Full Disclosure Report

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

Category: Single Server

Hardware: **IBM® @server® xSeries® 366**
Software: **Microsoft Exchange Server 2003**
Test Profile: **MAPI Messaging Benchmark 3**
Date Accepted: **06/14/2005**

Revision History

06/14/2005 – original submission

Executive Summary

IBM®@server xSeries 366	
Test results	
MMB3 score	**10,600**
Response time	**357** milliseconds (ms)
CPU utilization	**73.6**
Avg. queue	**99**
Messages submitted	**455,174** (4-hour steady state period)
Messages delivered	**1,137,061** (4-hour steady state period)
Messages sent	**455,053** (4-hour steady state period)
Server configuration	
CPU	**Intel® Xeon™ 3.6-gigahertz (GHz)**
CPU count	**Four, with Hyper-Threading enabled**
RAM	**8 gigabytes (GB)**
L1 cache	**Instruction: 12 Kilobytes (KB) μops Data: 8 kilobytes (KB)**
L2 cache	**1 megabytes (MB)**
L3 cache	**N/A**
Operating system	**Microsoft® Windows® Server 2003 Enterprise Edition**
Storage	**1) 1 x 36GB 2.5" 10K RPM SAS disk for Operating system, Active Directory, Paging file, and Exchanger Server system files 2) 303 x 36GB 15K RPM Fiber Channel disk for Exchange Information Store and Transaction log files**
Controller	**5- 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 xSeries 366

The IBM @server x366 is the third-generation of IBM's leadership 3U rack-optimized high performance 4-way server delivering an industry-leading combination of breakthrough x86 performance, enhanced mission-critical availability, and 64-bit compatibility to unlock competitive advantage in your application-serving tier. The x366 is the first xSeries system based upon the IBM @server X3 architecture, the third generation of mainframe-inspired IBM Enterprise X-Architecture™ Technology. Driving mission-critical applications including Enterprise Resource Planning, collaboration or custom-developed, Java®-based applications like IBM WebSphere® software, the x366 excels at performing transaction-intensive, traditional back-office functions.

Powered by the IBM XA-64e™ third-generation Enterprise X-Architecture chipset, the x366 will deliver exceptional 64-bit 4-way performance on either 32-bit or 64-bit applications. The x366 is also the first-to-market industry-standard x86 server powered by the latest 64-bit Intel Xeon MP processor delivering the reliability of the Intel Xeon processor architecture on a dual-core capable, 64-bit compatible application workhorse. More simply put, the x366 changes the game for 64-bit computing by delivering high performance and high availability on a mainstream, industry-standard x86 server platform.

Features

Highest performing 4-way Intel-based x86 server in the world!	• Accelerate your migration to an on-demand business with the leading commercial application-serving workhorse for Windows or Linux • Leadership x86 performance for 32-bit or 64-bit database, ERP, and Java™-based enterprise applications captured in IBM's third-generation 3U rack-dense industry-standard server design • With performance headroom to spare, the x366 is optimized for virtualization to lower costs through server consolidation • The x86 development platform of choice for the migration to mainstream 64-bit and the future of multi-core processing
IBM XA-64e™ 3rd generation chipset	• Unleashing the power of the IBM eServer X3 architecture: the third-generation of IBM's Enterprise X-Architecture™ design • Leadership performance with an integrated processor/memory controller reducing latencies by almost 3X over the previous generation • Dual 667MHz front-side bus architecture offers 3X the performance bandwidth of the x365 and greater reliability over alternative x86

	architectures • Simultaneous compatibility for 64-bit and legacy 32-bit applications plus dual-core capability providing headroom and investment protection
64-bit Intel Xeon MP	• First-to-market with the next-generation 64-bit Intel Xeon processor MP up to 3.66GHz with 1MB level-2 cache powering break-through 4-way performance up to 38% higher than the x365 (as measured by tpmC) • Support for Extended Memory 64 Technology (EM64T) that introduces 64-bit memory addressability into the mainstream x86 server market • Faster execution with hyper-threading technology based upon the Intel NetBurst™ micro-architecture that supports execution of multiple programs or threads within a single processor
XceL4v™ Dynamic Server Cache	• Virtual level-4 cache leverages an IBM-exclusive integrated snoop filter to minimize front-side bus congestion and maximize CPU performance, a key ingredient for higher performance on the new dual front-side bus architecture • Intelligent caching dramatically reduces system latencies to improve performance, as illustrated by the industry-leading benchmarks of the x366
Application & OS Flexibility	• The high-performance 64-bit solution for database, ERP, and server consolidation with support for legacy 32-bit applications • The leading x86-64 server platform for Windows application deployments supporting Microsoft Windows Server 2003 (32-bit and x64) as well as Windows 2000 • 64-bit Enterprise Linux support with Red Hat Enterprise Linux AS and SUSE LINUX Enterprise Server • Support for industry-leading virtualization applications including VMware ESX Server 2.5.1 for server consolidation and logical partitioning of up to 80 virtual servers
Up to 64GB DDR2 ECC SDRAM, 2GB standard	• Lowering cost without sacrificing availability, the x366 supports Chipkill and Memory ProteXion™ standard at no additional cost using off-the-shelf industry-standard DIMMs for the detection and

	correction of single-bit and double-bit memory errors • OS-independent, Hot-swap memory enables the replacement of failed DIMMs while the system is still running to maximize availability of this mission-critical server • Hot-add memory supported with Microsoft Windows Server 2003 powers the dynamic addition of main memory to increase performance • Memory mirroring dramatically reduces unscheduled downtime for memory failures through high availability redundant memory banks • IBM-exclusive Memory ProteXion™ uses spare bits for redundancy that re-route data around a failed chip on a DIMM in the event of a failure
Six Active™ PCI-X 2.0 slots standard	• "First to market with support for PCI-X 2.0, the new specification standard for high performance server I/O with backward compatibility for legacy PCI-X and PCI adapters • Quad-bus I/O southbridge of the XA-64e chipset supports all six slots up to the maximum 266MHz matching the performance of PCI-E 4x • High availability hot-swap and hot-add capability
Serial Attached SCSI (SAS)	• "First to market with support for internal serial attached SCSI, the latest in high performance, enterprise-reliable server storage • Support for up to six hot-swap 2.5" SAS hard disk drives for a maximum of 440GB of internal storage • Easily upgrade to hardware-based RAID-0, 1, or 5 without consuming a PCI slot with the high performance ServeRAID 8i for SAS
'Connection-grade' proven reliability & Systems Management	• Analogous to 'carrier-grade,' the x366 is the industry's first 'connection-grade' server for the commercial enterprise market delivering proven reliability and data integrity for database transactions • Complete N+N and hot-swap redundancy in all key subsystems mitigates downtime in the event of a power supply, cooling fan or memory failure • Light path diagnostics provides a lighted path to

	failed or failing components starting with the front-accessible, drop-down Light Path panel to expedite hardware repairs and reduce service time • Predictive Failure Analysis® provides proactive monitoring of critical system components enabling scheduled maintenance on processors, power supplies, memory, hard drives, or fans (more components than any competitive system) before a failure results in downtime • Support for IPMI standard with upgradeability to the more robust Remote Supervisor Adapter II Slimline for more advanced remote systems management • Award-winning IBM Director software marries hardware-based monitoring with comprehensive systems analysis and alerting
Three-year on-site warranty	• Flexible three-year limited warranty for parts and labor with 9x5 next business day response, upgradeable to 24x7, same business day, and 4-hour response

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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	**10,600** 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	455,174		
Total Message Recipients Delivered	1,137,061		
Total Messages Sent	455,053		
Message Recipients Delivered / Messages Submitted	2.50		
Total Messages Submitted	455,174		
Transaction Load (per hour)			
Messages Submitted / hour	112,219		
Message Recipients Delivered / hour	280,333		
Messages Sent / hour	112,189		
Transaction Load (per Second)			
RPC Read Bytes / sec	353,565		
RPC Write Bytes / sec	6,457,120		
Processor	**Average**	**Max**	**Min**
% Processor Time	70	90	0
Database	**Average**	**Max**	**Min**
Database cache size	**1,241,513,984**	**1,241,513,984**	**1,000,000,000**
Table opens/sec	**1,651**	**2,240**	**0**

Memory Utilization	**Average**	**Max**	**Min**
Available Mbytes	1,294	1,987	1,170
Cache Faults/sec	1,276	2,453	0
Free System Page Table Entries	18,296	19,330	17,890
Pages / sec	2	63	0
Pool Nonpaged Bytes (Bytes)	36,897,949	37,904,384	31,752,192
Pool Paged Bytes (Bytes)	39,499,311	40,472,576	22,863,872
System Cache Resident Bytes	48,472,581	79,360,000	34,570,240
Transition Faults/sec	7	506	0
MSExchangeIS Mailbox	**Average**	**Max**	**Min**
Folder Opens / sec	42.8	627.6	0
Message Opens / sec	109.7	149.5	0
MSExchangeIS Receive Queue Average Length	0	0	0
MSExchangeIS Send Queue Average Length	99	270	0
MSExchangeIS	**Average**	**Max**	**Min**
Active User Count	1,048	1,796	53
RPC Average Latency (ms)	18	40	3
RPC Num. of Slow Packets	1	9	0
RPC Packets/sec	1,416	1,887	0
Read bytes RPC Clients/sec	336,391	522,883	6
RPC Requests	25	44	0
RPC Operations/sec	2,384	3,008	0
Write bytes RPC Clients/sec	6,164,465	8,879,266	0
TempTable Current	13	40	0
MSExchangeIS VM Largest Block Size	533,095,873	551,223,296	530,644,992
MSExchangeIS VM Total 16MB Free Blocks	2	6	2
MSExchangeIS VM Total Free Blocks	280	292	273
MSExchangeIS VM Large Free Blocks Bytes	570,558,418	664,641,536	558,931,968

Paging File	**Average**	**Max**	**Min**
% Usage (_Total)	1	1	1
Processor Utilization	**Average**	**Max**	**Min**
System Processor Utilization (%)	70	90	0
System Processor Interrupts/sec (Total)	15,522	19,107	0
Process % CPU Time - Store	489	623	0
Process % CPU Time - Inetinfo	14	19	0
Exchange server is also domain controller? (yes/no)	Yes		
Process % CPU Time – LSASS (on domain controller)	12	42	0
Handle Count (STORE)	17,468	18,558	3,885
Private Bytes (STORE)	1,867,140,425	1,956,851,712	1,000,000,000
Virtual Bytes (STORE)	2,477,359,319	2,499,035,136	1,000,000,000
Working Set (STORE)	1,973,414,004	2,065,625,088	1,000,000,000
Handle Count (Inetinfo)	3,881	4,082	1,254
Private Bytes (Inetinfo)	41,357,848	45,981,696	29,618,176
Virtual Bytes (Inetinfo)	555,789,500	561,647,616	525,254,656
Working Set (Inetinfo)	151,191,771	162,643,968	31,698,944
SMTP Server	**Average**	**Max**	**Min**
Cat: Address lookups completions/sec	105	133	0
Cat: LDAP searches/sec	9	11	0
SMTP Categorizer Queue	0	3	0
DNS Queries/sec	0	0	0
SMTP Local Queue	109	290	0
Messages Currently Undeliverable	0	0	0
Messages Delivered/sec	31	40	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	4	36	0
System Context Switches/Sec	30,236	37,796	0
Disk Utilization (Aggregate for Database Logical Disks)	**Average**	**Max**	**Min**
Logical Drive Utilization (%)	4,748	7,516	0
Disk Reads/Sec	8,656	11,948	0
Disk Read Bytes/Sec	40,699,311	56,970,127	0
Disk Writes/Sec	2,374	3,189	0
Disk Write Bytes/Sec	16,678,707	22,290,316	0
Avg. Disk sec / Read	0.02	0.024	0
Avg. Disk sec / Write	0.004	0.011	0
Average Disk Queue Length	48	75	0
Disk Utilization (Aggregate for Transaction Log Logical Disks)	**Average**	**Max**	**Min**
Logical Drive Utilization (%)	27	33	0
Disk Reads/Sec	0	0.1	0
Disk Read Bytes/Sec	4	410	0
Disk Writes/Sec	991	1,254	0
Disk Write Bytes/Sec	7,918,681	11,223,071	0
Avg. Disk sec / Read	0	0.018	0
Avg. Disk sec / Write	0	0	0
Average Disk Queue Length	0.271	0.326	0
Network Utilization	**Average**	**Max**	**Min**
Packets Sent/sec	3,049	4,270	0
Packets Received/sec	2,306	4,098	0
Bytes Sent/sec	2,667,796	4,131,496	0
Bytes Received/sec	657,203	951,757	0

2.1 Response Times (Latencies)

Client Actions	95th Percentile Response Time (in milliseconds)
Send	**875**
Read	**235**
Reply	**109**
Reply All	**110**
Forward	**125**
Move	**297**
Delete	**188**
Permanently Delete	**203**
S+ Free/Busy	**156**
Browse Calendar	**313**
Make Appointment	**922**
Request Meeting	**1,562**
Create Smart Folder	**313**
Delete Smart Folder	**609**
Create Rule	**281**
Delete Rule	**343**
Apply View/Sort	**5,562**
Weighted Total	**357**

2.2 Message Throughput

Summary of the MMB3 profile for an 8 hour day:

	Expected	Measured
Messages Submitted/MMB3/Day	**85**	**84.7**
Messages Delivered/MMB3/Day	**210**	**211.6**
Average Recipients per Message	**2.47**	**2.50**

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	X366	
Processor	Intel Xeon 3.6GHz	
# of Processors (Physical)	4	
# of Processors (Logical)	8	
Hyper-Threading enabled?	Yes	
Primary Cache	Instruction: 12KB μops Data: 8KB	
Secondary Cache	1MB	
Other Cache	N/A	
Memory	8GB	
Disk Subsystem	1) 1 x 36GB 2.5" 10K RPM SAS disk for operating system, Active Directory, Paging file, and Exchange Server system files 2) 303 x 36GB 15K RPM Fibre Channel disk for Exchange Information Store and Transaction log files	
Disk Controllers	5- 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	Windows Server 2003 SP1 and Exchange Server 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)	18
Total # of LG processes	10,600
Simulated Users/Process	1 control client with 99 users 13 clients with 650 users each 1 client with 651 users 1 client with 200 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

Exchange Server Cache Size Setting:
msExchESEParamCacheSizeMax=303104