September 1999
ECG508/1099

Prepared by Knowledge Management and Messaging Solutions Domain

Enterprise Solutions and Services Division

Compaq Computer Corporation

Contents

New World-Record Microsoft Exchange Server for 8 Processors - Compaq ProLiant 8500 Pentium III Xeon 550 MHz Servers

Abstract: *Compaq accomplished record-breaking Exchange Server scalability by achieving a* ***32,500 MAPI Messaging Benchmark (MMB)*** *on a Compaq ProLiant 8500 server with eight 550 Megahertz Intel Pentium III Xeon processors. Using Microsoft's Load Simulation (LoadSim) utility, the ProLiant 8500 with eight 550 MHz processors was tested with a workload of 32,500 MMB. This result is the highest MAPI Messaging Benchmark (MMB) to date from any vendor. The Compaq ProLiant 8500 provided an average CPU utilization rate of* ***57.8%*** *during the 32,500 MMB test. The weighted 95th percentile response-time score was* ***209 milliseconds,*** *and the average send-queue size for the four-hour steady-state period was* ***41.6 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

Notice

New World-Record Microsoft Exchange Server Scalability on Compaq ProLiant 8500 Pentium III Xeon 550 MHz Servers
Solutions Guide prepared by Knowledge Management and Messaging Solutions Domain

Enterprise Solutions and Services Division

First Edition (September 1999)
Document Number ECG508/1099

Introduction

Compaq ProLiant 8500

Today's mission-critical applications demand ever-increasing scalability and availability from data center servers. The new ProLiant 8500, the latest addition to Compaq's ultra-density data server product line, delivers the performance and uptime required to meet the current and future demands of Enterprise server consolidation, e-business, ERP, thin-client and data mining applications. Based on the Profusion architecture jointly developed by Compaq, Corollary and Intel, the ProLiant 8500 offers excellent scalability driven by its balanced system architecture.

- The ultimate high-density data center server delivering breakthrough 8-way scalable performance for 7 x 24 multi-server rack environments
- 8-way server with Compaq/Intel co-developed Profusion architecture and Pentium® III Xeon™ support
- 7U rack-optimized design
- New modular design for increased ease of serviceability and future upgradability
- Supports one to eight Intel 550-MHz Pentium III Xeon processors with 100-MHz front-side bus & full speed cache
- 512-KB, 1-MB, and 2-MB L2 Cache
- ECC-protected memory bus and cache
- 100-MHz SDRAM DIMM 2-way interleaved memory that is expandable to 8 GB (future upgradability to 16 GB)
- Eleven 64-Bit PCI I/O expansion slots (2 x 66 MHz, 9 x 33 MHz) all PCI Hot Plug
- Integrated Smart Array Controller (Ultra2 support) (RAID 0, 0 + 1, 5 support)
- NC3131 Fast Ethernet NIC Dual Port 64 PCI 10/100, upgradable to Gigabit Ethernet
- Internal Hot Plug Drive Storage of 72.8 GB (4 x 1" 18.2-GB Wide Ultra2 SCSI hard drives). 35.2 TB of external storage using Fibre Channel Host Adapters, Hubs and Array Storage Subsystems
- Robust set of hot plug and redundant features including PCI Hot Plug, hot plug drive bays, redundant hot plug fans and power supplies and support for ECC memory, redundant NICs, ASR-2
- System Interconnect Status Indicators
- Integrated Management Display (IMD) (Optional for 512K Model)
- Integrated Remote Console (IRC)
    - Remote-Flash Redundant ROM
    - Remote ROM Flash
- Remote Redundant ROM
- Protected by Compaq Services, including a limited next day, three-year parts, labor and on-site warranty[1] with optional 4 hour response. Pre-Failure Warranty[1] and Compaq Service and Support Programs available on a Worldwide basis

1. Certain restrictions and exclusions apply. Consult the Compaq Customer Support Center at 1-800-345-1518 for details.

For more information about the ProLiant 8500, please refer to the Compaq web site, at http://www.compaq.com/products/servers/proliant8500/index.html.

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 8500, (8) Pentium III Xeon 550-MHz)

MAPI Messaging Benchmark (MMB)	32,500
Response Time (milliseconds)	209
Messages Submitted (4-hour steady-state period)	222,222
Message Recipients Delivered (4-hour steady-state period)	1,220,013
Messages Sent (4-hour steady-state period)	59,533

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

Table 2: Tested Configuration

COMPAQ PROLIANT 8500 TESTED CONFIGURATION
Eight (8) Pentium III Xeon 550-MHz Processors – 2 MB L2 cache per processor
4 GB RAM
One (1) Compaq SMART 3200 Array Controller with 64 MB Cache; two (2) Compaq KGPSA Fibre Controllers OS/Exchange DS/MTA Files: Two (1 + 1) 4.3-GB Drives – RAID 1 Pagefile: One (1) 4.3-GB Drive Exchange Log Files: six (3 + 3) 4.3-GB Drives – RAID 1 Exchange Information Store Files: Seventy-two (72) 9.2-GB Drives – RAID 0
Compaq NC3131 64 bit dual-port 10/100 Controller – 2 ports
Windows NT Server Version 4.0 Enterprise Edition (using /3GB BOOT.INI switch) with Service Pack 5 Exchange Server Version 5.5 – Enterprise Edition with Service Pack 2

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 8500 server can successfully scale to 32,500 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	6
			Notepad attachment	
Upsxlatt.msg	1K	15K	Body as RTF Microsoft Excel spreadsheet attached	4
Upswdatt.msg	1K	16K	Body as RTF	4
			Microsoft Word document attached	
Upsbmobj.msg	0.5K	43K	Body as RTF	2
			Bitmap attachment	
Upsxlobj.msg	1K	17K	Body as RTF	4
			Excel spreadsheet attachment	

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 homepage at http://www.microsoft.com/exchange/55/downloads/LoadSim.htm .

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	48 clients with 256 MB RAM (1000 users for 26; 500 users for 7; 250 users for 10; 100 users for five systems)
Network Topology (100Base T, Token Ring, etc.)	100 Base-TX
Network Controllers	Compaq NC3131
Client network software name and version	Microsoft Windows NT Workstation 4.0 with SP-5
LoadSim version	5.5 (Build 2187)

Performance Data

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

Table A-2: 32,500 MMB (Measured During Test Run at Steady State)

Summary	
Supported Benchmark Load	32,500 MMB
Benchmark Profile	MAPI Messaging Benchmark
Protocol	Exchange MAPI
Length of Steady State	4 hours
Length of Test	8 hours
Unless otherwise noted, values listed are averages over entire steady state period.	
Transaction Load (hourly)	
Messages Submitted	55555.5
Message Recipients Delivered	305003.25
Messages Sent	14883.25

continued

Table A-2 *(continued)*

Transaction Load (per Second)	
Message Opens/Sec	106.8
Folder Opens/Sec	29.5
RPC Read Bytes/Sec	100662
RPC Write Bytes/Sec	602372
Transaction Queues	
IS Send Queue Average Length	41.6
MTA Work Queue Average Length	4.66
Processor Utilization	
System Processor Utilization (%)	57.8
System Processor Queue Length	2.6
System Context Switches/Sec	23152
Process % CPU Time - Store	391.15%
Process % CPU Time - DS	19.18%
Process % CPU Time - MTA	14.36%
Memory Utilization	
Available Bytes	2.1GB
Pages/Sec	0.021
Process Working Set Bytes - Store	1.65GB
Process Virtual Bytes - Store	2.99GB
Logical Drive Utilization	
IS Database Disk Reads/Sec	1872
IS Database Disk Writes/Sec	584
IS Database Average Disk Queue Length	3.5
IS Log Disk Reads/Sec	0.0
IS Log Disk Writes/Sec	170
IS Log Average Disk Queue Length	0.06

Note: Performance Results were measured using Microsoft Windows NT Performance Monitor. Measurements were obtained by measuring averages for the period of steady-state activity (i.e. after 32,500 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	170
Send	300
Delete	250
Move	300
Submit	221

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

For more information regarding Microsoft Exchange performance on ProLiant platforms, please refer to the Microsoft Exchange section of the Compaq ActiveAnswers web site:

www.compaq.com/activeanswers

Other related documents include:

Record-breaking Exchange scalability achieved with 4-processor Compaq ProLiant 6400R Pentium III Xeon

http://www.compaq.com/solutions/messaging/performance/xeonscal.html

Microsoft Exchange Server Scalability on Compaq ProLiant 3000 Pentium III 500MHz Server

http://www.compaq.com/solutions/messaging/performance/3000-III-500.html

Microsoft Exchange Server Scalability on Compaq ProLiant 7000 Pentium III Xeon Servers

http://www.compaq.com/solutions/messaging/performance/xeonpiii.html

Microsoft Exchange Server: Interpreting Benchmarks in the Light of Real-World Deployment Concerns

http://www.compaq.com/solutions/messaging/performance/mes.html

Disk Subsystem Performance and Scalability,

www.compaq.com/support/techpubs/whitepapers/ECG0250997.html

Configuring Compaq RAID Technology for Database Servers,

www.compaq.com/support/techpubs/technotes/184206-1html

Compaq SMART Array Controller Technology,

www.compaq.com/support/techpubs/whitepapers/667A0697.html

Hardware vs. Software Fault Tolerance,

www.compaq.com/support/techpubs/whitepapers/ECG0660298.html

Compaq White Paper Index,

www.compaq.com/support/techpubs/whitepapers