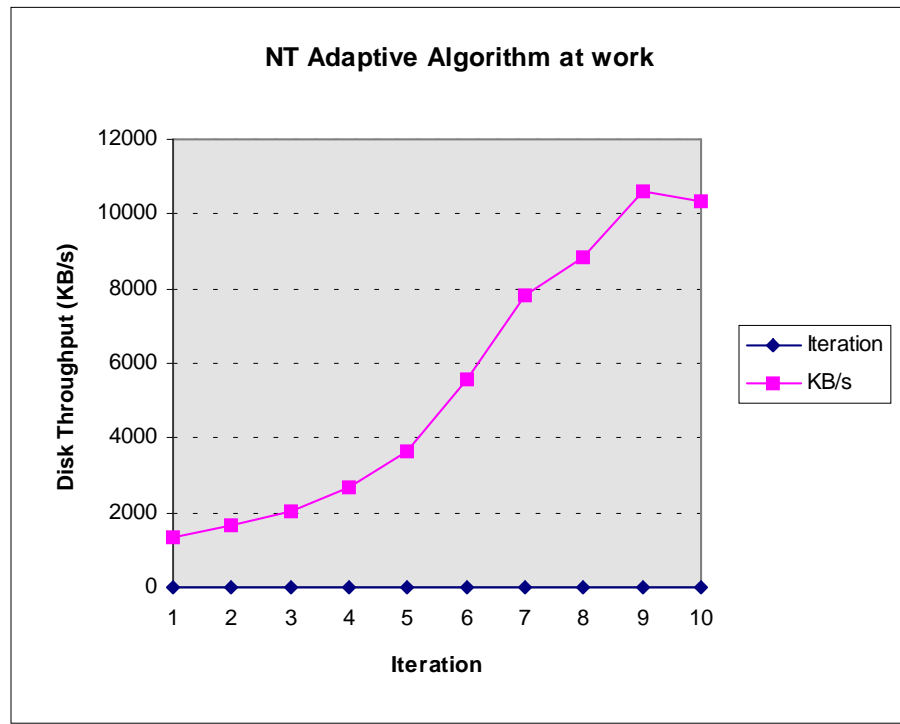


Figure 4-7. Windows NT Server Parameter Benchmark

Performance Conclusions

Based upon performance tests and data analysis, the performance conclusions are as follows:

CPU: The CPU is the most important server subsystem for Lotus Notes. Our tests show you can expect 15% to 44% improvement in client response time and up to 15% improvement in server CPU utilization by selecting the fastest CPU available. All tests were done with Pentium Processor. The performance gain should be better than 200% if upgrading from a 486-type processor to a 133-MHz Pentium. Another benefit is the fact that reducing CPU utilization is quite important in a stressed server environment and under server boundary conditions.

Memory: The Compaq engineers recommend at least 64 megabytes of RAM for the Lotus Notes Server for Windows NT Server. This is especially true for tasks such as concurrent replication, which requires a large amount of memory.

Hardware or Software Striping: The engineering team recommends using hardware striping rather than the Windows NT Server software striping because hardware striping requires less CPU and provides increased fault tolerance benefits.

Fault Tolerance: The engineering team recommends configuring the server with Hardware Distributed Data Guarding (RAID5). This is because there is only 5-10% performance loss when using hardware RAID5. Additionally, RAID5 provides the highest reliability of data protection while maximizing usable disk space. Although Windows NT Server also provide the RAID5 technology, the test shows the performance degradation is just too much for us to recommend. (up to 42%)

Number of Disk Drives (Spindles): Although there is relatively little I/O contention in the Lotus Notes environment, stripe as many drives as possible into each volume or drive array. Using multiple drive spindles helps improve concurrent drive access. For applications with multiple large concurrently accessed Lotus Notes databases, distribute the databases to different striped volumes.

Hard Disk Controller: The engineering team strongly recommends the SMART Controller over Fast SCSI-2 for two reasons. First, it performs better with on board write back cache in a many modification situations. Furthermore, it provides hardware fault tolerance features like RAID5 as recommended above.

Client Performance Capacity: Lotus Notes is a typical client/server model application: the processing labor is distributed between the server and client. Depending on the task, Lotus Notes could impact the overall system performance. Faster clients will have better response time but be aware that they can cause higher stress on the server. Therefore, you will always need to balance your client response time with your server capacity for optimal performance.

Hardware Platform Recommendation: Based on the above subsystem recommendations, Compaq can recommend various server products for use as a Lotus Notes Server with Windows NT Server. It is important to note that although our recommendations are based upon performance, this feature should not be your only criterion for choosing the best server for your environment. You will need to look at other factors such as the ease of use, serviceability, and reliability offered by different Compaq server products, in addition to performance, prior to making your hardware platform decision.

Since the speed of the CPU is the most important component in determining your overall performance in a Lotus Notes environment, you should consider the following configuration:

- A Compaq ProLiant 4500 with 64 megabytes of RAM and 1 system processor. This server offers either a 100-MHz Pentium (standard) or a 133-MHz Pentium (optional) CPU as well as the SMART Controller (standard) which provides the recommended Distributed Data Guarding (RAID5) fault tolerance. Additionally, the ProLiant 4500 provides you with future scalability as the Windows NT Server operating system evolves to multi-processing.
- Compaq has additional servers such as the ProLiant 1000, the ProSignia Family of Servers, and the ProSignia VS. Each of these servers is fully capable of performing well as a Lotus Notes Server with Windows NT Server, generally at lower cost. Keep in mind that specific models of these servers may not provide you with the complete set of standard features you may need. However, depending upon the server model and the feature you desire, optional upgrades may be available.

Appendix A

Multivendor Integration From Compaq

To help you successfully integrate and optimize your network or multivendor system, Compaq has developed a library of systems integration TechNotes for the NetWare, Microsoft Windows NT, SCO UNIX, and OS/2 operating system environments. TechNotes provide you with important information on topics such as network performance management, server management, and operating system interconnectivity.

Pricing

Compaq TechNotes

U.S. \$15 (CND \$20)*

*Plus shipping & handling

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To order by PHONE (credit card orders only), call:

- 1-800-952-7689 (In U.S.: 7 a.m. - 7 p.m. C.S.T.)
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- 1-317-364-7281 (From outside U.S. & Canada:
7 a.m. - 7 p.m. C.S.T.)

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A-2 *Multivendor Integration From Compaq*

To order by MAIL or FAX, send complete order information to:

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Compaq Computer S.A.R.L.
5, Avenue de Norvege
91959 LES ULIS Cedex
France

FAX: 1-331-64-46-51-81

Current TechNotes

The current TechNotes available are listed in the following tables.

COMPAQ TechNotes	AVAILABLE ON SmartStart	PART NUMBER
<i>Insight Management Agents</i>		
Integrating Compaq Insight Management Agents (10/94)	√	145806-002
<i>NetWare</i>		
Performance Management in a NetWare v3.1x Environment (4/93)		133399-002
NetWare Tape Backup Management Using ARCserve from Compaq (4/93)		137535-001
Tape Backup Using ARCserve v5.01 - Windows Edition from Compaq (1/94)	√	137672-001
NetWare 4 Performance Management (7/94)	√	137989-001
ORACLE Server Planning in a NetWare v3.11 Environment (5/93)		145143-001
NetWare Server Management (9/92)		145231-001
Compaq IDA-2 Configuration for NetWare (12/92)		145536-001
Compaq ProSignia Configuration Guidelines for NetWare v3.x (12/92)		145537-001
Compaq Answers to Technical Support Questions for NetWare Environments (1/95)		145710-001
NetWare SFT III v3.11 Installation (9/93)		145905-001
NetWare Migration from 2.x to 3.12 (6/94)	√	181069-001
NetWare Migration from 3.12 to 4 (11/94)	√	181152-001
SYBASE SQL Server 4.2.2 for NetWare: Tuning and Performance (1/95)	√	184429-001
Performance of Lotus Notes 3.1 on Compaq ProLiant Servers with NetWare 3.1x (1/95)		184430-001
Configuration and Tuning of Oracle7 for NetWare on Compaq Servers (11/94)	√	

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A-4 Multivendor Integration From Compaq

COMPAQ TechNotes	AVAILABLE ON SmartStart	PART NUMBER
Microsoft		
Implementing Lotus Notes on Compaq Servers with Microsoft LAN Manager (9/92)		145201-001
Microsoft SQL Server and Novell NetWare Requester for OS/2 (9/92)		145376-001
Drive Subsystem Performance with Microsoft LAN Manager 2.1 (11/92)		145517-001
Configuration and Tuning of Microsoft SQL Server for Windows NT on Compaq Servers (7/94)	√	184207-001
Compaq Backup and Recovery for Microsoft SQL Server (1/95)		184489-001
UNIX		
SCO UNIX in an SNA Environment Using CLEO DataTalker U/X (5/92)		145081-001
SCO UNIX in an SNA Environment Using Computone LYNX (7/92)		145116-001
SCO UNIX Database Servers in Novell Networks (10/92)		145402-001
Printing in SCO UNIX and NetWare Integrated Environments (3/93)		145538-001
SCO UNIX Connectivity to SNA Environments Over X.25 Networks (1/93)		145583-001
Disk Mirroring with VERITAS VxMirror (12/93)		145656-001
SCO UNIX IP Routing Over X.25 Networks (4/93)		145711-001
Performance Tuning for SCO UNIX on Compaq Systems (5/93)		145730-001
Configuration and Tuning of Oracle7 for SCO UNIX on Compaq Servers (11/94)	√	184329-001
The Compaq, SCO UNIX, and ORACLE7 Database Server (9/93)		195818-001
IBM		
Compaq Answers to Technical Support Questions for OS/2 Environments (11/94)	√	
Technology Overview		
Configuring Compaq RAID Technology for Database Servers (7/94)	√	184206-001

Appendix B

Example of Notes Server Statistics Report

Statistics Report for server: master/groupware -

Session Information:

Boot ID: 5308446

Statistics collected at: 10/10/95 10:00:08 AM

Reporter task running for: 0:14:43 (hr:min:sec)

Server Location:

Server Administrator: CN=chung c tam/O=groupware; CN=1 client/O=groupware

Disk Statistics (in bytes):

Free space on swapfile disk: Not Applicable

Volume	Size	Bytes Free	%Free
C:	1,042,284,544	362,136,064	34.74%
E:	1,049,608,192	455,797,760	43.43%
F:	1,048,559,616	405,163,008	38.64%

Memory Statistics (in bytes):

Free memory: 2,100,125,696

Memory allocated: 5,254,784

Memory allocated as shared memory: 3,554,242

Memory allocated by server processes: 1,700,542

Memory availability: Plentiful

Swap file size: Not Applicable

Server Configuration Information:

Number of volumes on file server: 3

Number of RS232 ports: Not Available

Coprocessor: Not Available

Operating System version: Windows NT 3.51

Notes version: Release 3.30

Data file path: C:\NOTES

Swap file path: Not Applicable

Number of processors: 1

Processor type: Intel Pentium

Server Load Statistics:

Transactions in last minute: 0

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B-2 Multivendor Integration From Compaq

Peak transactions per minute: 1243
Time of last peak transactions per minute: 10/10/95 09:54:00 AM
Total transactions processed: 10,866
Number of current users: 20
Peak number of users: 21
Time of last peak number of users: 10/10/95 09:56:22 AM
Number of sessions dropped in mid-transaction: 0
Number of server tasks: 24

Server Tasks:

- Database Server: Perform console commands
- Database Server: Listen for connect requests on LAN0
- Database Server: NetBIOS name server for LAN0
- Database Server: Perform housekeeping chores
- Database Server: Database server for 2 client/groupware
- Database Server: Database server for 3 client/groupware
- Database Server: Database server for 1 client/groupware
- Database Server: Database server for 4 client/groupware
- Database Server: Database server for 7 client/groupware
- Database Server: Database server for 6 client/groupware
- Database Server: Database server for 5 client/groupware
- Database Server: Database server for 8 client/groupware
- Database Server: Database server for 9 client/groupware
- Database Server: Database server for 10 client/groupware
- Database Server: Database server for 8 client/groupware
- Database Server: Database server for 5 client/groupware
- Database Server: Database server for 4 client/groupware
- Database Server: Database server for 2 client/groupware
- Database Server: Database server for 10 client/groupware
- Database Server: Database server for 7 client/groupware
- Database Server: Database server for 3 client/groupware
- Database Server: Database server for 1 client/groupware
- Database Server: Database server for 6 client/groupware
- Database Server: Database server for 9 client/groupware
- Reporter: Idle
- Router: Idle
- Replicator: Idle
- Indexer: Idle

Mail Statistics:

Number of dead mail messages:
Total number of mail messages routed:
Total number of mail messages transferred:
Total number of mail messages delivered:
Mail waiting to be routed:
Mail waiting to be delivered:

Replication Statistics:

Number of successful replications:

Number of replication failures:

Number of documents deleted:

Number of documents added:

Number of documents updated:

Database Statistics (in bytes):

Buffer control pool size: 262144

Buffer control pool used: 15292

Buffer pool maximum: 6291456

Buffer pool used: 984140

NSF pool size: 393216

NSF pool used: 7204

STATS Package Statistics:

Time started: 10/10/95 09:44:43 AM

Communications Statistics

Number of old sessions closed: 0

Appendix C **NOTES.INI**

```
[Notes]
Directory=C:\NOTES
KitType=2
Window_Title=Lotus Notes Windows NT Administration
RemoteServer=Windows/32
ServerTasks=Replica,Router,Update
ServerTasksAt1=Catalog,Design
ServerTasksAt2=UpdAll
ServerTasksAt5=Statlog
Ports=LAN0
LAN0=NETBIOS,0,15,2000,,12288,
COM1=XPC,1,15,2000
COM2=XPC,2,15,2000
COM3=XPC,3,15,2000
COM4=XPC,4,15,2000
COM5=XPC,5,15,2000
DisabledPorts=COM1,COM2,COM3,COM4,COM5
LOG_REPLICATION=0
LOG_SESSIONS=0
KeyFilename=server.id
CertificateExpChecked=C:\NOTES\server.id 08/30/95
ProgramMode=0
CertifierIDFile=C:\NOTES\CERT.ID
RemoteSetup=2
MailServer=CN=master/O=groupware
Domain=groupware
Admin=CN=chung c tam/O=groupware
Setup=37
ServerSetup=3
ZONE_SET=1
Timezone=6
DST=1
CertifierLog=CERTLOG.NSF
PhoneLog=2
Log=log.nsf, 1, 0, 7, 8000
DESKWINDOWSIZE=17 24 420 288
(NOTES.INI - continued)
WINDOWSIZEWIN=32 5 574 470
MAXIMIZED=0
FileDlgDirectory=C:\NOTES
ADMIN_ACCESS=CN=chung c tam/O=groupware,CN=1 client/O=groupware
ShowEditorObjects=1
```

Glossary

Abend (Abnormal end)	A message issued by the operating system when it detects a serious problem, such as a hardware or software failure. The abend stops the server.
Abnormal end	See Abend.
Atomic Task	A fundamental operation initiated either from the Lotus Notes Server (Server Atomic Task), or from the Lotus Notes client (User Atomic Task), which is executed by one of the Lotus Notes Server Programs.
Bottleneck	An area of congestion on the network that slows down network performance. As you add applications to the network and as the number of users or workstations on the network changes, network bottlenecks may emerge.
Compaq Insight Manager	Server management software delivering intuitive fault, performance, and configuration management capabilities for all key server subsystems in a variety of operating environments.
Compaq SMART SCSI Array Controller	A 32-bit EISA bus master with two SCSI channels that support up to 14 SCSI drives per controller, delivering maximum fault management, performance, and configuration capabilities.
EISA	See Extended Industry Standard Architecture.
Ethernet	Network cabling and signaling scheme with the 10 megabits per second rate that works over a wide variety of cabling.
Extended Industry Standard Architecture (EISA)	Open extension to the industry-standard expansion bus architecture, allowing the use of 8-/16-bit peripherals as well as 32-bit devices.

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G-2 Glossary

Fault Tolerance	The capability of a system to perform its function in accordance with design specifications, even in the presence of hardware or software failures. If, in the event of faults, the system functions can be performed but do not meet the design specifications with respect to the time required to complete the job or the storage capacity required for the job, the system is said to be partially or quasi fault tolerant. Fault tolerance is provided by the application of protective reliability. These resources can consist of more hardware, software, or time, or a combination of all three.
IDA	See Intelligent Drive Array.
Intelligent Drive Array (IDA)	Compaq Drive Array Controllers, including the Compaq 32-Bit Intelligent Drive Array Controller-2, the Compaq 32-Bit Intelligent Drive Array Controller, and the Compaq 32-Bit Intelligent Drive Array Expansion Controller.
Internet Packet Exchange (IPX)	NetWare LAN communication protocol; moves data between server and/or workstation running on different network nodes.
Internet Protocol (IP)	The part of the TCP/IP protocol set that provides the routing mechanism. TCP controls the transfer of data.
IP	See Internet Protocol.
IPX	See Internet Packet Exchange.
Network board	See Network Interface Controller.
Network Interface Controller (NIC)	A circuit board installed in each workstation to allow stations to communicate with each other and with the file server. Also called Network board.
NIC	See Network Interface Controller.
NLM	See NetWare Loadable Modules.
PALM	See Profiling and Load Modeling Tool.

Performance management	“Tuning” the network components to maximize performance and address user productivity issues, application software design, and data structure.
Profiling and Load Modeling Tool (PALM)	There were no readily available performance monitoring and load generation test tools for Lotus Notes. Therefore, the Compaq Groupware Engineering Team developed a custom tool called the Profiling And Load Modeling (PALM) Tool . The PALM Tool consists of an editor, a script execution program, and a set of Lotus Notes Atomic Task scripts. The editor was written with Visual Basic 3.0 and the scripts were written using Microsoft Test 2.0.
RAID	See Redundant Arrays of Inexpensive Disks.
Redundant Arrays of Inexpensive Disks (RAID) Technology	A system with more consistent performance, higher levels of fault-tolerance, and easier fault-recovery than traditional non-RAID systems.
TCP/IP	Protocol that manages the transmission of packets on a network and checks for errors. This protocol includes the Internet connection-based (TCP) and connectionless (IP) protocol.
Server Atomic Task	See Atomic Task.
Client Atomic Task	See Atomic Task.