

NotesBench Disclosure Report
for
IBM Netfinity 4500R Server
using
Lotus Domino Server 5.01
and
Windows NT Server 4.0

Results Certified May 2, 2000

IBM Corporation



Table of Contents

Section 1: Executive Summary

Section 2: Benchmarking Objectives

Section 3: Test Methodologies

Section 4: Data

Section 5: Analysis

Section 6: Conclusions

Section 7: Statement by Auditor

Appendix A: Overall Test Setup and Software Versions

Appendix B: System Configurations

Appendix C: Operating System Parameters Values

Appendix D: Notes Parameters (NOTES.INI file)

Appendix E: Network Configuration File(s)

Appendix F: Guidelines for Information Usage

Appendix G: Pricing

Appendix H: Optional (vendor-defined information)

Edition Notice

Executive Summary

The IBM Netfinity* 4500R server demonstrated leadership performance running Lotus** Domino** Server Release 5.01 on Microsoft** Windows** NT Server 4.0 (with Service Pack 5). The server under test (SUT) supported an R5Mail-Only workload of 7,800 active mail users (see price/performance results¹ in the table).

Test Script	Maximum Users	NotesMark (tpm)	Average Response Time (Seconds)	\$/User	\$/NotesMark
R5Mail-Only	7,800	11,240	0.185	\$5.19	\$3.60

The IBM Netfinity 4500R server was configured with two 733MHz² Intel** Pentium** III processors, 2.25GB³ of memory, and 26 hard disk drives. For complete details about the configuration benchmarked, see Appendix A: Overall Test Setup and Software Versions.

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 4500R as a Domino Server 5.0 mail server configured with the Netfinity ServeRAID Ultra2 SCSI Adapter for RAID-1 data redundancy.

¹ The price/performance results are based on IBM's Estimated Reseller Price. IBM resellers set their own prices, and actual prices may vary.

² MHz only measures microprocessor internal clock speed, not application performance. Many factors affect application performance.

³ When referring to hard drive capacity, GB stands for one thousand million bytes. Total user-accessible capacity may vary depending on operating environments.

Test Methodologies

Test Setup and Hardware/Software Configuration

The IBM Netfinity 4500R system under test (SUT) was configured with two 733MHz Pentium III processors (256KB of ECC full-speed L2 write-back cache and 133MHz front-side bus per processor), 2.25GB of memory, and twenty-six 9.1GB 10K rpm hard disk drives. Each of four RAID-1 arrays, which contained the mail files, was connected to a channel on a Netfinity ServeRAID-3L Ultra2 SCSI Adapter. Six drives, five of which were contained in a RAID-1 array, and one of which was used as the boot disk, were connected to a ServeRAID-3L Ultra2 SCSI Adapter. A more detailed description of the configuration of the RAID-1 arrays is provided in Appendix A.

The network consisted of a CISCO** Catalyst 5505 switch with two 24-port 10/100 modules. All child drivers, parent and SUT were connected to a port on the switch. The IBM Netfinity 4500R server ran Microsoft Windows NT Server 4.0 with Service Pack 5 and Domino Server 5.01.

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
MailMaxThreads=2
NSF_DBCache_MaxEntries=10000
MailLogToEventsOnly=1
Log_MailRouting=10
Log_Sessions=0
Mail_Number_Of_MailBoxes=2
Server_Pool_Tasks=100
Max_Users=10000
DBMaxEntries=10000

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=\\Parent1\Results\SUTINFO.TXT
```

All Notes server tasks were disabled except Router. All Domino data files were located on the D:, E:, F:, G: and J: RAID-1 arrays. The Domino executable codes and data link files were located on the J: RAID-1 array.

Test Procedures

Several experimental runs were conducted starting with a single Domino server to attempt to exhaust at least one of the system resources (e.g., 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 resource 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 7,800 users were distributed across 13 clients. Each client added 600 users to the system under test. The test ran for 8 hours and 50 minutes, including ramp-up. The actual ramp-up period from startup of child 1 to the point when all 7,800 users were shown on the server console was approximately 2-1/2 hours. The test ran for more than 6 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. The child stagger interval ranged from 6 to 17 minutes, and the thread stagger interval ranged from 0.6 to 1.8 seconds.

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 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 found to be consistent.

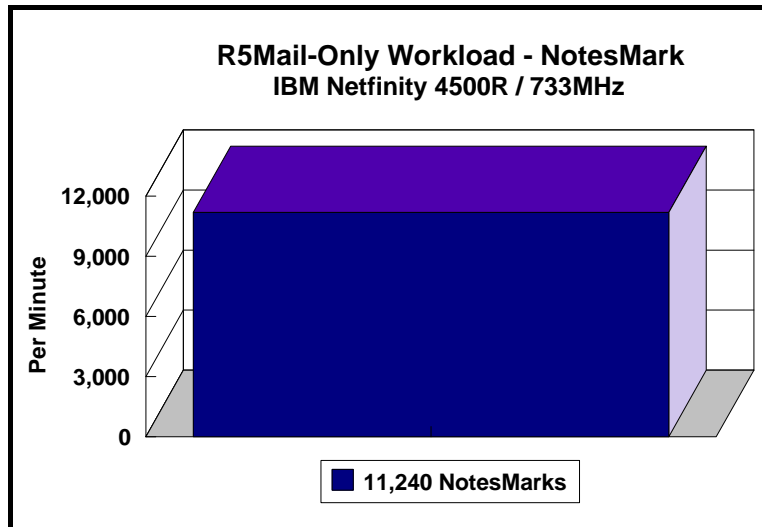
Other NotesBench Tests

IBM intends to continue conducting NotesBench measurements to further optimize and exploit the performance capability of the Netfinity product line running Domino Server 5.x.

Data

NotesMark Value for R5Mail-Only Test

The IBM Netfinity 4500R server demonstrated that it can support 7,800 concurrent, active users with this workload. The NotesMark throughput value was 11,240. Average response time was 0.185 seconds. The test ran error-free for a period of 6 hours and 5 minutes.



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.

Compared with the previous Domino R4Mail-Only workload, the R5Mail-Only workload generates more data traffic at the system under test. 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.

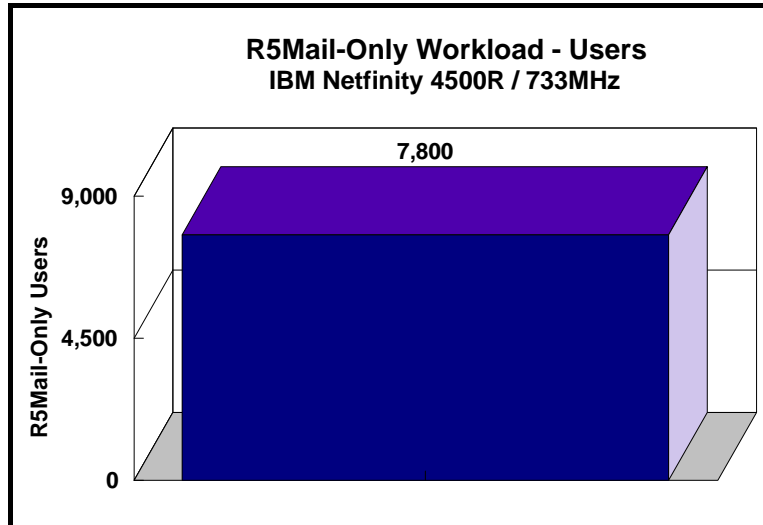
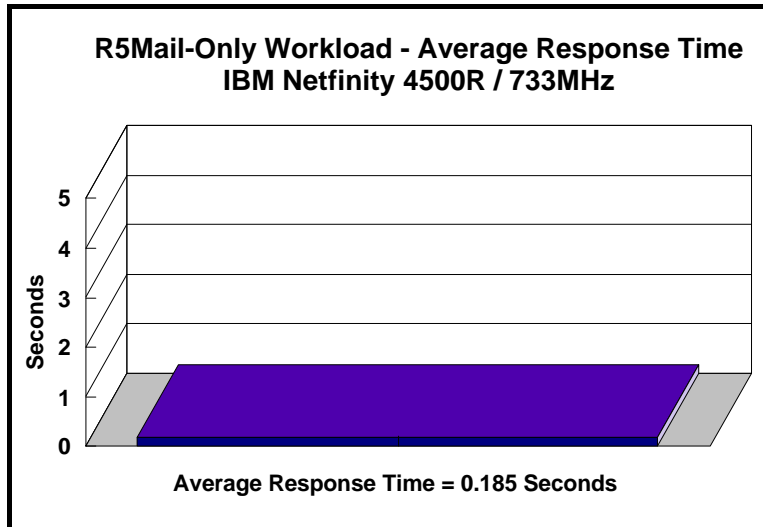
NotesNum Output for R5Mail-Only Test

Min Start Time = 04/05/2000 09:22:24 AM Max Stop Time = 04/05/2000 06:20:58 PM

Total Test Errors = 0

Total Test Time = 32280 sec

Test Run: Users = 7800 NotesMark = 11240 Response Time = 185 msec (04/05/2000
11:58:00 AM to 04/05/2000 06:03:00 PM



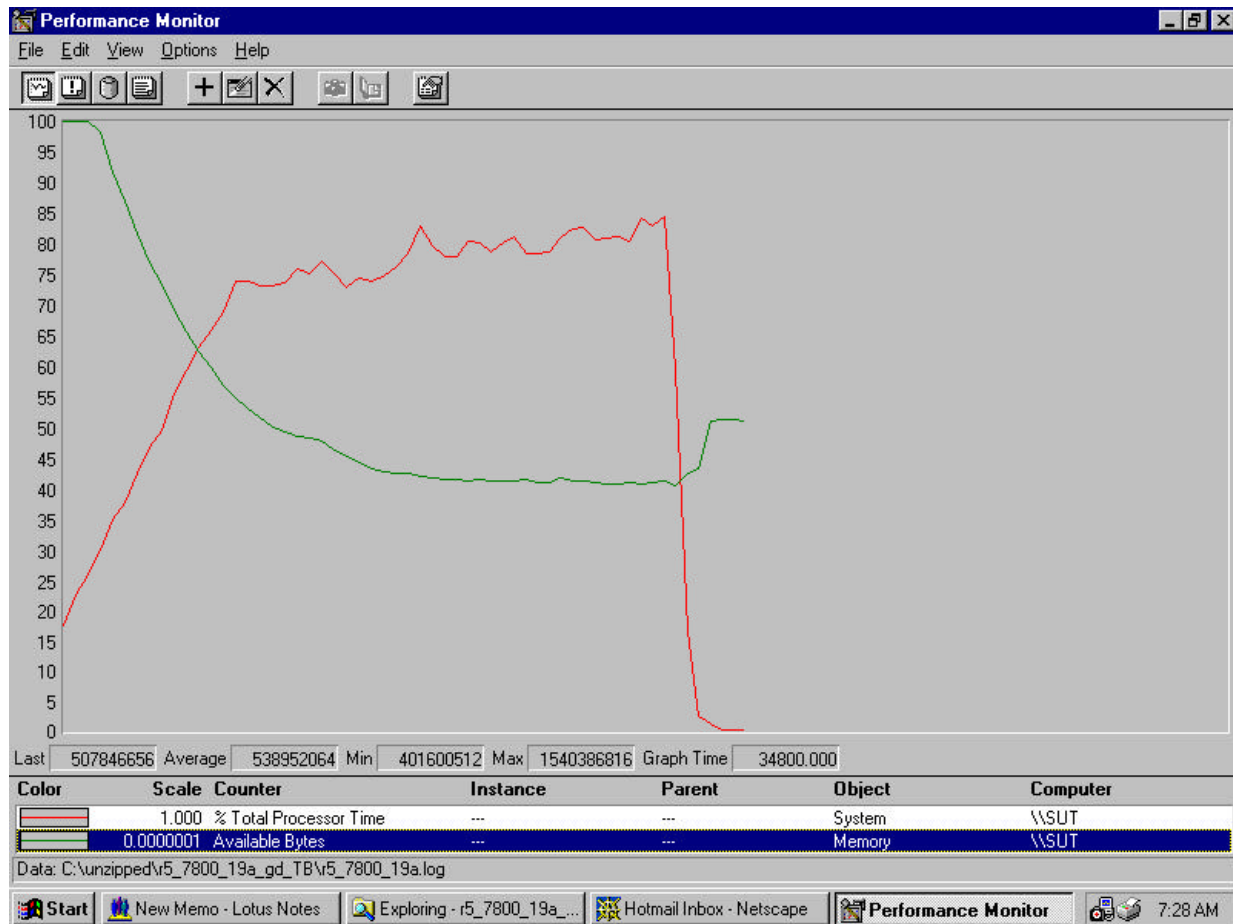
Analysis

When configured optimally as described in this report, the IBM Netfinity 4500R server demonstrated that it can manage the intense resource usage that occurs during ramp-up to 7,800 concurrent R5Mail users with no errors at the clients. During the steady-state period on one of the successful 7,800-user runs, the average CPU utilization was 83 percent. The available memory decreased steadily as more users logged on to the system. The PerfMon screen below captures the CPU and memory utilization of the system under test during steady state.

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.

Domino 5.01 server allowed the use of multiple arrays to off-load user mail databases from the standard notes\data subdirectory. It provides load-balancing capability without using complicated partition servers.

CPU and Memory Utilization



Conclusions

These results, which represent leadership performance in a hardware platform for the Domino Server 5.0 environment, demonstrate that the IBM Netfinity 4500R server configured as described in this report can support up to 7,800 concurrent, active R5Mail users with a response time well below that permitted by the test criteria.

These results are based on running the IBM Netfinity 4500R as a dedicated Domino server. 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.

The Netfinity 4500R server's architecture provides for the addition of options that can expand its capability. With upgradable memory and I/O subsystems, the system can accommodate an increased workload.

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

For the R5Mail-Only test, 14 driver systems were used. Thirteen of those systems were configured as child drivers (child 1 through child 13). A parent system was used for debug_output data collection and to control the run.

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

- Child drivers 1-13
- C: Partition (512MB - NTFS) - Windows NT 4.0.
- D: Partition (1.5GB - NTFS) - Notes 5.01 code and data

Number of Server Platforms

One server platform, the IBM Netfinity 4500R server with two 733Mz Pentium III processors and 2.25GB of memory, was benchmarked.

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

- C: Single disk drive (9.1GB - NTFS) - Windows NT Server Version 4.0 (boot partition)
- D: Partition (22.5GB - NTFS) - Domino mail 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
- J: Partition (22.5GB - NTFS) - Domino executables and Domino mail data subdirectory

Network

The network consisted of a single segment. All child drivers, parent and SUT were connected to one of 24 ports on a CISCO Catalyst 5505 switch.

Software Versions

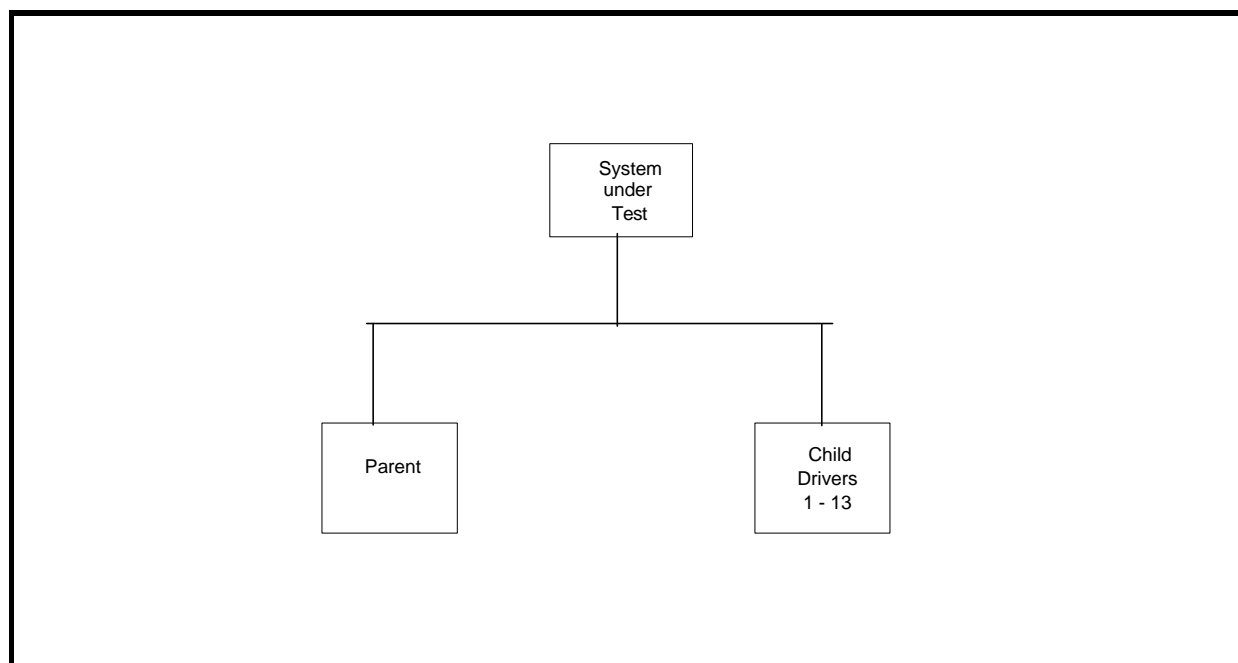
Software versions used on the system under test were as follows:

- Microsoft Windows NT Server 4.0 and Service Pack 5
- Lotus Domino Server Release 5.01
- 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 5
- Lotus Domino Client Release 5.02c for Windows NT
- NotesBench Version 5.0 - Windows/32, released March 12, 1999

Test Setup Diagram



Details of Configuration

System Under Test	Child Drivers 1-13	Parent Source Driver
IBM Netfinity 4500R	IBM PC 365	IBM PC Server 325
2 x 733MHz Pentium III Processor	1 x 200MHz Pentium Pro Processor	1 x 200MHz Pentium Pro Processor
2.125GB Memory	128MB Memory	128MB Memory
26 x 9.1GB Drives (five RAID-1arrays and one boot drive)	1 x 2GB Drive	1 x 4.51GB Drive
5 x ServeRAID-3L Ultra2 SCSI Adapter		
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 with Service Pack 5	Windows NT Workstation 4.0 with Service Pack 5	Windows NT Workstation 4.0 with Service Pack 5

Appendix B: System Configurations

Server under Test	
System	IBM Netfinity 4500R
Processor	2 x 733MHz Pentium III
Memory	2.25GB
Cache	256KB ECC Full-Speed L2 Cache per Processor
RAID Controller	5 x Netfinity ServeRAID-3L Ultra2 SCSI Adapter
Disk Drive	26 x 9.1GB 10K rpm (configured as five RAID-1 arrays and one boot drive)
Network Interface	Integrated 10/100 Ethernet Controller
I/O	PCI Bus
Operating System	Microsoft Windows NT Server 4.0 with Service Pack 5
Notes	Lotus Domino Server Release 5.01 for Windows NT
NotesBench	NotesBench Version 5.0 - Windows/32, released March 12, 1999

Child Drivers 1 - 13	
System	IBM PC 365
Processor	1 x 200MHz Pentium Pro
Memory	128MB
Disk Drive	1 x 2GB
Network Interface	1 x Intel EtherExpress 10/100 PCI TX Adapter
I/O	PCI Bus
Operating System	Microsoft Windows NT Workstation 4.0 with Service Pack 5
Notes	Lotus Domino Client Release 5.02c for Windows NT
NotesBench	NotesBench Version 5.0 - Windows/32, released March 12, 1999

Parent	
System	IBM PC Server 325
Processor	1 x 200MHz Pentium Pro
Memory	128MB
Disk Drive	1 x 4.51GB
Network Interface	1 x Intel EtherExpress 10/100 PCI TX Adapter
I/O	PCI Bus
Operating System	Microsoft Windows NT Workstation 4.0 with Service Pack 5
Notes	Lotus Domino Client Release 5.02c for Windows NT
NotesBench	NotesBench Version 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]
;       Server Performance
:
DBMaxEntries=10000
MailMaxThreads=2
Mail_Number_Of_MailBoxes=2
Max_Users=10000
NSF_DBCache_Maxentries=10000
;(IRIS recommended 2 params: 100 & 1000)
;Server_Pool_Tasks=100
;Server_Max_Concurrent_Trans=1000
Server_Pool_Tasks=100
Server_Max_Concurrent_Trans=1000
;View_Rebuild_dir=m:\view_dir
;
;MailUseThreads=1
LOG_SESSIONS=0
MailLogToEventsOnly=1
LOG_MAILROUTING=10
SERVER_SHOW_PERFORMANCE=1
No_Force_Activity_Logging=1
DEBUG_OUTFILE=\\parent1\c$\results\sutinfo.txt
;Server_MaxSessions=8000
;Server_Session_timeout=15
;       end performance parameters

Directory=j:\notes5\data
KitType=2
SetupDB=Setup.nsf
UserName=sut
CompanyName=IBM
NotesProgram=j:\notes5
InstallType=3
CONSOLE_Lotus_Domino_Server=80 25 7 31 67 683 398
WinNTIconPath=J:\NotesR5\data\W32
Timezone=5
DST=1
$$HasLANPort=1
WWWDSPP_SYNC_BROWSERCACHE=0
WWWDSPP_PREFETCH_OBJECT=0
EnablePlugins=1
Preferences=3185
AltNameLanguage=en
ContentLanguage=en-US
WeekStart=1
ViewWeekStart=2
NavWeekStart=2
XLATE_CSID=52
SPELL_LANG=1033
Region=en-US
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,
```



```

NumClients3=600
NumClients4=600
NumClients5=600
NumClients6=600
NumClients7=600
NumClients8=600
NumClients9=600
NumClients10=600
NumClients11=600
NumClients12=600
NumClients13=600
;NumClients14=600
;NumClients15=600
;NumClients16=700
;NumClients17=700
;NumClients18=100
; NumClients19=400
; NumClients20=100
ResultsDirectory=c:\results
DEBUG_OUTFILE=c:\results\notesnum.txt
;----End
.*****
;
;       Multirun Variables
.*****
; ProbeIntervalDelay=wait after end of one run before starting next
; ProbeWaitTime=wait to start Probe (default=15mins)
; ProbeRunTime=#minutes probe will collect stats
;;Probe_Interval=2800,2900,3000
;;ProbeIntervalDelay=30
;;ProbeWaitTime=30
;;ProbeRunTime=180
; ProbeRunTime=2 because we want 240 minutes of runtime after ramp-up
; without overhead of PROBE
; Next line cause command 'show stat' to execute on SUT console
; before start of each multi-run and when ramped up for that run
; Mail statistics required for audit at ramp-up and before ramp-down
;;ProbeTestIncrementCMD=show stat mail
;;ProbeTestIncrementCMD=show stat database
;;NBTestReset=1
.*****
;
;       Server.Planner Variables
.*****
;;CPDatabase=c:\notesb3\data\Server.Planner.nsf
;;SUTMachineID=Teton600
;-----End

Directory=c:\notes5\data
KitType=1
InstallType=1
WinNTIconPath=c:\notes5\data\W32
Timezone=5
DST=1
$$HasLANPort=1
WWWDSPP_SYNC_BROWSERCACHE=0
WWWDSPP_PREFETCH_OBJECT=0
EnableJavaApplets=1
EnablePlugins=1
Preferences=-2147480463
AltNameLanguage=en
ContentLanguage=en-US
WeekStart=1
ViewWeekStart=2
NavWeekStart=2
XLATE_CSID=52
SPELL_LANG=1033
Region=en-US
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 RTF,0_IW4W_IRTF,,DOC,,RTF,,2,
EDITIMP3=Lotus 1-2-3,0_IW4W_IWKSE,,WKS,,WK1,,WR1,,WRK,,WK3,,WK4,,123,,4,
EDITIMP4=Lotus PIC,0_IPIC,,PIC,,8,
EDITIMP5=CGM Image,0_IFL,,GMF,,CGM,,8,

```


MailTemplate=Mail50.NTF
Domain=IBM
UseServerNAB=1

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  
UseServerNAB=1
```

Appendix E: Network Configuration

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

In the system under test, the network adapter speed for the integrated 10/100 Ethernet controller was changed from the default 'Auto' to 100Mbps. This forced the Duplex Mode to 'full'.

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 Extended Price
IBM Netfinity 4500R	8656-2RY	1	\$4,138	\$4,138
1 x 733 MHz Pentium III Processor with 256KB L2				
733MHz / 256KB L2 Cache Processor Upgrade	00N7943	1	1,325	1,325
1GB 133MHz SDRAM ECC RDIMM Memory	33L3129	2	6,249	12,498
128MB 133MHz SDRAM ECC RDIMM Memory	33L3123	1	309	309
Netfinity ServeRAID-3L Ultra2 SCSI Adapter	01K7364	5	745	3,725
9.1GB 10K Wide Ultra SCSI Hard Disk Drives	36L9748	26	479	12,454
Netfinity EXP200 Rack Storage Expansion Enclosure	35301RU	2	2,595	5,190
IBM G54 15" (13.7" Viewable) Color Monitor	65464AN	1	179	179
Software				
Windows NT Server 4.0		1	683	683
Lotus Domino Server Release 5.01		1	NC	
Total System Price				\$40,501

Appendix H: Vendor-Defined Information

None.

First Edition - April 2000

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