Full Disclosure Report

Microsoft® Exchange Server 2003 MAPI Messaging Benchmark 3 (MMB3)

Category: Single Server

Hardware:	**IBM® @server® BladeCenter® HS20**
Software:	**Microsoft Exchange Server 2003**
Test Profile:	**MAPI Messaging Benchmark 3**
Date Accepted:	**02/09/2005**

Revision History

02/09/2005 – original submission

Executive Summary

IBM @server BladeCenter HS20	
Test results	
MMB3 score	**7,800**
Response time	**346** milliseconds (ms)
CPU utilization	**76.1**
Avg. queue	**80**
Messages submitted	**277976** (4-hour steady state period)
Messages delivered	**723677** (4-hour steady state period)
Messages sent	**277894** (4-hour steady state period)
Server configuration	
CPU	**Intel® Xeon™ 3.6-gigahertz (GHz)**
CPU count	**Two, with Hyper-Threading enabled**
RAM	**4 gigabytes (GB)**
L1 cache	**Instruction: 12 Kilobytes (KB) μops Data: 8 kilobytes (KB)**
L2 cache	**2 megabytes (MB)**
L3 cache	**N/A**
Operating system	**Microsoft® Windows® Server 2003 Enterprise Edition**
Storage	**1) 1 x 36GB 2.5" 10K RPM U320 SCSI disk for Operating system, Active Directory, Paging file, and Exchanger Server system files 2) 143 x 36GB 15K RPM Fiber Channel disk for Exchange Information Store and Transaction log files**
Controller	**1- QLogic Fibre Channel Adapter**
NIC	**1 – Integrated Broadcom NeXtreme Gigabit Ethernet controller**

Results based on 4 hours of steady state running.

Results should be interpreted as a benchmark for messaging throughput and should *not* be confused with deployment recommendations. Factors such as backup/restore, topology and other issues should be considered when planning a deployment. For information on how MMB3 results differ from deployment and configuration information refer to the "Benchmark vs. Production Configuration Disclosure Note" section.

IBM @server BladeCenter HS20

The powerful Intel processor-based blade server delivers uncompromising performance for your mission-critical applications.

Designed to support the Intel® Xeon processor and packed with high-availability features, the IBM @server BladeCenter HS20 delivers density without sacrificing processor performance or availability. Highly scalable and modular in design, the BladeCenter server can XpandonDemand™ — adding capacity only when you need it.

Features

Modular system delivering raw processing power	• Ultra-slim and powerful, blade design delivers high density without sacrificing server processor performance. • Up to 84 servers in an industry-standard rack or up to 80 into a telco-industry-standard 84-inch rack, packaging more performance per square foot and saving you valuable central office and datacenter real estate. • Hot-swappable, designed to allow you to add or change servers without disrupting the operation of others servers in the chassis.
Supports up to two Intel Xeon processors with 800MHz front-side bus	• Equipped with Intel Hyper-Threading technology, the Intel Xeon processor delivers server performance ideal for compute-intensive, next-generation network and IT application workloads. • Select models include a full-performance, lower-power-consuming version of the Xeon processor.
Up to 8GB of DDR2 memory	• DDR2 delivers better memory bandwidth and reduced latency than previous DDR 333. • Error checking and correction offer high performance with mainframe-inspired fault protection. • Reduced power consumption over previous generations.
64-Bit Extensions	• Newer HS20 blade versions support the Intel Xeon processors with EM64T • Provides 64-bit addressability while supporting both 64- and 32-bit applications, allowing for a smooth transition to 64-bit-enabled applications while leveraging the price and performance of existing applications.

Support for up to four hard disk drives	• New versions of the HS20 now support two internal small form factor Ultra320 SCSI hard drives. • Capability of adding two additional hot-swap Ultra320 hard drives with the Blade SCSI Expansion Unit. • Supports up to 4GB flash for flexibility and choice in storage
Integrated dual Gigabit Ethernet connections	• Enabled to transmit large amounts of data at fast speeds for high-performance network applications. • Robust design supports teaming and failover.
Two high-availability mid-plane connections	• Provides durable and reliable connections to all chassis resources.
Blade server interconnects	• Supports an optional two-port (2Gb per port) Fibre Channel Expansion Card (Host Bus Adapter) to deliver a high-performance, highly manageable Storage Area Network. • Supports an optional two-port (1Gb per port) Gigabit Ethernet Expansion Card to enable additional Ethernet bandwidth and allow for connection to multiple LAN segments.
LightPath Diagnostics standard	• Provides quick and easy guide to troubleshoot your server for higher availability and system uptime. • Independently powered, allowing you to remove the server from the chassis and still illuminate the light path LEDs.
Predictive Failure Analysis™ (PFA)	• Helps save you time and money by decreasing planned and unplanned downtime. • Increases uptime by allowing you to receive proactive alerts as much as 24-48 hours in advance.
Integrated System Management Processor	• Increases server availability by continuously monitoring your system and notifying you of potential system failures or changes.

IBM Director and IBM Director Extensions comprehensive systems management tools	• Exploits hardware capabilities by surfacing pertinent information about your system, allowing you to automate a response. • Helps increase uptime, reduce costs and improve productivity via advanced server management capabilities. • Provides intelligent system management for rock-solid reliability. • IBM Remote Deployment Manager simplifies and automates deployment and redeployment for efficient installation and startup of your IBM eServer™ BladeCenter T servers.
Operating System Support	• Microsoft® Windows® 2003 Server, Advanced Server, Web (standard editions) • Red Hat® Enterprise Linux 3.0 - Advanced Server (Carrier Grade) • SUSE® (SLES) 8.0 Linux (Carrier Grade)
3-Year On-Site Limited Warranty1 for parts and labor	• The IBM Global Services organization provides reliable, dedicated and skilled assistance when you need it. • Provides peace of mind for an extended period of time.

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1 Benchmark vs. Production Configuration Disclosure Note

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. This 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 contact a Microsoft or IBM representative.

The MMB3 benchmark does not account for:

- Usage profiles not matching that of the Load Simulator MMB3 profile
- Per-user storage and per-server backup requirements
- Fault-tolerance requirements
- Anti-virus processes and effects on the server
- UBE/UCE (spam) mail flow
- Workloads other than MAPI private folder access, including Public Folder, NNTP, POP3 and other e-mail 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 and fail-over path issues.

2 Test Results

The new MAPI Messaging Benchmark (MMB3) measures throughput in terms of a specific profile of user actions, executed over an 8-hour working day.

This benchmark is different from the "MMB2" setting that was used with Exchange 2000 in that the rate of client requests is significantly greater for the MMB3 profile.

Summary			
Supported Benchmark Load	**7,800** MMB3s		
Benchmark Profile	MAPI Messaging Benchmark 3 (MMB3)		
Protocol	Exchange MAPI		
Length of Steady State	4 Hours		
Length of Test	8 Hours		
Transactions in Total			
Total Messages Submitted	342,375		
Total Message Recipients Delivered	861,118		
Total Messages Sent	342,347		
Message Recipients Delivered / Messages Submitted	2.52		
Total Messages Submitted	342,347		
Transaction Load (per hour)			
Messages Submitted / hour	84,578		
Message Recipients Delivered / hour	212,724		
Messages Sent / hour	84,571		
Transaction Load (per Second)			
RPC Read Bytes / sec	259,906		
RPC Write Bytes / sec	4,765,570		
Processor	**Average**	**Max**	**Min**
% Processor Time	73	100	2
Database	**Average**	**Max**	**Min**
Database cache size	**1,260,726,272**	**1,275,024,816**	**228,139,008**
Table opens/sec	**1,210**	**1,594**	**2**

Memory Utilization	**Average**	**Max**	**Min**
Available Bytes	975	2,843	833
Cache Faults/sec	937	1,193	13
Free System Page Table Entries	9,402	10,352	9,112
Pages / sec	3	608	1
Pool Nonpaged Bytes (Bytes)	53,732,821	54,317,056	50,028,544
Pool Paged Bytes (Bytes)	28,155,791	29,016,064	15,974,400
System Cache Resident Bytes	42,076,832	59,179,008	29,298,688
Transition Faults/sec	12	649	2
MSExchangeIS Mailbox	**Average**	**Max**	**Min**
Folder Opens / sec	31.4	95.1	0.7
Message Opens / sec	82.3	120.1	0
MSExchangeIS Send Queue Average Length	0	0	0
MSExchangeIS Receive Queue Average Length	76	257	0
MSExchangeIS	**Average**	**Max**	**Min**
Active User Count	**665**	**1,189**	**0**
RPC Average Latency (ms)	**16**	**44**	**0**
RPC Num. of Slow Packets	**1**	**9**	**0**
RPC Packets/sec	**1,036**	**1,285**	**0**
RPC Read bytes/sec	**245,176**	**396,809**	**0**
RPC Requests	**17**	**40**	**0**
RPC Operations/sec	**1,753**	**2,238**	**0**
RPC Write bytes/sec	**4,525,781**	**6,561,250**	**0**
TempTable Current	**10**	**31**	**0**
MSExchangeIS VM Largest Block Size	**594,813,968**	**1,031,417,856**	**531,038,208**
MSExchangeIS VM Total 16MB Free Blocks	**4**	**10**	**2**
MSExchangeIS VM Total Free Blocks	**259**	**281**	**176**
MSExchangeIS VM Large Free Block Bytes	**759,835,320**	**2,086,612,992**	**759,835,320**

Paging File	**Average**	**Max**	**Min**
% Usage (_Total)	**1**	**7**	**1**
Processor Utilization	**Average**	**Max**	**Min**
System Processor Utilization (%)	73	100	2
System Processor Interrupts/sec (Total)	7,544	8,769	687
Process % CPU Time - Store	255	336	0
Process % CPU Time - Inetinfo	9	13	0
Exchange server is also domain controller? (yes/no)	Yes		
Process % CPU Time – LSASS (on domain controller)	7	10	0
Handle Count (STORE)	13,799	14,885	2,185
Private Bytes (STORE)	1,724,241,865	1,802,170,368	592,306,176
Virtual Bytes (STORE)	2,439,315,186	2,485,444,608	1,000,000,000
Working Set (STORE)	1,794,606,946	1,883,631,616	9,424,896
Handle Count (Inetinfo)	3,314	3,508	1,090
Private Bytes (Inetinfo)	37,299,603	40,984,576	28,295,168
Virtual Bytes (Inetinfo)	455,872,657	459,157,504	447,836,160
Working Set (Inetinfo)	116,334,037	126,787,584	22,212,608
SMTP Server	**Average**	**Max**	**Min**
Cat: Address lookups completions/sec	78	108	0
Cat: LDAP searches/sec	**7**	**8**	**0**
SMTP Categorizer Queue	**0**	**2**	**0**
DNS Queries/sec	**0**	**0**	**0**
SMTP Local Queue	85	276	0
Messages Currently Undeliverable	0	0	0
Messages Delivered/sec	23	33	0
Messages Received/sec	0	0	0
Messages Sent/sec	0	0	0
NDRs Generated	0	0	0
Remote Queue Length	0	0	0

System	Average	Max	Min
System Processor Queue Length	7	32	0
System Context Switches/Sec	15,674	21,022	2,283
Disk Utilization (Aggregate for Database Logical Disks)	**Average**	**Max**	**Min**
Logical Drive Utilization (%)	4,147	6,914	0
Disk Reads/Sec	3,830	5,193	0
Disk Read Bytes/Sec	18,851,594	26,800,215	0
Disk Writes/Sec	1,443	2,227	0
Disk Write Bytes/Sec	11,109,575	16,057,729	0
Disk Avg. Disk sec / Read	0.033	0.045	0
Disk Avg. Disk sec / Write	0.023	0.039	0
Average Disk Queue Length	41	69	0
Disk Utilization (Aggregate for Transaction Log Logical Disks)	**Average**	**Max**	**Min**
Logical Drive Utilization (%)	30	40	0
Disk Reads/Sec	0	0.084	0
Disk Read Bytes/Sec	2	341	0
Disk Writes/Sec	609	73	0
Disk Write Bytes/Sec	5,394,532	8,363,308	0
Disk Avg. Disk sec / Read	0	0.015	0
Disk Avg. Disk sec / Write	0.001	0.007	0
Average Disk Queue Length	0.307	0.411	0
Network Utilization	**Average**	**Max**	**Min**
Packets Sent/sec	2,227	3,134	1
Packets Received/sec	1,697	2,197	2
Bytes Sent/sec	1,967,420	3,103,194	150
Bytes Received/sec	480,792	688,303	375

2.1 Response Times (Latencies)

Client Actions	95th Percentile Response Time (in milliseconds)
Send	**828**
Read	**219**
Reply	**109**
Reply All	**110**
Forward	**125**
Move	**297**
Delete	**187**
Permanently Delete	**219**
S+ Free/Busy	**125**
Browse Calendar	**266**
Make Appointment	**859**
Request Meeting	**1,422**
Create Smart Folder	**328**
Delete Smart Folder	**750**
Create Rule	**235**
Delete Rule	**313**
Apply View/Sort	**5,531**
Weighted Total	**346**

2.2 Message Throughput

Summary of the MMB3 profile for an 8 hour day:

	Expected	Measured
Messages Submitted/MMB3/Day	**85**	**86.7**
Messages Delivered/MMB3/Day	**210**	**218.2**
Average Recipients per Message	**2.7**	**2.52**

3 Test Configuration

Describe below the configuration of the Exchange Server machines (physical) used for this test. If more then one, they should have an identical configuration.

Hardware	**Exchange Server**	**Domain Controller (if remote)**
Vendor	IBM	
Model	BladeCenter HS20	
Processor	Intel Xeon 3.6GHz	
# of Processors (Physical)	2	
# of Processors (Logical)	4	
Hyper-Threading enabled?	Yes	
Primary Cache	Instruction: 12KB μops Data: 8KB	
Secondary Cache	2MB	
Other Cache	N/A	
Memory	4GB	
Disk Subsystem	1) 1 x 36GB 2.5" 10K RPM U320 SCSI disk for operating system, Active Directory, Paging file, and Exchange Server system files 2) 143 x 36GB 15K RPM Fibre Channel disk for Exchange Information Store and Transaction log files	
Disk Controllers	1- QLogic Fibre Channel Adapter	
Other Hardware	1 – Integrated Broadcom NeXtreme Gigabit Ethernet controller	
Mail Software	**Exchange Server**	**Domain Controller (if remote)**
Vendor	Microsoft Corporation	n/a
Mail Server	Exchange Server	n/a
Release Version	**2003**	n/a

Operating System	Exchange Server	Domain Controller (if remote)
OS Version	Microsoft Windows Server 2003 Enterprise Edition	
Service Pack	SP1	
OS Hot-fixes/patches		
File System Type	NTFS	
Network	**Exchange Server**	**Domain Controller (if remote)**
Type of Network	Ethernet	
Network Speed	1 Gbit	
TCP/IP Offload/Checksum	Yes	
PCI Flow Control?	n/a	
Interrupt Coalescing?	n/a	

3.1 Load Generator Configuration

This section holds all the configuration parameters of the load generator machines used in the test.

# of Load Generators (LG)	14
Total # of LG processes	7,800
Simulated Users/Process	1 control client with 50 users 13 clients with 600 users each 1 client with 550 users
Model	IBM eServer xSeries 330
Processor	Intel Pentium™ III 933MHz
# of Processors (Physical)	1
# of Processors (Logical)	0
Hyper-Threading enabled?	N/A
Memory	1GB
Network Controller	Integrated IBM 10/100 Ethernet Adapter
Network Bandwidth	100 Mbit
Operating System	Microsoft Windows Server 2003 Enterprise Edition

4 Additional Configuration and Tuning

Describe below in items any modifications done to the Exchange Server(s) and the server/client operating systems. These modifications include but are not restricted to performance tuning changes like registry keys and boot.ini settings. All modifications must be approved by Microsoft prior to the testing and submission of the MMB3 result.

Boot.ini Modifications:
/3GB
/userva=3030

Registry Changes:
HeadDeCommitFreeBlockThreshold=0x00040000