HP ProLiant DL360 G4 server benchmark results for Microsoft Exchange Server 2003

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Abstract

In August 2004, HP produced new Microsoft® Exchange MAPI Messaging Benchmark (MMB3) results using Microsoft Windows® Server 2003 and Microsoft Exchange Server 2003, on an HP ProLiant DL360 G4 server powered by two Intel® Xeon™ processors (3.4GHz/800MHz/1MB L2). The MMB3 benchmarking workload and methodology serves as the standard for Exchange Server 2003 MAPI server comparison. The MMB3 workload is characteristic of a medium corporate mail environment. Using the Microsoft LoadSim utility, the ProLiant DL360 G4 server was tested at the HP Performance Center in Nashua, New Hampshire.

Executive summary

HP achieved world-class Microsoft Exchange Server 2003 scalability results of 6,500 MMB3 on a ProLiant DL360 G4 server equipped with:

- Two Intel Xeon processors (3.4GHz/800MHz, 1MB L2)
- 56 – 36.4 GB hard drives on one Smart Array 6402 controllers for databases.
- 28 – 36.4 GB hard drives with one KGPSA Fibre Channel Host Bus Adapter
- One – 36.4 GB hard disk drive for Active Directory and pagefiles
- One – 36.4 GB hard disk drive for the Exchange files, operating systems

The ProLiant DL360 G4 (dual processor) server achieved the following:

- Average CPU utilization rate of 85% during the 6,500 MMB3 test
- Weighted 95th percentile response-time score was 748 milliseconds
- Average send-queue size for the four-hour steady-state period was 106 messages

ProLiant DL360 G4 – the server behind the outstanding performance

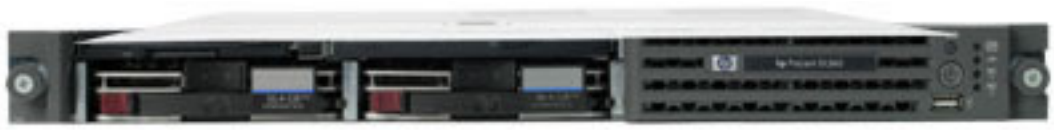
Overview

The new ProLiant DL360 G4 is a 1U, two processor capable, two PCI-X slot, two disk drive server with Integrated Light-Out (iLO) management.

New ProLiant DL360 G4 server models:

- Intel Xeon 3.4GHz/800MHz processor and 1MB L2 cache
- Intel Xeon 3.0GHz/800MHz processor and 1MB L2 cache

Figure 1. HP ProLiant DL360 G4 server



ProLiant DL360 G4 server features

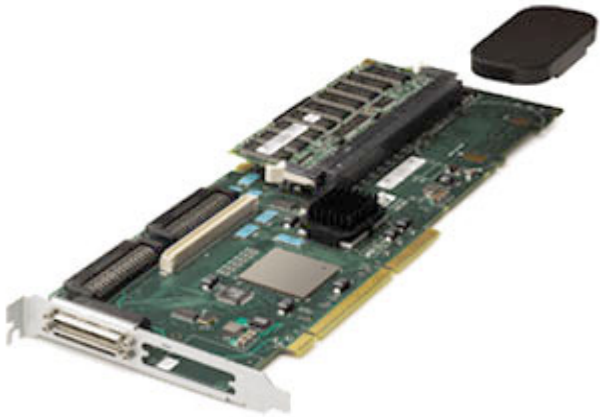
- Intel Xeon 3.4 GHz processors with EM64T, a 800MHz front side bus and 1MB of L2 cache (two 3.4GHz or 3.0GHz)
- Intel E7520 chipset
- Two 64 bit/133 MHz PCI-X slots (one full length slot and one half length); optional PCI-Express. **Note:** For information about PCI Express visit: http://www.hp.com/servers/pci-express
- 1GB or 2GB (depending on model) of 2-way interleaved PC2700 DDR SDRAM at 333 MHz memory. Up to 8GB maximum
- Embedded HP Smart Array 6i Ultra320 RAID controller
- Embedded NC7782 Dual Port NIC
- 1.44-MB diskette drive
- USB ports (3)
- Maximum internal storage of 600 GB SCSI (2x300 GB SCSI) or 500 GB (2x250 GB serial ATA)
- Support for new integrated Lights-Out (iLO) Shared Network Port enables access to the iLO management processor through one of the embedded system NICs

Smart Array 6402 controllers

Description

The Smart Array 6402 high performance Ultra320, PCI-X array controller, as shown in Figure 2, provides maximum performance, flexibility, and reliable data protection for HP ProLiant servers, through its unique modular design and support for Advanced Data Guarding (RAID ADG). This new generation performance Smart Array controller again raises the standards of performance, introducing Double Data Rate (DDR) battery-backed write cache (BBWC) architecture and a new RAID engine. Designed and tested with industry standard HP ProLiant servers for greater reliability, this controller is ideal for workgroup and departmental servers. And, like other Smart Array controllers, the Smart Array 6402 controller features complete data compatibility with previous generation's Smart Array controllers for easy data migration from server to server and for controller upgradeability.

Figure 2. Smart Array 6402 controller



Smart Array 6402 controller features

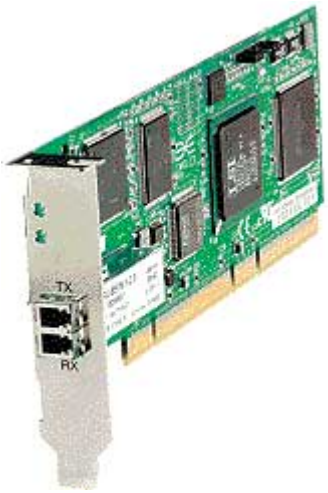
- Modular, easy to upgrade design lets you optimize performance and increase capacity as needed from 128 to 256 MB battery-backed cache (BBWC). Increase capacity as needed from two to four channels with the U320 expansion option.
- High performance, sixth-generation architecture offers a new hardware RAID engine and a new performance 266 MHz DDR memory architecture for increased performance over previous controllers.
- Recovery ROM protects against a ROM failure or corruption.
- Ultra320 SCSI technology delivers high performance and data bandwidth up to 320 MB/s bandwidth per channel.
- Mix and match LVD SCSI compatibility protects your investments and lets you deploy drives as needed.
- BBWC protects cached data in the event of a power outage, server failure or controller failure, and redundant, replaceable batteries take that protection even further. Maximum cache configuration is 256 MB of BBWC.
- 64 bit, 133 MHz PCI-X interface boosts bandwidth above 1 GB/s burst transfer rate over PCI-X bus.
- 64 bit memory addressing supports servers with greater than 4 GB of memory.
- Online management features:
  - Online Capacity Expansion
  - Online RAID Level Migration
  - Online Stripe Size Migration
  - Multiple Online Spares (Global)
  - User Selectable Read/Write cache
  - User Selectable Expand and Rebuild Priority

FCA 2101 StorageWorks PCI-to-Fibre Channel Host Bus Adapter

Description

FCA 2101 StorageWorks 2GB, Fibre Channel Host Bus Adapter is a single channel, 64bit/66MHz PCI to Fibre Channel Host Bus Adapter (HBA), as shown in Figure 3.

Figure 3. FCA 2101 PCI-to-Fibre Channel Host Bus Adapter



FCA 2101 features

- Operating system support split between two HBAs, one supporting x86 NT environments and the other HBA supporting Tru64 and OpenVMS operating environments
- Embedded physical interface requires no GBICs to purchase
- 64-bit PCI data and addressing
- Hardware context cache for superior fabric performance
- Full fabric support using F_Port and FL_port connections
- Support for concurrent use of multiple protocols (FC/SCSI)
- Full support for both FC service Class 2 and 3
- Support FC-Tape (FC-2) devises
- End-to-end parity protection for high data integrity
- Buffered data architecture to support up to 500m cabling

StorageWorks MSA1000

Description

The HP StorageWorks Modular Smart Array 1000 (MSA1000) as shown in Figure 4, is a 2 Gb Fibre Channel storage system for the entry-level to midrange storage area network (SAN). It provides the customer with a low-cost, scalable, high performance storage consolidation system with investment protection. It is designed to reduce the complexity and risk of SAN deployments. The powerful but easy to use management software makes it ideal for departmental and remote location SANs. With the addition of two more drive enclosures, it can control up to 42 drives allowing capacity of six terabytes. All configuration, management and partitioning and licensing software come standard with no extra charges.

Figure 4. StorageWorks MSA1000

StorageWorks MSA1000 features

- Flexible: supports Windows Server 2003 (32 & 64-bit), Windows 2000 and NT, NetWare, Linux (32 & 64-bit), Tru64 UNIX. OpenVMS, or HP-UX operating systems
- Performance: provides transmission rate of up to 30K I/Ops (cache), throughput of up to 200 MB per second
- Compatible: supports 14 1-inch drives, 1 or 2 Gb Fabric Switches or hubs, in a 4U rack space
- Scalable: is easily expanded to 6 TB using forty-two 146 GB hard drives in 10U of rack space
- Integrated: allows installation of an optional internal MSA 8-port switch or an MSA 3-port hub
- Serviceable: supports hot plug drives, controllers, fans, power supplies, switches and hubs
- Reliable: supports the highest level of fault tolerance (RAID ADG)

Test methodology and workload

For Microsoft Exchange Server 2003, the benchmarks were measured using the MAPI Messaging Benchmark 3 (MMB3).

The MMB3 workload, for LoadSim 2003, is a modification of the previous MMB2 workload. It is designed to include new features from Microsoft Exchange Server 2003 and Microsoft Outlook 2003. This workload achieves the following:

- Uses the Microsoft Outlook 2003 client
- Introduces Smart Folders
- Introduces the use of server-side rules
- Allows the message distribution to be composed of a larger message size than MMB2
- Increases the mailbox size to 100MB per user
- Removes journaling from the benchmark

For more detailed information regarding the differences between MMB2 and MMB3, please refer to Appendix C – MMB2 and MMB3 workload comparison in this document.

This test measures the messaging throughput of a single server, single site topology. Its purpose is to measure the maximum throughput of a Microsoft Exchange Server on this hardware configuration.

Note: This test can provide a benchmark for comparing hardware and/or software products, but cannot be used as a deployment guide for production environments. For deployment specific information, visit http://www.hp.com/solutions/exchange.

The MMB3 benchmark does not account for:

- Usage profiles not matching that of the LoadSim MMB3 profile
- Per user storage, and per server backup requirements
- Fault tolerance requirements, such as protected storage (RAID 0+1, RAID 5) for the system/page file volume, information store and transaction logs
- Anti-virus and management processes and effects on the server
- UBE/UCE (spam) mail flow
- Workloads other than MAPI private folder access. This includes Public Folder, NNTP, POP3 and other email interfaces
- Multiple Exchange Server deployments, where additional resources are required to forward mail intra-site
- Connectors, Links and Replication to remote Exchange sites
- Network topologies, bandwidth availability, latency requirement and SLA related factors like QOS (Quality of Service) and fail-over path issues
- Manageable database sizes and partitioning beyond the 2 Storage Group, 2 database/SG configuration

Test result highlights

Hewlett Packard	
Server:	HP ProLiant DL360 G4
Test results	
MMB3 score:	6,500
Response time:	748 ms
CPU utilization:	85%
Avg. queue:	106
Msgs. submitted	274,493(4-hour steady state period)
Msgs. delivered	682,761 (4-hour steady state period)
Msgs. sent	274,319 (4-hour steady state period)
Server configuration	
CPU:	Intel Xeon 3.4 Gigahertz (GHz) / 800MHz
CPU count:	2 Physical
RAM:	4 Gigabytes (GB)
Secondary cache:	1 MB L2 Cache
Operating system:	Microsoft Windows Server 2003 Enterprise Edition
Storage:	56 – 36.4 GB – Information Store and transaction 28 – 36.4 GB – log files 1 – 36.4 GB – Operating system, Exchange files 1 – 36.4 GB – page files and Active Directory
Controller:	1 – HP Smart Array 6402 controllers 1 – FCA 2101 PCI-to-Fibre Channel Host Bus Adapter
NIC:	ProLiant NC7782 Gigabit Server Adapter

Note: Complete disclosure of test results can be found on the Microsoft Exchange Server 2003 Performance Scalability website:

http://www.microsoft.com/exchange/evaluation/performance/default.asp

Appendix A – Detailed test results

Descriptive terms

Messages Submitted – Submitted calls made by clients. This equates to total messages sent by users.

Messages Sent – Messages that the Store sends to the categorizer in Inetinfo (SMTP Service in particular).

Note: All messages – even MAPI messages – are sent to the categorizer, as this replaces the MTA for all but communication via X.400, with a Microsoft Exchange 5.5 server.

Message Recipients Delivered – Separate mailboxes where messages have been delivered.

Message Opens/Sec – Messages accessed for reading per second.

Folder Opens/Sec – Folders opened for browsing per second.

RPC Read Bytes/Sec – Bytes read from clients, sent via RPCs.

RPC Write Bytes/Sec – Bytes written to clients, sent via RPCs.

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

Test results

Table 1. Test results

Summary	
Supported Benchmark Load	6,500 MMB3s
Benchmark Profile	MAPI Messaging Benchmark 3 (MMB3)
Protocol	Exchange MAPI
Length of Steady State	4 Hours
Length of Test	8 Hours
Category	Single Server
Unless otherwise noted, values listed below are averages over entire 4-hour steady state period.	
Transactions in total	
Total Messages Submitted	274,493
Total Message Recipients Delivered	682,761
Total Messages Sent	274,319
Ratio Message Recipients Delivered / Messages Submitted	2.49
Transaction Load (per hour)	
Messages Submitted / hour	68,623
Message Recipients Delivered / hour	170,690
Messages Sent / hour	68,580
Transaction Load (per Second)	
Message Opens/Sec	74
Folder Opens/Sec	25
RPC Read Bytes/Sec	218,454
RPC Write Bytes/Sec	3,875,941
Transaction Queues	
IS Send Queue Average Length	106

(Table 1 continued next page)

Table 1. Test results *(continued)*

Processor Utilization	
System Processor Utilization (%)	84.7%
System Processor Queue Length	8
System Context Switches/Sec	14976
Process % CPU Time – Store	298%
Process % CPU Time – Inetinfo	10%
Exchange Server 2003 is also domain controller? (yes/no)	Yes
Process % CPU Time – LSASS (on domain controller)	8%
Memory Utilization	
Available Bytes	1.79
Pages/Sec	2
Process Working Set Bytes - Store	1.4 GB
Process Virtual Bytes - Store	2 GB
Logical Drive Utilization	
IS Database Disk Reads/Sec	(912,890,898,919)
IS Database Disk Writes/Sec	(343,322,316,306)
IS Database Average Disk Queue Length	(8,10,9,7)
IS Log Disk Reads/Sec	(2,2)
IS Log Disk Writes/Sec	(88,86)
IS Log Average Disk Queue Length	(0,0)

Response times

Table 2. Response times (Latencies)

Client Actions	95th Percentile Response Time (in milliseconds)
Send	3065
Read	481
Reply	331
Reply All	380
Forward	391
Move	511
Delete	370
Permanently Delete	391
S+ Free/Busy	561
Browse Calendar	1172
Make Appointment	2814
Request Meeting	4016
Create Smart Folder	1122
Delete Smart Folder	1592
Create Rule	470
Delete Rule	531
Apply View/Sort	7301
Weighted Total	748

Message throughput

Table 3. Summary of the MMB3 profile for an 8 hour day

	Expected	Measured
Messages Submitted/MMB3/Day	85	84.5
Messages Delivered/MMB3/Day	210	210.1
Average Recipients per Message	2.47	2.49

- List Any Modifications to the default profile – None

Exchange Server configuration

Table 4. Exchange Server configuration

Component	Description
Vendor	Hewlett-Packard
Model	ProLiant DL360 G4
Processor	Intel Xeon processors (3.4GHz/800MHz)
# of Processors	2
Primary Cache	
Secondary Cache	1 MB L2cache
Other Cache	
Memory	4 GB
Disk Subsystem	56 – 36.4 GB disks for Information Store files 28 – 36.4 GB disks Log files 1– 36.4 GB disks for operating system, Exchange system files 1– 36.4 GB disks for pagefiles and Microsoft Active Directory
Disk Controllers	1– HP Smart Array 6402 Controller 1- FCA 2101 PCI-to-Fibre Channel Host Bus Adapter
Other Hardware	1- MSA 1000
Hardware Tunings	None
Comments	
Mail Software	Outlook 2003
Vendor	Microsoft Corporation
Mail Server	Exchange Server 2003
Build\Release Version	RTM
	Boot.ini /3GB Userva=3030
Additional Software Tuning	HeapDecommitFreeBlockThreshold=0x40000
Service Pack	SP1
OS Software	Windows Server 2003 Enterprise Edition
Operating System\Version	Version 5.2.3790, Built 3790

(Table 4 continued next page)

Table 4. Test results *(continued)*

Service Pack\Patch Info	None
OS Hot-fixes/patches	Windows Server 2003 Hotfix – KB831464
File System Type	
Other Software	
Network	
Type of Network	NC7782 Gigabit Server Adapter
Network Speed	1000 Mbps
MSL (sec)	
Time-Wait (sec)	

Load Generator configuration

Table 5. Load Generator configuration

# of Load Generators (LG)	8
Total # of LG processes	1
Simulated Users/Process	1-100, 1-900, 5-1000, 1-500
Model	ProLiant BL10e
Processor	900 MHz
# of Processors	1
Memory	1024 MB
Network Controller	NC3163 Fast Ethernet NIC
Operating System	Windows XP Professional

Appendix B – LoadSim changes from previous version

- New user profile – In the Test Properties dialog box of LoadSim 2003, there is a "Cached Mode" profile. The "Cached Mode" profile is an example of which tasks should be enabled to simulate a cached mode user.
- RPC/HTTP– LoadSim 2003 allows simulation of RPC/HTTP deployments in its entirety. You can use the Test/Logon tab to configure your RPC/HTTP settings, including SSL encryption.
- Outlook 2003 specific tasks – In LoadSim 2003, you can use the new "Smart Folders", "Offline Address Book", "Synchronize Folders" tasks to better simulate real-life users.
- Dynamic Distribution Lists – In Topology Properties dialog box of LoadSim 2003, there is a "Dynamic Distribution List" (DDL, also known as Query-Based Distribution Group) group of settings that allow the creation of DDLs. The "Send Mail" task also allows sending mail to DDLs with a desired frequency.
- Rules – In LoadSim 2003, you can populate users with server-side rules and simulate how users create and delete them over time. All LoadSim-created rules are visible and capable of being manipulated by Outlook.
- Profile improvements – The medium and heavy profiles have enhanced simulation capabilities that are disabled by default in MMB2. These improvements include keeping messages open and loading message properties in a consistent manner with Outlook 2003.

Appendix C – MMB2 and MMB3 workload comparison

Table 6. Topology properties

Topology properties	MMB2	MMB3
Security		
Use a separate account for each Exchange user	No	Yes
Use one account for all Exchange users	Yes	Not Tested
Credentials		
Logon to users using their respective accounts	No	No
Distribution Lists		
Use Distribution Lists	Yes	Yes
Number of Distribution Lists per site	100	1000
Distribution List minimum/average/maximum	2/10/20	2/10/20
Dynamic Distribution Lists (DDLs)		
Use DDLs	No	No
Create one for all LoadSim Users	No	No
Create one per MDB	No	No

Table 7. Test Properties

Test Properties	MMB2	MMB3
Tasks		
Send Mail		
Number of times per day	7	8
Priority percent high	1	15
Priority percent low	0	15
Request receipts percent delivery	0	0
Request receipts percent read	0	0
Request receipts percent both	0	0

(Table 7 continued next page)

Table 7. Test properties *(continued)*

Test Properties	MMB2	MMB3
Filename (Weight)		
Oups1k.msg [1]	37	15
Oups2k.msg [1]	18	18
Oups4k.msg [1]	14	16
Oups10kat.msg [1]	0	0
OupsWDatt.msg [1]	7	20
OupsXLatt.msg [1]	7	17
OupsBMobj.msg [1]	10	5
OupsXLobj.msg [1]	0	0
McPP1Matt.msg [1]	1	2
McPP100katt.msg [1]	5	5
McWD2Matt.msg [1]	1	2
Recipients per message	1-5, avg 3	1-5, avg 3
Add a Distribution List to percent message sent	30	30
Add a DDL to percent message sent	0	0
Save a copy in Sent Items	Yes	Yes
Process Inbox		
Read new mail per day	Yes	Yes
Load MAPI Properties as Outlook 2003 does	No	Yes
Apply Random views to Inbox % of the time	Not Tested	75
Message Actions		
Reply	20	45
Reply All	7	5
Forward	10	5
Delete	100	25
Copy	0	0
Move	0	10

[1] All messages were converted to have HTML bodies in LoadSim 2003.

Table 7. Test properties *(continued)*

Test Properties	MMB2	MMB3
Message Actions		
Permanently Delete	0	10
Read note delay minimum/average/maximum	1.0/1.0/1.0	0.0/0.0/0.0
Load percent of attachments	75	95
Accept percent of meeting requests	70	70
Open Messages		
Keep up to messages open after browsing	0	0
Leave messages open % of the time	0	0
Maximum Messages in Folders		
No Limit	No	No
Limit number of messages	125	125
Browse Mail		
Browse mail per day	15	15
Apply Random views to Folders % of the time	Not Tested	75
Open Messages		
Keep up to messages open after browsing	Not Tested	0
Leave messages open % of the time	Not Tested	0
Maximum Messages in Folders		
No Limit	Yes	Yes
Limit number of messages		
Public Folder Post	Not Tested	Not Tested
Browse Public Folders	Not Tested	Not Tested
Free/Busy		
Update schedule times per day	4	4
Update Free/Busy information	No	Yes
Schedule size (KB) minimum/maximum/average	5/40/22	5/40/22

(Table 7 continued next page)

Table 7. Test properties *(continued)*

Test Properties	MMB2	MMB3
Request Meetings		
Make new meetings per day	2	2
Meeting Length (in hours) minimum/average/ maximum	1/2/7	1/2/7
Attendees minimum/average/maximum	1/5/40	1/5/40
Add a Distribution List percent of the time	20	20
Make Appointments		
New appointments per day	4	4
Appt length minimum/average/maximum	1/3/9	1/3/9
Percent recurring appointments	15	15
Percent all day events	5	5
Browse Calendar		
Number of times per day	6	6
Journal Mail Items		
Number of times per day	Not Tested	Not Tested
Journal Applications		
Activity Number of times per day	3	Not Tested
Logoff		
Number of times per day to log off	3	3
Always keep connection	No	No
Empty Deleted Items	Yes	Yes
Browse Contacts		
Number of times per day	10	10
Create contact		
Number times/day to make new contact	1.4	1.4
Smart Folders		
Number of times per day	Not tested	3

(Table 7 continued next page)

Table 7. Test properties *(continued)*

Test Properties	MMB2	MMB3
Actions		
Delete	Not tested	40
Create	Not tested	60
Browse	Not tested	0
Number of Smart Folders (min/max)	Not tested	3/10
Criteria for mail in Smart Folders		
Unread	Not tested	20
Important	Not tested	5
Old Mail	Not tested	5
For follow up	Not tested	10
Conversation with random person or DL	Not tested	5
Unread or for follow up	Not tested	5
Received this week	Not tested	5
From random person or DL	Not tested	20
Large (size)	Not tested	10
Sent to random DL	Not tested	5
With specific word	Not tested	10
Rules		
Number of times per day	Not tested	3
Activities with Rules		
Delete	Not tested	40
Create	Not tested	50
Number of Rules (min/max)	Not tested	0/10
Conditions		
From DL	Not tested	20
From person	Not tested	45
Sent only to me	Not tested	0

(Table 7 continued next page)

Table 7. Test properties *(continued)*

Test Properties	MMB2	MMB3
Conditions		
With word in Subject or body	Not tested	5
Name in To/CC box	Not tested	0
With attachment	Not tested	10
Name not in To Box	Not tested	0
With word in subject	Not tested	20
Actions		
Delete	Not tested	0
Move to Folder	Not tested	100
Copy to Folder	Not tested	0
Forward to Person	Not tested	0
Forward to DL	Not tested	0
Permanently Delete	Not tested	0
Stop processing more rules	Not tested	100
Test/Logon		
Logging on immediately at the very beginning of the test	Yes	Yes
Logging off at the end of each simulated day	Yes	Yes
Empty Deleted Items folder while logging off	Yes	Yes
Test Report: Approximate Message Traffic, per User, per Day		
Total received	185	205
Reply	20.56	46.61
Reply All	6.48	4.78
Forward	10.08	4.78
Total submitted	51	84
Average Number of Recipients per Message (All Messages)	3.63	2.44
Approximate receipts requested, per user, per day		
Read receipts	0	0
Delivery receipts	0	0

Table 8. Initialization properties

Initialization Properties	MMB2	MMB3
Mailbox Setup		
Number of messages in Inbox	55	250
Number of messages in Deleted Items	1	1
Number of new folders	10	5
Messages per new folder	55	200
Number of smart folders	0	3
Number of rules in inbox	0	5
Initialize Free/Busy Information	No	No
Calendar Setup		
Number of appointments	25	25
Contacts Setup		
Number of contacts	64	64

Table 9. Action Weights

Action Weights (for calculating response times)	MMB2	MMB3
Mailbox Setup		
Send	1	1
Read	10	25
Reply	1	3
Reply All	1	3
Forward	1	3
Move	1	5
Delete	3	5
Permanently Delete	0	5
S+ Free/Busy	0	2

(Table 9 continued next page)

Table 9. Test properties *(continued)*

Browse Calendar	1	1
Make Appointment	1	1
Request Meeting	1	1
Create Smart Folder	0	1
Delete Smart Folder	0	1
Create Rule	0	1
Delete Rule	0	1
Apply View/Sort	0	1

For more information

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

HP ActiveAnswers

http://www.hp.com/solutions/activeanswers/exchange

http://www.hp.com/solutions/exchange

Managing and Monitoring Microsoft Exchange Server

Microsoft Exchange Server Performance and Configuration Guide

Implementing High Availability for Microsoft Exchange Server

Microsoft Exchange Server

http://www.microsoft.com/exchange

9/2004