

February 2000
ECGnnn/0200

Prepared by Knowledge
Management and Messaging
Business Unit

Enterprise Solutions Division

Compaq Computer Corporation

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Compaq Achieves 26,500 MMB on the ProLiant 6400R 550/2m System with Windows 2000

Abstract: Using Microsoft Windows 2000 and Microsoft Exchange V5.5, Compaq demonstrated a 26,500 Exchange MAPI Messaging Benchmark (MMB) operating on a ProLiant 6400R powered by four 550-megahertz (MHz) Intel Pentium III Xeon processors.

Compaq achieved new record-breaking Exchange Server scalability by reaching 26,500 MMB with a 207-millisecond response time on a ProLiant 6400R server equipped with four 550-MHz Intel Pentium III Xeon processors. Using Microsoft's Load Simulation utility, the ProLiant 6400R was tested at Compaq's Performance Center in Nashua, New Hampshire. This performance test resulted in the highest numbers of a benchmarked MMB to date on any four-processor system, from any vendor. It also shows that migrating from NT4.0 to Windows 2000 in an Exchange environment will show an improvement in performance.

The Compaq ProLiant 6400R provided an average CPU utilization rate of 76.4% during the 26,500 MMB test. The weighted 95th percentile response-time score was 207 milliseconds, and the average send-queue size for the four-hour steady-state period was 7.5 messages.

Compaq enables a confident deployment and management of Microsoft Exchange Server on their products by conducting extensive integration engineering and capacity planning. Microsoft Exchange Server has been the focal point for extensive development and testing by both Microsoft and Compaq. Throughout this activity, Compaq and Microsoft have worked to optimize Microsoft Exchange Server performance on Compaq server products in order to provide an optimal balance between performance, availability, manageability, and cost. Compaq not only provides world-class server platforms, but also the experience necessary for successful deployments of messaging and collaborative applications.

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Solutions Guide prepared by Knowledge Management and Messaging Business Unit

Enterprise Solutions Division

First Edition (February 2000)

Document Number ECGnnn/0200

Introduction

Compaq ProLiant 6400R

The Compaq ProLiant 6400R is the ultimate standards-based server delivering the most scalable performance and the highest levels of availability. The ProLiant 6400R supports up to four Pentium® III Xeon™ processors and 4 GB of system memory. Its architecture supports Enhanced PCI Hot-Plug and five 64-bit PCI, and one ISA slot). The Compaq ProLiant 6400R can support nearly 7 terabytes of external storage. Combined with the latest high-availability features and processor technology, the ProLiant 6400R is designed for the most demanding and mission-critical applications.

Key features of the ProLiant 6400R include:

- Supports one to four Intel Pentium® III Xeon 550 MHz processors with 512-KB, 1-MB, or 2-MB L2 Cache
- Innovative, space saving 4U (7") rack-optimized design
- Six 64-bit slots (5 PCI Hot Plug and 1 shared PCI/ISA)
- ECC protected buffered EDO DIMM memory (expandable to 4 GB)
- Support for SmartStart and Compaq Insight Manager
- 24X CD ROM drive and floppy drive
- Compaq NC3131 64 bit dual-port 10/100 Controller upgradeable to Gigabit
- Uncompromising reliability features:
 - Industry Standard push button PCI Hot Plug
 - Hot plug drives
 - New, redundant hot plug fan design provides protection for entire system
 - ECC protected memory and processor bus
 - ASR-2 and Online Recovery Server Option
 - Optional redundant hot plug power supplies
 - Optional redundant power processor modules
 - Optional redundant NICs
 - Integrated Remote Console (IRC)
- Diagnostic interlocks for enhanced serviceability
- Tool-free internal design for easy access to system components
- Protected by Compaq Services, including a limited three-year parts, labor and on-site warranty¹ with optional 4-hour response. Pre-Failure Warranty¹ and Compaq Service and Support Programs available on a Worldwide basis

Test Methodology

The tests were conducted using Microsoft Messaging Application Program Interface (MAPI) Messaging Benchmark. The MAPI Messaging Benchmark (MMB) measures throughput in terms of a specific profile of user actions, executed over an 8-hour working day. This benchmark utilizes the 'Medium User' setting of the Load Simulator (LoadSim) MAPI tool. Results should be interpreted as a benchmark for comparing messaging throughput of various servers and configurations and should not be confused with deployment recommendations. Factors such as backup/restore, topology and other issues should be considered when planning a deployment.

Exchange Server Performance Test Results

Test Result Highlights

Table 1: Performance Highlights (Compaq ProLiant 6400R, (4) Pentium III Xeon 550-MHz)

MAPI Messaging Benchmark (MMB)	26,500
Response Time (milliseconds)	207
Messages Submitted (4-hour steady-state period)	181,746
Message Recipients Delivered (4-hour steady-state period)	997,772
Messages Sent (4-hour steady-state period)	48,393

Note: Complete disclosure of test results can be found in Appendix A of this document.

Table 2: Tested Configuration

COMPAQ PROLIANT 6400R TESTED CONFIGURATION
Four (4) Pentium III Xeon 550-MHz Processors – 2 MB L2 cache per processor
4 GB RAM
One (1) Compaq SMART 4200 Array Controller and Integrated 4200 Controllers OS/Exchange DS/MTA Files (4GB): Two (1 + 1) 9.2-GB Drive – RAID 1 Pagefile: (2 nd partition on System Disk) Exchange Log Files: two (1 + 1) 9.2-GB Drives– RAID 1 Exchange Information Store Files: Forty-eight (48) 9.2-GB Drives – RAID 0
Compaq NC3131 64 bit dual-port 10/100 Controller – 2 ports
Windows NT 2000 Advanced Server – Build 2195 Exchange Server Version 5.5 – Enterprise Edition with Service Pack 3

Note: Complete disclosure of test results can be found in Appendix A of this document.

What the Benchmarks Don't Tell You

It is important to understand that benchmarks such as these are designed to give planners of Exchange Server implementations baseline references for understanding and comparing the relative capabilities of hardware platforms from a single vendor such as Compaq or among competing hardware vendors. When interpreting these benchmarks, two things should be kept in mind.

First, consider whether benchmark tests are performed on what can be referred to as *customer-deployable configurations*. A hardware vendor may publish a result that is based on a platform or configuration that should not be deployed in a “real world” Exchange Server deployment. For example, many vendors (including Compaq) publish results using disk subsystems configured with RAID0. While RAID0 does provide the highest levels of disk subsystem performance, it fails to provide any protection against data loss. Compaq recommends deploying an Exchange Server with disk fault tolerance such as RAID1 or RAID5 for the highest levels of data protection.

Second, most vendors, including Compaq, conduct benchmark tests for Exchange Server that are *single-server* in nature. Also keep in mind that benchmarks do not account for issues such as backup and disaster recovery or information-store-maintenance sizing. Whatever the issue, care must be taken when interpreting benchmarks to ensure that they represent useful information for your Exchange Server deployment and are based on valid simulation methodologies.

While it is significant that the Compaq ProLiant 6400R server can successfully scale to 26,500 MMB in a single-server benchmark exercise, Compaq recommends careful evaluation of all issues involved in real-world Exchange Server deployments – issues such as management, administration, and disaster recovery.

MAPI Messaging Benchmark (MMB) – LoadSim Medium User Redefined

To distinguish clearly between throughput benchmarks and capacity planning information for Microsoft Exchange Server, Microsoft has established the MAPI Messaging Benchmark (MMB) based on the workload from LoadSim Medium User profile. The MAPI Messaging Benchmark representative workload focuses on the resulting throughput and clearly communicates the profile under test.

The workload profile has not changed from the LoadSim Medium User profile formerly used, but is now expressed in clearer fashion. The intent is to make sure that customers can understand the MAPI Messaging Benchmark workload and can compare the MMB for one platform to the MMB for other platforms. In addition, the renaming of the benchmark reinforces the fact that the test is a measurement of messaging throughput and that additional considerations are required in capacity planning.

MMB Transaction Load

The transaction load created by the benchmark is equivalent to the user actions outlined in Table 3 over an eight-hour day.

Table 3: MMB Transaction Load

User Action	Actions Per Day
Check Inbox	12
Send Message	14.18
Avg. Recipients per Message	4.7
Messages Received	66.3
Read Message	81.3
Move Message	16.3
Delete Message	32.5
Update Calendar	5

Thirty percent of all mail messages have one distribution-list recipient. The average size of the distribution list (DL) is ten recipients. (Recipients created by distribution lists are included in the summary transaction load outlined in Table 3). All users are logged on prior to the benchmark measurement as the users are assumed to be using mail in a corporate setting. Mail is not cleared from the deleted-items folder during the test as this is assumed to occur when the user logs off.

Message Mix Description

The weights used when the Load Simulator randomly selects which message to send are listed in the following Table 4.

Table 4: Weights Given to Different Types of Messages in LoadSim Random Selection

Message Files	Body	Attachment	Content Description	Weight
Ups1k.msg	1K		Body as RTF	60
Ups2k.msg	2K		Body as RTF	16
Ups4k.msg	4K		Body as RTF	4
Ups10kat.msg	1K	10K	Body as RTF Notepad attachment	6
Upsxlatt.msg	1K	15K	Body as RTF Microsoft Excel spreadsheet attached	4
Upswdatt.msg	1K	16K	Body as RTF Microsoft Word document attached	4
Upsbobj.msg	0.5K	43K	Body as RTF Bitmap attachment	2
Upsxobj.msg	1K	17K	Body as RTF Excel spreadsheet attachment	4

Load Simulator

The tool used in generating the workload for the MMB benchmark was Microsoft Load Simulator (LoadSim). Load Simulator is a tool for simulating a client-user load on a server running Microsoft Exchange. Its purpose is to enable a single Windows NT server, called a LoadSim client, to simulate multiple Microsoft Exchange client users.

The operation of Load Simulator users is governed by a Load Simulator profile. This profile controls factors such as how long a Load Simulator "day" is, how many e-mail messages to send in a day's time, how many times to open and read e-mail, whether to use distribution lists, whether to use public folders, etc.

Load Simulator creates a highly accurate simulation of reality. It mimics the full Microsoft Exchange Client in many respects. First, it uses .MSG files, the same format used by the Exchange Client. This guarantees that messages generated by Load Simulator have the same properties as those sent by actual users of the Exchange Client. Second, Load Simulator uses the same MAPI remote-procedure-call (RPC) semantics as those used by the Client. Third, Load Simulator registers MAPI change notifications in the same manner as they are registered by the Client. Finally, Load Simulator even emulates the Microsoft Exchange Client list-box cache, which the Client uses for folder and message panes in the viewer when a user browses and selects messages on the server. For more information on LoadSim Medium canonical profiles, refer to the LoadSim documentation, which can be found at <http://www.microsoft.com/>

Appendix A

LoadSim Client

Table A-1 details the configuration of the LoadSim clients used to simulate multiple Microsoft Exchange users generating the MMB workload for the MMB measurement.

Table A-1: Configuration of LoadSim Client

LoadSim Clients	Configuration
Model	Compaq Deskpro-EN 450
Client CPU types and speeds	1P/450-MHz Pentium II processor
Number of clients	38 clients with 256MB RAM (1000 users for 22; 500 users for six; 250 users for four; 100 users for four; 50 users for two systems)
Network Topology (100Base T, Token Ring, etc.)	100 Base-TX
Network Controllers	Compaq 10/100 TX
Client network software name and version	Microsoft Windows NT Workstation 4.0 with SP4
LoadSim version	5.5 (Build 2187)

Performance Data

Performance data for the MMB measurement are detailed in Table A-2.

Table A-2: 26,500 MMB (Measured During Test Run at Steady State)

Summary	
Supported Benchmark Load	26,500 MMB
Benchmark Profile	MAPI Messaging Benchmark
Protocol	Exchange MAPI
Length of Steady State	4 hours
Length of Test	9 hours
Unless otherwise noted, values listed are averages over entire steady state period.	
Transaction Load (hourly)	
Messages Submitted	45,436.5
Message Recipients Delivered	249,443
Messages Sent	12,098.25

continued

Table A-2 (continued)

Transaction Load (per Second)	
Message Opens/Sec	88.7
Folder Opens/Sec	24.09
RPC Read Bytes/Sec	83,236.2
RPC Write Bytes/Sec	605,480.1
Transaction Queues	
IS Send Queue Average Length	7.5
MTA Work Queue Average Length	2.7
Processor Utilization	
System Processor Utilization (%)	76.4%
System Processor Queue Length	5.1
System Context Switches/Sec	12,004
Process % CPU Time - Store	256.9%
Process % CPU Time - DS	13.6%
Process % CPU Time - MTA	16.5%
Memory Utilization	
Available Bytes	1.8GB
Pages/Sec	0.007
Process Working Set Bytes - Store	1.82GB
Process Virtual Bytes - Store	2.87GB
Logical Drive Utilization	
IS Database Disk Reads/Sec	1192.4
IS Database Disk Writes/Sec	464.5
IS Database Average Disk Queue Length	10
IS Log Disk Reads/Sec	0.0
IS Log Disk Writes/Sec	142.6
IS Log Average Disk Queue Length	0.06

Note: Performance Results were measured using Microsoft NT Performance Monitor. Measurements were obtained by measuring averages for the period of steady-state activity (i.e. after 26,500 users were successfully logged on). Tests measure the messaging throughput of a single-server, single-site topology.

For deployment-specific information contact a Microsoft or Compaq representative. More information can be found at:

<http://www.microsoft.com/exchange/DeployAdmin/DeployAdmin.htm>

User Response Times

Table A-3 details response times for various user actions during benchmark testing.

Table A-3: User Response Times (Latencies) from Load Simulator

Client Actions	95th-Percentile Response Time (in Milliseconds)
Read	140
Send	341
Delete	290
Move	321
Submit	261

Descriptive Terms

Messages Submitted

Submit calls made by clients. This equates to total message sends by users.

Messages Sent

Messages that the Information Store sends to the MTA (not messages sent by clients). Normally all messages submitted by the clients are sent to the MTA, except in the case where all recipients are local mailboxes. In that case, since all the deliveries can be performed locally, no message is sent to the MTA.

Message Recipients Delivered

Separate mailboxes that messages have been delivered to. Think of this as the number of Reads that are 'caused' by sending a message (one per recipient).

Message Opens/Sec

Messages accessed for reading per second.

Folder Opens/Sec

Folders opened for browsing per second.

RPC Read Bytes/Sec

RPC Bytes read from clients (i.e., submit calls).

RPC Write Bytes/Sec

RPC Bytes written to clients (i.e., message opens).

IS Send Queue Average Length

Send Queue Size is the number of messages in the private information store's send queue.

MTA Work Queue Average Length

Work Queue Length is the number of outstanding messages in the Work Queue, which indicates the number of messages not yet processed to completion by the MTA.

Appendix B: Related Documents

The following key documents and locations provide a wealth of information regarding successful deployment of Microsoft Exchange Server on Compaq platforms.

Compaq ActiveAnswers

www.compaq.com/activeanswers

Managing and Monitoring Microsoft Exchange Server

Microsoft Exchange Server Backup and Restore Performance using Compaq 35/70 DLT Arrays

Microsoft Exchange Server Performance and Tuning Guide

Implementing High Availability for Microsoft Exchange Server

Compaq White Paper Index

www.compaq.com/support/techpubs/whitepapers

Compaq TechNote Index

www.compaq.com/support/techpubs

RAID Technology for Database Servers

Microsoft Exchange Server Web site

www.microsoft.com/exchange