

NotesBench Disclosure Report
for
IBM Netfinity 7600
using
Lotus Domino Server 5.01b
and
Windows NT Server 4.0 Enterprise Edition

Results Certified April 14, 2000



IBM Corporation

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Edition Notice

Executive Summary

The IBM Netfinity* 7600 server demonstrated leadership performance running Lotus** Domino** Server Release 5.01b on Microsoft** Windows** NT Server 4.0 Enterprise Edition (with Service Pack 6). The Netfinity 7600 achieved the highest number of R5Mail users recorded to date on a single instance of a Domino server at a very attractive price/performance point.

The results detailed in this report were obtained using the NotesBench R5Mail-Only workload.

Test Script	Maximum Users	NotesMark (tpm)	Ave. Response Time (sec)	\$/User	\$/NotesMark
R5Mail-Only	10,045	13,916	0.104	\$7.83	\$5.65

The IBM Netfinity 7600 server was configured with four 550MHz¹ Intel** Pentium** III Xeon** processors, 4GB² of memory, and 37 hard disk drives. All configuration details are provided in Appendix A: Overall Test Setup and Software Versions.

The server under test supported an R5Mail-Only workload of 10,045 active mail users (see price/performance results³ above). The Domino Directory contained more than 20,100 person entries.

IBM's Netfinity Server Performance Laboratory in Research Triangle Park, NC, conducted the benchmark in March, and KMDS Technical Associates, Inc., audited the results in April 2000.

NotesBench provides an objective method for evaluating the performance of different platforms running Lotus Domino Server. NotesBench generates a transactions-per-minute (tpm) throughput metric, called a NotesMark, for each test, along with a value for the maximum capacity (number of users) supported, and the average response time.

Benchmarking Objectives

The benchmark objective was to provide customers with information on how to fully utilize the capability of the IBM Netfinity 7600 system as a Domino Server 5.01b mail server configured with the Netfinity ServeRAID Ultra2 SCSI Adapter for RAID-1 data redundancy.

¹ MHz only measures microprocessor internal clock speed, not application performance. Many factors affect application performance.

² When referring to hard drive capacity, GB stands for one thousand million bytes. Total user-accessible capacity may vary depending on operating environments.

³ The price/performance results are based on IBM's Estimated Reseller Price. IBM resellers set their own prices, and actual prices may vary.

Test Methodologies

Test Setup and Hardware/Software Configuration

The IBM Netfinity 7600 system under test (SUT) was configured with four 550MHz Pentium III Xeon processors (2MB of L2 write-back cache per processor), 4GB of memory, thirty seven 9.1GB 10K rpm hard disk drives, an integrated Ethernet controller, one Netfinity 10/100 Fault Tolerant Adapter. Each of seven RAID-1 arrays, which contained the mail files, was connected to a channel on one of three Netfinity ServeRAID-3HB Ultra2 SCSI Adapters. A detailed description of the configuration of the RAID-1 arrays is provided in Appendix A.

The network consisted of two LAN segments. The LAN segments, each consisting of one 12-port SuperStack 10/100 Hub, were configured as follows:

- Segment 1 connected port 1 on the SUT to child drivers 1, 3, 5, 7, 9, parent2 port 1.
- Segment 2 connected port 2 on the SUT to child drivers 2, 4, 6, 8, 10, parent2 port 2.

The IBM Netfinity 7600 system under test ran Microsoft Windows NT Server 4.0 Enterprise Edition with Service Pack 6 with hotfixes and Domino Server 5.01b.

The RAID controller configuration value for Stripe Unit Size was set at 16KB. Write-back cache was enabled for all RAID-1 arrays.

The following NOTES.INI parameters were modified as recommended in the NotesBench operator's manual.

R5Mail-Only Workload
Server_Max_Concurrent_Trans=1000
NSF_DBCache_MaxEntries=10100
SetMailLogToEventsOnly=1
Log_MailRouting=10
Log_Sesions=0
Mail_Number_Of_MailBoxes=2
Server_Pool_Tasks=100
Max_Users=10100
MailUseProcesses=0

The following parameters were added to suppress database activity logging after long runs and to capture server console output:

```
No_Force_Activity_Logging=1
Server_Show_Performance=1
Debug_Outfile=\\nbtest1\lastrun\SUTINFO.TXT
```

All Notes server tasks were disabled except Router.

All Domino data files and mail file links were located on the D: partition of a two-drive RAID-1 array. The Domino executables were located on the C: partition of the same two-drive RAID-1 array. The actual mail files were distributed among the 7 five-drive RAID-1 arrays (E:, F:, G:, H:, I:, J:, and K:).

Test Procedures

Several trial runs were conducted starting with a single Domino server to attempt to exhaust at least one of the system resources (i.e., processor, memory or disk subsystem). When average user response time reached an unacceptable level before any one of these resources had been fully utilized, an additional disk array was installed. System resource utilization was monitored using Windows NT Performance Monitor (PERFMON), which enabled the system configuration to be optimized while balancing system resources.

The 10,045 users were distributed across 10 clients. Clients 1-9 each added 1,004 users, and client 10 added 1,009 users to the system under test. The test ran at steady state for almost 7 hours.

The actual ramp-up period from startup of child 1 to the point when all 10,045 users were shown on the server console was approximately 3 hours. The test ran for almost 7 hours after ramp-up. During the test runs, the tools used to determine steady state included the child driver RES files, Notesizer command outputs, and Domino Server statistics output to the server console on a minute-by-minute basis.

To confirm steady state, we verified the number of users at the server and its logs. We confirmed steady state when the number of users on the SUT Domino Server console reached the intended number of users. We also used the Show Stat Mail command on the server to verify that at least 90 percent of the mail generated during the test period was delivered to the local mail databases during the test period. In fact, during the test period, the SUT Domino Server delivered more than 99.9 percent of the mail generated to the local mail databases.

To ensure that the test results were reproducible, all tests were repeated, and the results were compared and were found to be consistent.

ChildStagger in Minutes

The ChildStagger parameter is set between 10 to 21 minutes in the PARENT.INI files.

ThreadStagger in Seconds

Child 1 through child 10 each had a different setting for the ThreadStagger value. This parameter varied from ½ second to 1-1/2 second. The purpose of the ThreadStagger value is used to help balance the workload during the initialization phase of the test.

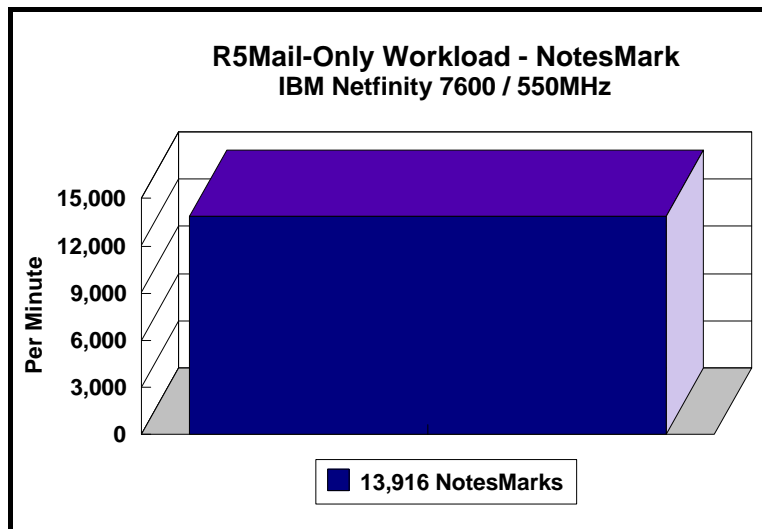
Other NotesBench Scripts

IBM intends to continue conducting NotesBench measurements to further optimize and exploit the performance capability of the Netfinity product line running Domino Server 5.01b.

Data

IBM Netfinity 7600 NotesMark Value for R5Mail-Only Test

The IBM Netfinity 7600 server demonstrated that it can support 10,045 concurrent active users with this workload. The NotesMark throughput value was 13,916. Average response time was 0.104 seconds. The test ran error-free for nearly 7 hours.



The R5Mail workload executes Notes transactions that model a server for mail users at sites that rely only on mail for communication. The resulting capacity metric for a mail-only server is the maximum number of users that can be supported before the average user response time becomes unacceptable.

The Domino R5Mail-Only test script models an active user who is reading and sending mail. The script contains an average of 15 minutes of waiting; thus, the average user would execute this script a maximum of four times each hour. For each iteration of the test script, there are 5 documents read, 2 documents updated, 2 documents deleted, 2 documents added, 1 view scrolling operation, 1 database opened and closed, 1 view opened and closed, looking up of recipients and sending an invitation every 30 minutes, as well as some miscellaneous operations. In sending messages, each user creates and sends a mail message to NumMessageRecipients no more frequently than every 90 minutes. About every 90 minutes, each user creates a meeting invitation and responds to an invitation.

All R5Mail users access the name and address book, which resides on the SUT. All mail is delivered locally. With R4Mail, all users access a local name and address book, and mail is routed to destination servers. R5Mail message size is 10 times larger than R4Mail message size, and the name and address directory contains twice as many entries as the number of concurrent users.

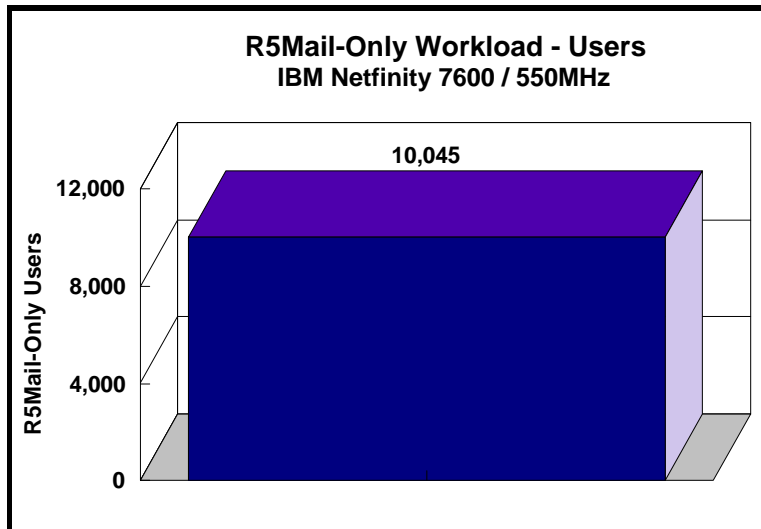
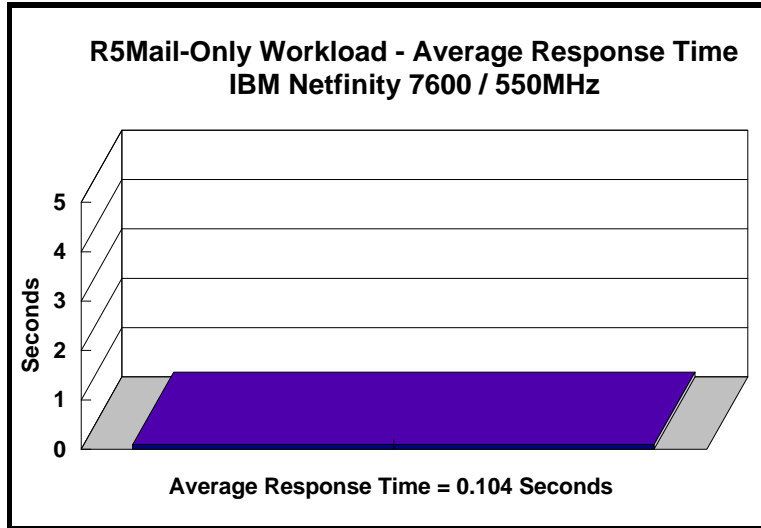
NotesNum Output for R5Mail-Only Test

Min Start Time = 03/24/2000 11:51:39 AM Max Stop Time = 03/24/2000 09:54:22 PM

Total Test Errors = 0

Total Test Time = 36180 sec

Test Run: Users = 10045 NotesMark = 13916 Response Time = 104 msec (03/24/2000 02:48:00 PM to 03/24/2000 09:41:00 PM)



Analysis

When configured optimally as described in this report, the IBM Netfinity 7600 server demonstrated that it can manage the intense resource usage that occurred during ramp-up to 10,045 concurrent R5Mail users with no errors at the clients.

Steady-State Performance Statistics

During steady state, the following PERFMON measurements were noted:

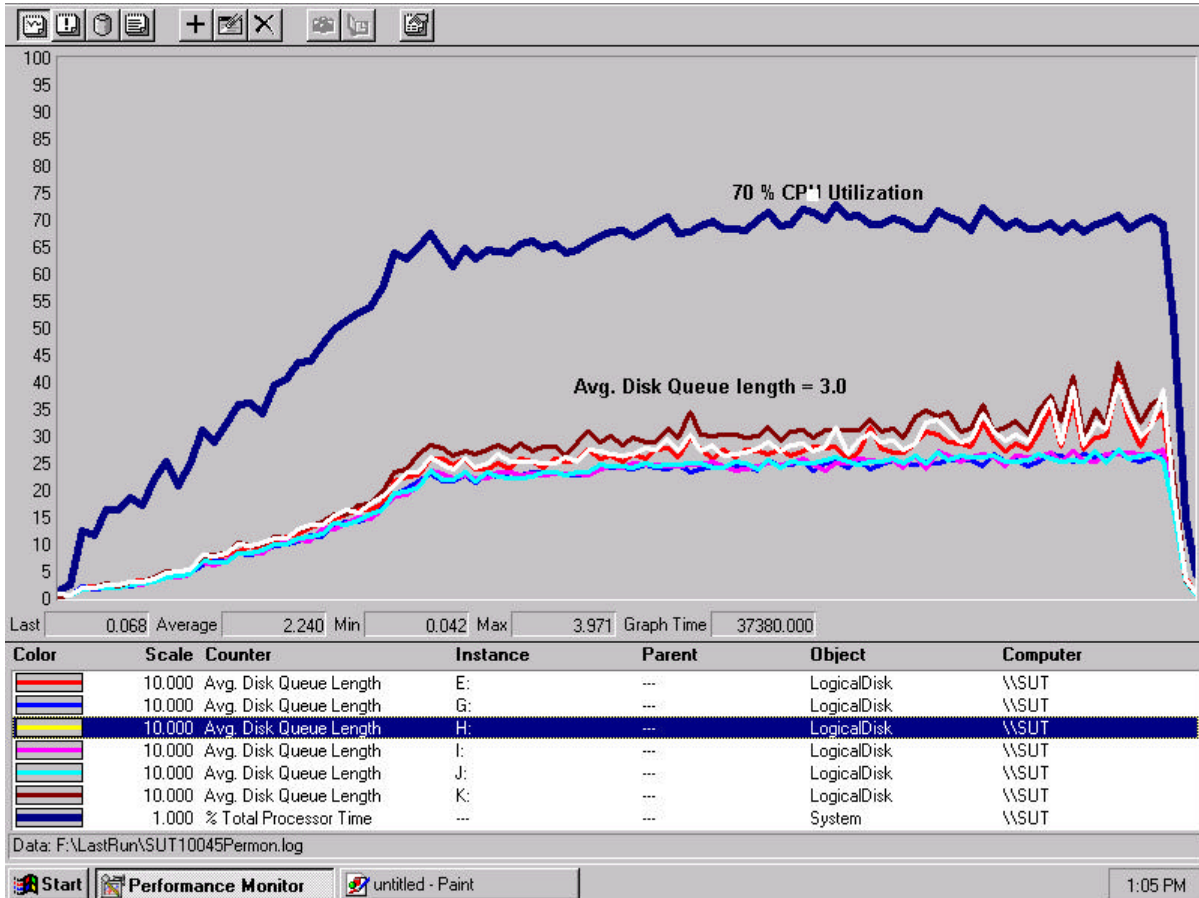
- Percentage of System Total Processor Utilization
 - Average: 70%
- Amount of Available Memory
 - Average: 1.66GB
- Average Disk Queue Length for Each Array (E:, F:, G:, H:, I:, J:, K:) ranged from 2.55 to 3.0
- Average Percentage of Free Disk Space available for each disk array was 5.6GB.
- I/O Statistics for a Data Array
 - Average I/O rate: 234 I/Os per second
 - Average Transfer Size: 12KB

Domino Server 5.01b allowed the use of multiple arrays to off-load user mail databases from the standard notes\data subdirectory. It provides load-balancing capability without the complication of setting up Domino partitioned servers.

The transaction logging option was not enabled for this audit run. When this option is enabled, we recommend placing the transaction logging directory on a dedicated disk that is attached to a less-busy adapter on a less-busy PCI bus to improve response time.

The PERFMON screen capture below shows that:

- Average processor utilization during ramp-up was slightly higher than processor utilization after ramp-up.
- Available memory decreased during ramp-up and increased during ramp-down.
- Queue lengths for disk I/O fluctuated during the run.



Conclusions

The test results demonstrate that the IBM Netfinity 7600 configured as a dedicated Domino server, can support up to 10,045 concurrent, active R5Mail-Only users with a response time well below that permitted by the test criteria.

The addition of other application workloads will affect the number of users supported as well as the response time. Achieving optimum performance in a customer environment is highly dependent upon selecting adequate processor power, memory and disk storage as well as balancing the configuration of that hardware and appropriately tuning the operating system and Domino software.

By taking advantage of the expansion capability of the Netfinity 7600 (e.g., 8GB, 64-bit PCI), the system can accommodate not only a high number of mail users but also additional Domino server tasks and other applications.

Statement by Auditor

The original “Lotus NotesBench Test Results Report Certification Letter” was signed by Daryl K. Thompson, NotesBench Auditor for KMDS Technical Associates, Inc., and is on file at IBM.

Appendix A: Overall Test Setup and Software Versions

Number of Client Systems

Eleven driver systems were used. Ten of those systems were configured as client driver systems and one as the parent (source driver).

The client drivers were IBM IntelliStation M Pro systems, each configured with one 400MHz Pentium II processor. Each client driver was configured with 256MB of memory, one 8.4GB hard disk, and one IBM 10/100 Ethernet PCI Adapter.

The disk configuration used for the client systems is as follows:

- C: Partition (786MB - NTFS) - Windows NT Workstation 4.0
- D: Partition (7.2GB - NTFS) - Notes Client 5.02c

Number of Server Platforms

One server platform, the IBM Netfinity 7600 with four 550MHz Pentium III Xeon processors and 4GB of memory was benchmarked.

The disk configuration used for the system under test is as follows:

- C: Single disk drive (4.GB - NTFS) - Windows NT Server Version 4.0 EE (Boot Partition) and Domino Server 5.01b executables
- D:Partition (5GB - NTFS) - Domino server data and mail link files
- E: Partition (22.5GB - NTFS) - Domino mail files
- F: Partition (22.5GB - NTFS) - Domino mail files
- G: Partition (22.5GB - NTFS) - Domino mail files
- H: Partition (22.5GB - NTFS) - Domino mail files
- I: Partition (22.5GB - NTFS) - Domino mail files
- J: Partition (22.5GB - NTFS) - Domino mail files
- K:Partition (22.5GB - NTFS) - Domino mail files

Network

The network consisted of two LAN segments. The LAN segments, each consisting of two 12-port SuperStack 10/100 Hubs, were configured as follows:

- Segment 1 connected port 1 on the SUT to child drivers 1, 3, 5, 7, 9, parent2 port1.
- Segment 2 connected port 2 on the SUT to child drivers 2, 4, 6, 8, 10, parent2 port 2.

Software Versions

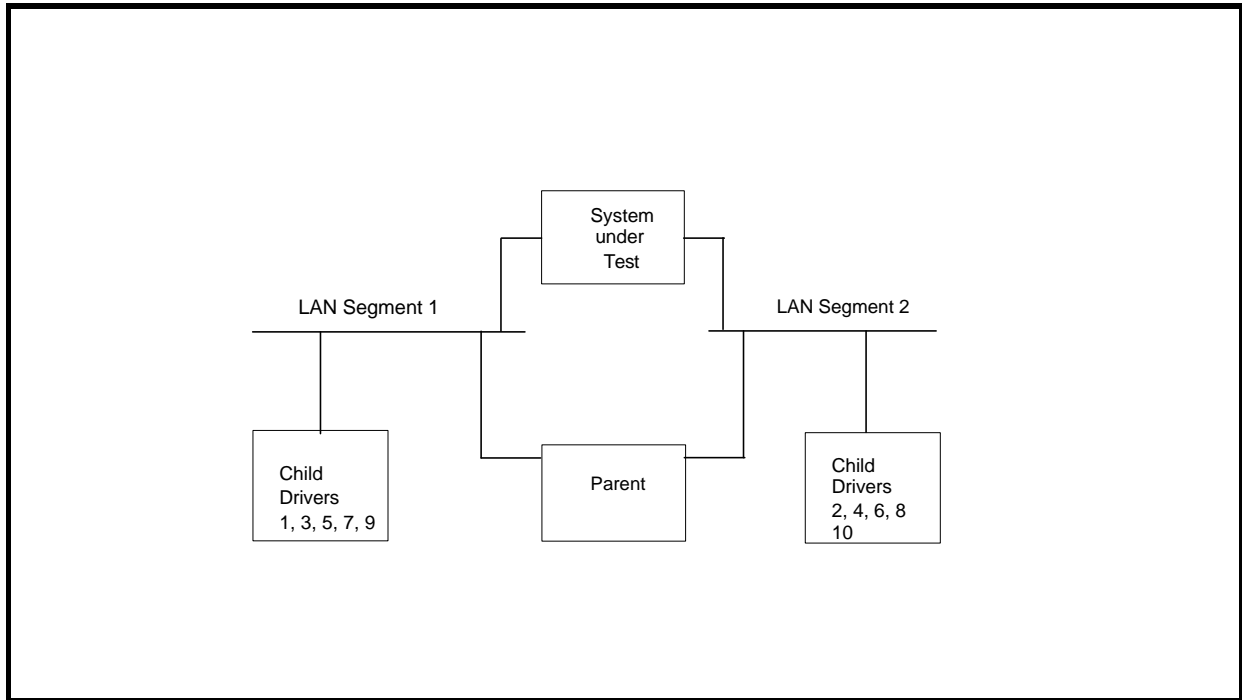
Software versions used on the system under test were as follows:

- Microsoft Windows NT Server 4.0 Enterprise Edition and Service Pack 6 with hotfixes
- Lotus Domino Server Release 5.01b
- NotesBench Version 5.0 - Windows/32, released March 12, 1999

Software versions used on the child and parent drivers were as follows:

- Microsoft Windows NT Workstation 4.0 and Service Pack 6 with hotfixes
- Lotus Domino Client Release 5.02c for Windows NT
- NotesBench Version 5.0 - Windows/32, released March 12, 1999

Test Setup



Configuration

System Under Test	Child Drivers 1-10	Parent Source Driver
IBM Netfinity 7600	IBM IntelliStation M Pro	IBM Personal Computer 750
4x 550MHz Pentium III Xeon Processor	1 x 400MHz Pentium Pro Processor	1 x 100MHz Pentium Processor
4.0GB Memory	256MB Memory	128MB Memory
2 x 9.1GB Drives (RAID-1 boot and code array) 35 x 9.1GB Drives (7 RAID-1 mail arrays)	1 x 8.4GB Drive	1 x 4.51GB Drive
3 x ServeRAID-3HB Ultra2 SCSI Adapter		
1 x Netfinity 10/100 Ethernet PCI Adapter 1 x integrated 10/100 Ethernet Controller	1 x Intel EtherExpress 10/100 PCI TX Adapter	1 x Intel EtherExpress 10/100 PCI TX Adapter
Windows NT Server 4.0 Enterprise Edition with Service Pack 6 and Hot Fixes	Windows NT Workstation 4.0 with Service Pack 6 and Hot Fixes	Windows NT Workstation 4.0 with Service Pack 6 and Hot Fixes

Appendix B: System Configurations

Server under Test	
System	IBM Netfinity 7600
Processor	4 x 550MHz Pentium III Xeon with 2MB L2 Cache
Memory	4GB
Cache	2MB L2 Write-Back Cache per Processor
RAID Controller	3 x Netfinity ServeRAID-3HB Ultra2 SCSI Adapter
Disk Drive	2 x 9.1GB Drives (RAID-1 boot and code array) 35 x 9.1GB Drives (7 RAID-1 mail arrays)
Network Interface	1 x Netfinity 10/100 Ethernet PCI Adapter; 1 x integrated 10/100 Ethernet Controller
I/O	PCI Bus
Operating System	Microsoft Windows NT Server 4.0 Enterprise Edition with Service Pack 6 and Hot Fixes
Notes	Lotus Domino Server Release 5.01b for Windows NT
NotesBench	NotesBench for Domino 5.0 - Windows/32, released March 12, 1999

Clients 1-10	
System	IBM IntelliStation M Pro
Processor	1 x 400MHz Pentium II Processor
Memory	256MB
Disk Drive	1 x 8.4GB
Network Interface Adapter	1 x 10/100 Ethernet PCI Adapter
I/O	PCI Bus
Operating System	Microsoft Windows NT Workstation 4.0 with Service Pack 6 and hotfixes
Notes	Notes Client Release 5.02c for Windows NT Workstation 4.0
NotesBench	NotesBench for Domino 5.0 - Windows/32, released March 12, 1999

Parent Source Driver	
System	IBM Personal Computer 750
Processor	1 x 100MHz Pentium Processor
Memory	128MB
Disk Drive	1 x 4.51GB
Network Interface Adapter	IBM 10/100 Ethernet PCI Adapter
I/O	PCI Bus
Operating System	Microsoft Windows NT Workstation 4.0 with Service Pack 6 and hotfixes
Notes	Notes Client Administrator Release 5.02c for Windows NT Workstation 4.0
NotesBench	NotesBench for Domino 5.0 - Windows/32, released March 12, 1999

Appendix C: Operating System Parameters

In the system under test, the following registry variables were changed from their default values of 2 to 0:

HKEY_LOCAL_MACHINE/System/CurrentControlSet/Control/PriorityControl\Win32PrioritySeparation:
REG_DWORD:0

HKEY_LOCAL_MACHINE/System/CurrentControlSet/Control/SessionManager/MemoryManager/
LargeSystemCache: REG_DWORD:0

Appendix D: NOTES.INI Settings

NOTES.INI for System under Test

[Notes]

```
Directory=D:\Domino\Data
KitType=2
SetupDB=Setup.nsf
UserName=Jackal
CompanyName=Wacko
NotesProgram=C:\Domino
InstallType=4
;=====NotesBench's Parameters=====
Mail_Number_Of_MailBoxes=2
Max_Users=10100
NSF_DBcache_Maxentries=10100
Server_Pool_Tasks=100
Server_Max_Concurrent_Trans=1000
MAILLOGTOEVENTSONLY=1
LOG_SESSIONS=0
LOG_MAILROUTING=10
SERVER_SHOW_PERFORMANCE=1
MAILUSEPROCESSES=0
NAMES=names.nsf
No_Force_Activity_Logging=1
DEBUG_OUTFILE=\\NBTEST1\Lastrun\sutinfo.txt
;=====
CONSOLE_Lotus_Domino_Server=80 40 7 -2 15 650 398
WinNTIconPath=D:\Domino\Data\W32
$$HasLANPort=1
WWWDSPP_SYNC_BROWSERCACHE=0
WWWDSPP_PREFETCH_OBJECT=0
EnablePlugins=1
Preferences=-2147480463
Region=en-US
AltNameLanguage=en
ContentLanguage=en-US
WeekStart=1
ViewWeekStart=2
NavWeekStart=2
XLATE_CSID=52
SPELL_LANG=1033
Passthru_LogLevel=0
Console_LogLevel=2
VIEWIMP1=Lotus 1-2-3 Worksheet,0_IWKS,.,WKS.,WK1.,WR1.,WRK.,WK3.,WK4.,4,
VIEWIMP3=Structured Text,0_ISTR,.,LTR,.,CGN,.,STR,.,1,
VIEWIMP4=Tabular Text,0_ITAB,.,PRN,.,RPT,.,TXT,.,TAB,.,1,
VIEWEXP1=Lotus 1-2-3 Worksheet,0_XWKS,.,WKS.,WK1.,WR1.,WRK.,4,
VIEWEXP3=Structured Text,0_XSTR,.,LTR,.,CGN,.,STR,.,1,
VIEWEXP4=Tabular Text,1_XTAB,.,LTR,.,RPT,.,CGN,.,TAB,.,1,
EDITIMP1=ASCII Text,0_ITEXT,.,TXT,.,PRN,.,C,.,H,.,RIP,.,1,
EDITIMP2=Microsoft Word RTF,0_IRTF,.,DOC,.,RTF,.,2,
EDITIMP3=Lotus 1-2-3 Worksheet,0_IWKSE,.,WKS.,WK1.,WR1.,WRK.,WK3.,WK4.,4,
EDITIMP4=Lotus PIC,0_IPIC,.,PIC,.,8,
EDITIMP5=CGM Image,0_IFL,.,GMF,.,CGM,.,8,
EDITIMP6=TIFF 5.0 Image,0_ITIFF,.,TIF,.,18,
EDITIMP7=BMP Image,0_IBMP,.,BMP,.,18,
EDITIMP8=Ami Pro,0_IW4W,.,W4W33F/V0,.,SAM,.,2,
EDITIMP9=HTML File,0_IHTML,.,HTM,.,HTML,.,1,
EDITIMP17=WordPerfect 5.x,0_IW4W,.,W4W07F/V1,.,DOC,.,WPD,.,2,
EDITIMP21=WordPro 96/97,0_IW4W,.,W4W12F/V0,.,LWP,.,2,
EDITIMP22=PCX Image,0_IPCX,.,PCX,.,18,
EDITIMP28=Binary with Text,0_ISTRNGS,.,*,.,1,
EDITIMP29=WordPerfect 6.0/6.1,0_IW4W,.,W4W48F/V0,.,WPD,.,WPT,.,DOC,.,2,
EDITIMP30=Excel spreadsheet,0_IW4W,.,W4W21F/V4C,.,XLS,.,4,
EDITIMP31=Word for Windows,0_IW4W,.,W4W49F/V0,.,DOC,.,2,
EDITIMP32=GIF Image,0_IGIF,.,GIF,.,18,
EDITIMP33=JPEG Image,0_IJPEG,.,JPG,.,18,
EDITEXP1=ASCII Text,2_XTEXT,.,TXT,.,PRN,.,C,.,H,.,RIP,.,1,
EDITEXP2=Microsoft Word RTF,2_XRTF,.,DOC,.,RTF,.,4,
EDITEXP3=CGM Image,2_XCGM,.,CGM,.,GMF,.,8,
EDITEXP4=TIFF 5.0 Image,2_XTIFF,.,TIF,.,18,
EDITEXP5=Ami Pro,2_XW4W,.,W4W33T/V0,.,SAM,.,2,
EDITEXP14=WordPerfect 5.1,2_XW4W,.,W4W07T/V1,.,DOC,.,2,
EDITEXP21=WordPerfect 6.0,2_XW4W,.,W4W48T/V0,.,DOC,.,2,
```


TRANSLLOG_Status=0
TASKS_FRAME_PERCENT=30
MONITOR_VIEW_TYPE=0
MONITOR_DATA_STORAGE_HOURS=168
WINDOWSIZEWIN=12 9 616 447
Previous_TRANSLLOG_Path=d:\domino\Data\Tlog\
Previous_TRANSLLOG_Style=0
MailTemplate=mail50.ntf
SCHEDULE_VERSION=3

DefaultMailTemplate=mail50.ntf

NBCONFIG.INI for Child Drivers

```
.*****  
,  
; NotesBench parms  
.*****  
NthIteration=6  
;NthIteration=9999  
Tmp=Notestmp  
MaxSessions=100  
NumAddLocalReplica=1  
NumDeleteLocalReplica=1  
NumStampLocalReplica=1  
NumUpdateLocalReplica=1  
NormalMessageSize=10000  
NumMessageRecipients=3  
NumMailNotesPerUser=100  
AttachmentSize=500000  
LargeMessageSize=32000  
MAXDocToDelete=10000  
, *****  
; * MaxUsers=9000 total *  
; * NumNotesLocalReplica=1% MaxUsers *  
; * NumSharedNotes=10% MaxUsers *  
, *****  
NumNotesLocalReplica=90  
NumSharedNotes=900  
MailTemplate=Mail50.NTF  
;NormalMessageSize=10000  
Domain=IBM;*****
```

Appendix E: Network Configuration

The standard TCP/IP stack provided by Microsoft Windows NT Server 4.0 Enterprise Edition was used.

In the system under test, the network adapter speed for the Netfinity 10/100 Fault Tolerant Adapter was changed from the default 'Auto' to 100Mbps. This forced the Duplex Mode to 'Half'.

Appendix F: Guidelines for Information Usage

This report is intended for IBM Business Partners, customers, and IBM marketing and technical support personnel. The report may be distributed in accordance with the requirements stated in the Edition notice.

Appendix G: Pricing

The table provides the IBM Estimated Reseller Price to end users for the U.S. only. Actual Reseller prices may vary, and prices may also vary by country. Prices are subject to change without notice. For additional information and current prices, contact your local IBM representative.

Item Description	Order Number	Qty	IBM Estimated Reseller Unit Price	IBM Estimated Reseller Enterprise Price
IBM Netfinity 7600	8665-2RY	1	\$13,305	\$13,305
1 x 550MHz Pentium III Xeon Processor / 2MB L2 Cache				
550MHz / 2MB L2 Cache Processor Upgrade	33L5058	3	5,725	17,175
256MB DIMM	33L3115	16	779	12,464
Netfinity ServeRAID-3HB Ultra2 SCSI Adapter	37L6086	3	1,932	5,796
Netfinity 10K-3 Wide Ultra2 SCSI Hot-Swap Hard Disk Drives	36L9748	37	479	17,723
Netfinity EXP200 Rack Storage Expansion Enclosure	35301RU	3	2,595	7,785
Netfinity 10/100 Ethernet PCI Adapter	34L1501	1	99	99
IBM G76 17" (16" Viewable) Color Monitor	654841N	1	299	299
Software				
Windows NT Server 4.0 EE (Service Pack 6 free on Internet)		1		3,999
Lotus Domino Server Release 5.01b		1		
Total System Price				\$78,645

Appendix H: Vendor-Defined Information

None.

First Edition - April 2000

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