

Using Server.Load to evaluate and enhance IBM® Lotus® Domino® server performance

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Abstract: The purpose of this white paper is to provide a method for using the IBM® Lotus® Domino® Server.Load utility to evaluate and improve Domino Server performance for a given workload. Included are performance considerations for running Lotus Domino on Linux®. Also presented is a detailed procedure for running the utility to evaluate the performance of Lotus Domino on Red Hat Enterprise Linux, for simulated workloads of 600 and 1200 users.

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1 Introduction

IBM® Lotus® Domino® software provides world-class collaboration capabilities that can be deployed as a core e-mail and enterprise scheduling infrastructure, as a business application platform, or both. Lotus Domino software and its client software options deliver a reliable, security-rich messaging and collaboration environment. This paper introduces concepts that will help you get the most out of your environment. For more information, visit the [Features and benefits of Lotus Domino](#) page.

The goal of performance tuning is to get the most out of your hardware and your particular Domino environment. Since each environment is unique, performance tuning is largely a process of analyzing the systems' shortcomings and correcting them. This paper outlines some general guidelines that apply to tuning Lotus Domino and explains how to use the Domino Server.Load utility to find and correct bottlenecks.

For more information on Domino performance tuning, refer to the developerWorks article, [Introduction to Domino Performance Tuning](#). For more comprehensive results on Lotus Notes®/Domino 8 server performance and scalability, refer to the article, [IBM Lotus Domino v8 Server with the IBM Lotus Notes V8 client: Performance](#).

Lotus Server.Load is the IBM Lotus Domino load generation tool that can be used to measure and characterize various Domino server capacity and response time metrics. This tool, along with the provided workloads, allows you to run consistent, repeatable loads against Lotus Domino so that various operating system, hardware, and other configuration changes can be assessed for performance. For more information on getting started with Lotus Domino Server.Load V8, refer to the article, [Quick start guide to IBM Lotus Domino Server.Load V8](#).

2 Test environment

Our Domino Server environment under test consists of a single Domino 8.0.1 Server on an IBM System x3650 configured with one Dual Core Intel Xeon processor and 4 GB of RAM.

Domino 8.0.1 Server (one)

- IBM System x3650
- 4 GB PC2-5300 Memory
- Four 73.4-GB IBM SAS 15K hard drives
- Two 146.8-GB IBM SAS 15K hard drives
- One Intel Xeon Dual-Core 3.0 GHz
- One ServerRAID 8k-I SAS Controller
- Two full-duplex Broadcom 5721 Gigabit Ethernet PCI controller
- 32-bit Windows 2003 Server/32-bit RHEL 5.2 Server
- 32-bit Domino 8.0.1 for Windows/32-bit Domino 8.0.1 for Linux

We configured three Windows XP Clients with the Domino Administrator Client to run the N8Mail Initialization Workload, N8Mail Workload, the Data Collection Script, and The Data Rollup Workload included with the Server.Load utility, to simulate a workload of up to 1200 users. Two clients running the N8Mail workload and one running the Data Collection Script.

Lotus Notes 8 Administrator Client Systems (three)

- IBM System x325
- 4 GB PC2700 ECC DDR SDRAM memory
- Two 18.2-GB IBM SAS 15K hard drives
- One 2-GHz AMD Opteron Processor

- Integrated dual Gigabit Ethernet ports
- Windows XP
- Lotus Notes 8.0.1 Administrator Client

NOTE: Results published in this paper are from benchmarks executed in this limited and controlled environment. They do not represent recommendations for a production environment. For assistance with Domino Capacity Planning, it is recommended that you consult your hardware vendor and the IBM Techline, which handles capacity planning for new hardware.

3 Performance considerations for Lotus Domino

Before tuning your Domino server for performance, ensure that your network components are operating efficiently. Next, make sure that your Domino systems are using the network efficiently. You can check the network utilization and Total Bytes sent per second, to see how much processor time is spent servicing the network.

Plan your Domino server installation so that work will be distributed across hard disks and processors as evenly as possible. At a minimum, place the main operating system (OS) files and the Domino application files on a separate disk from your Domino data files. If using Transaction Logging, you should put the log files on your fastest drive. The Domino server can be very IO intensive, so the manner in which you configure your disk drives can greatly enhance server performance.

When installing Domino on Linux it is important to consider which file system is best for your environment. Several options are available, including xfs, ext3, jfs, reiserfs, and ext2. Journalled file systems will perform slower than non-journaling file systems; however, they recover from errors faster. Domino mail databases, like any mail files, can get quite large, so you want to avoid file systems that are optimized for working with small files.

Finally, to reduce unnecessary load on your server, disable or uninstall any OS services and features that are not required by your Domino server. You can also optimize Lotus Domino by not running Domino server tasks that aren't required in your Domino environment.

3.1 Domino Server settings and configuration

Before running Server.Load against the Server Under Test (SUT), we applied the following Domino server optimization settings to it:

- Two Raid 0 Arrays were created. The first was a 73-GB partition to store the OS and Domino server binaries. The second consisted of the five remaining disks and was used to store the Domino Data directory.
- Ext2 was chosen as the Linux File System,
 - To further enhance performance of the ext2 filesystem on Linux, the Domino Data partition was mounted with the noatime option, which turns off ext2 filesystem access time tracking.
- In the Configuration Settings document on the Router/SMTP Basics tab, the Number of mailboxes field was set to 2.
- The following Notes.ini setting were set on the Domino Server:
 - SERVER_SHOW_PERFORMANCE=1

- platform_statistics_enabled=1
Note: There is a known issue with Domino 7.x/8.x related to enabling platform statistics. Before running any performance testing, complete the procedure outlined in [Technote: 1292478](#)
- SCHEDULE_NO_VALIDATE=1
- NSF_buffer_pool_size_MB=512
Note: 512 is the default value for NSF_buffer_pool_size_MB with 32-bit Domino 8.0.1 and does not need to be explicitly set. For recommendations for setting NSF_BUFFER_POOL_SIZE_MB, refer to [Technote: 21286171](#)
- Server_Max_Concurrent_trans=100
- server_pool_tasks=80
- Servertasks=Router,Update,AMgr,Adminp,Sched,CalConn,RnRMgr,HTTP,LDAP

Lotus Domino includes a utility called **tunekrnl** that is used to tune the Linux environment. The memory data returned by the Linux operating system is not always accurate, however, so it is sometimes necessary tell Lotus Domino the amount of memory it has available. We do this by setting additional Notes.ini variables.

For the purpose of this paper, in addition to the Notes.ini variables set above, the following Notes.ini variables were also set on the Linux-based Domino Server:

- MEM_AddressableMemSizeMB=2560
- ConstrainedSHMSizeMB=2048
- MEM_EnablePreAlloc=1

NOTE: *These Notes.ini parameters deal with the allocation of memory for the Domino server. These setting should be used with caution. Before setting these variables, you should attempt to run Lotus Domino using the default settings. Granting too much or too little memory to Lotus Domino can cause performance to degrade, so always test your server performance before and after changing these values.*

The Notes.ini parameter **MEM_AddressableMemSizeMB=2560** tells Lotus Domino that it has 2560 MB of memory to use. The 32-bit Linux OS reserves 1 GB of memory for kernel process. Since the Domino server is the main application running on the OS, we choose to allocate most of the remaining memory for Lotus Domino. Of course, some memory must be left for other user space applications; usually 500 MB is an ample amount for this purpose.

The next parameter, **ConstrainedSHMSizeMB=2048**, tells Lotus Domino how much shared memory it can use. Because most of the memory Lotus Domino requires is shared memory, we give it 2 GB for these tests.

The third parameter, **MEM_EnablePreAlloc=1**, tells Lotus Domino to pre-allocate the shared memory defined in the Notes.ini parameters. This helps prevent Lotus Domino from crashing with an insufficient shared memory error.

However, it's a balancing act because locking down more shared memory than needed is not wise. Doing so can cause a shortage of local memory for applications to use and cause insufficient memory errors and application failure.

4 Domino Server.Load

Lotus Server.Load is the Lotus Domino load generation tool that can be used to measure and characterize various Lotus Domino server capacity and response time metrics. This section explains how to install and configure Domino Server.Load to run the N8Mail Workload against a Domino SUT.

4.1 Installing and running Server.Load

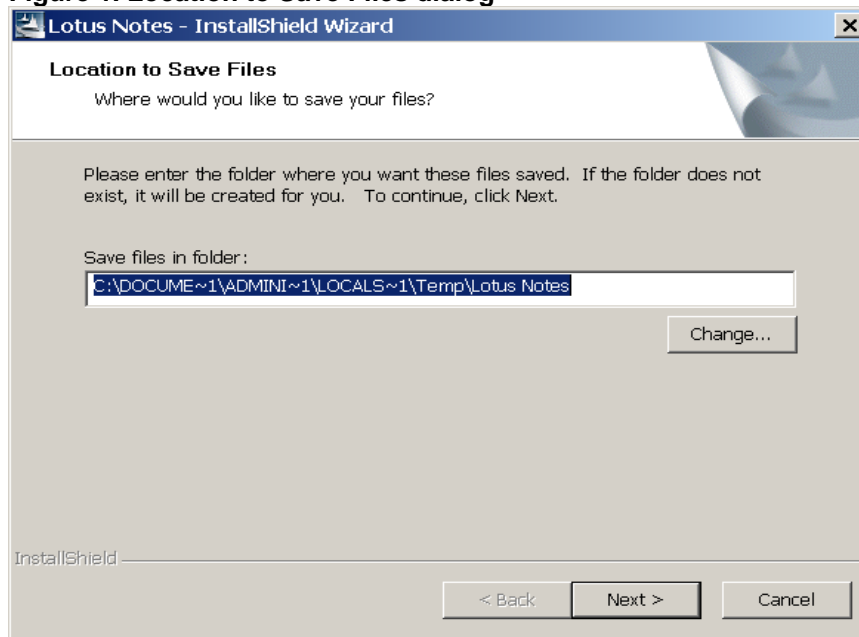
The Server.Load utility and its associated workloads are included as part of the Domino Administrator Client. To install Server.Load, you must select this feature during installation. Domino Designer is also required to deploy and run the setup agents required by the N8Mail Workload.

4.1.1 Install and configure Domino Administrator, Domino Designer, and Server.Load

To install the Domino Administrator, change to the client running Microsoft Windows XP and follow these steps:

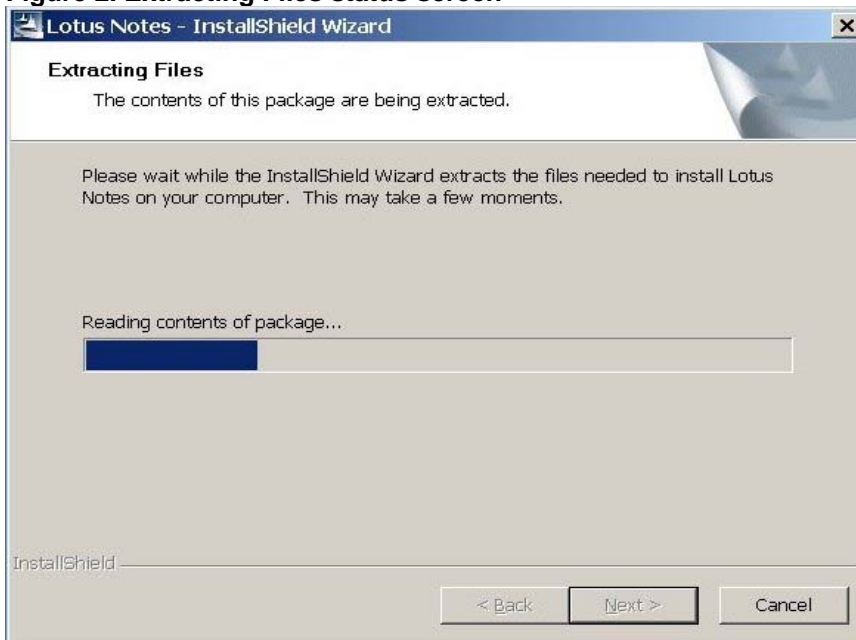
1. Log in as user *Administrator*.
2. Open Windows Explorer by selecting Start > Programs > Accessories > Windows Explorer.
3. Change to location of the Notes Installer executable and double-click *notes8basicallclient_w32_prod.exe* to start the installation.
4. You are asked where to save files; keep the default path, that is, C:\Documents and Settings\Administrator\Local Settings\Temp\Lotus Notes (see figure 1).

Figure 1. Location to Save Files dialog



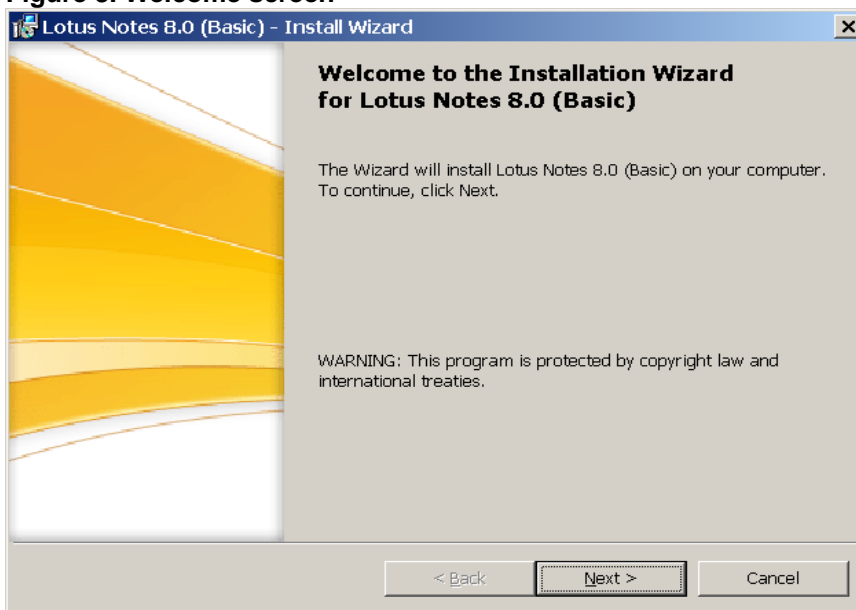
9. Click Next; the files are extracted (see figure 2). Be patient; this may take a few minutes.

Figure 2. Extracting Files status screen



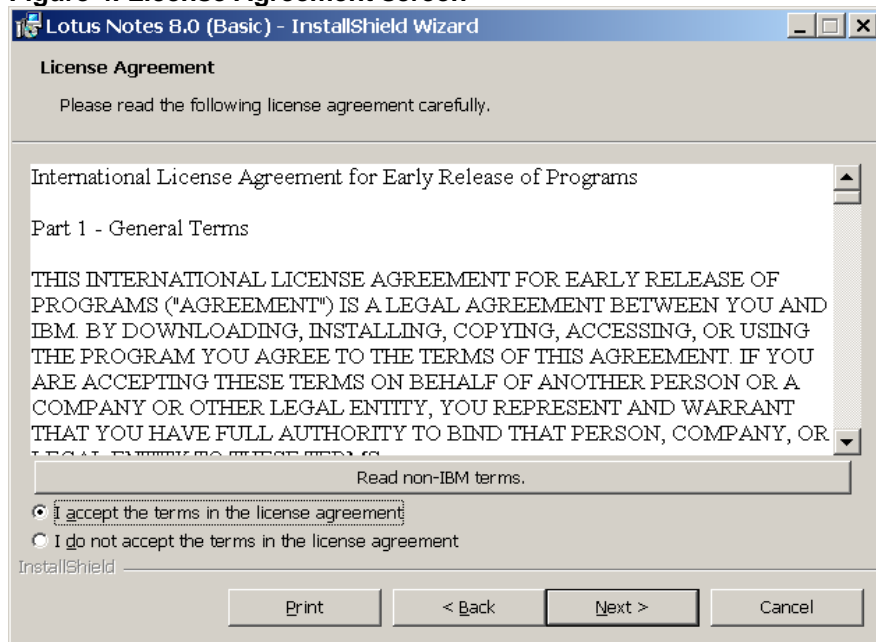
10. When the file extraction is finished, the Install Wizard Welcome screen (see figure 3) will display. Click Next.

Figure 3. Welcome screen



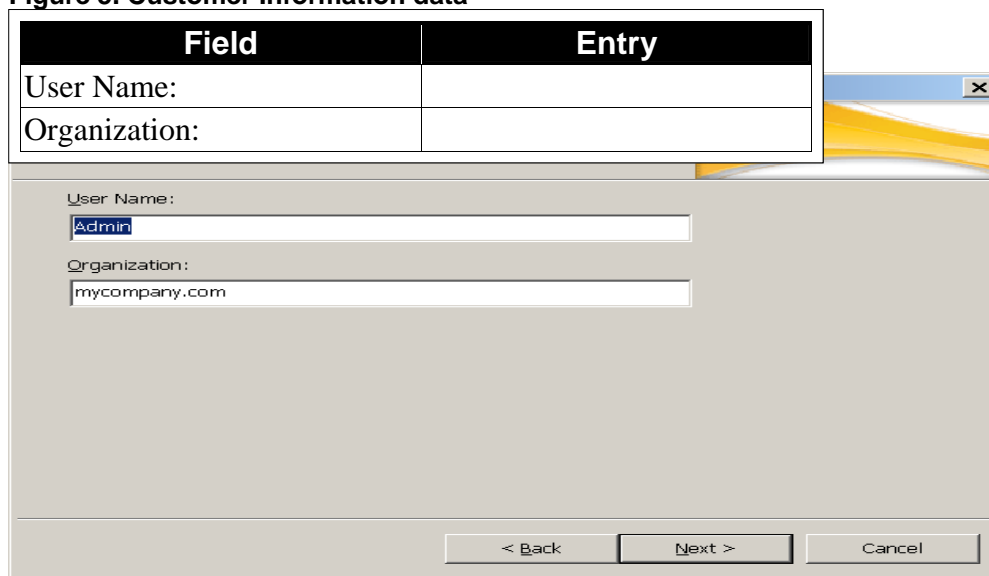
7. In the License Agreement screen (see figure 4), select "I accept the terms in the license agreement" and Click Next.

Figure 4. License Agreement screen



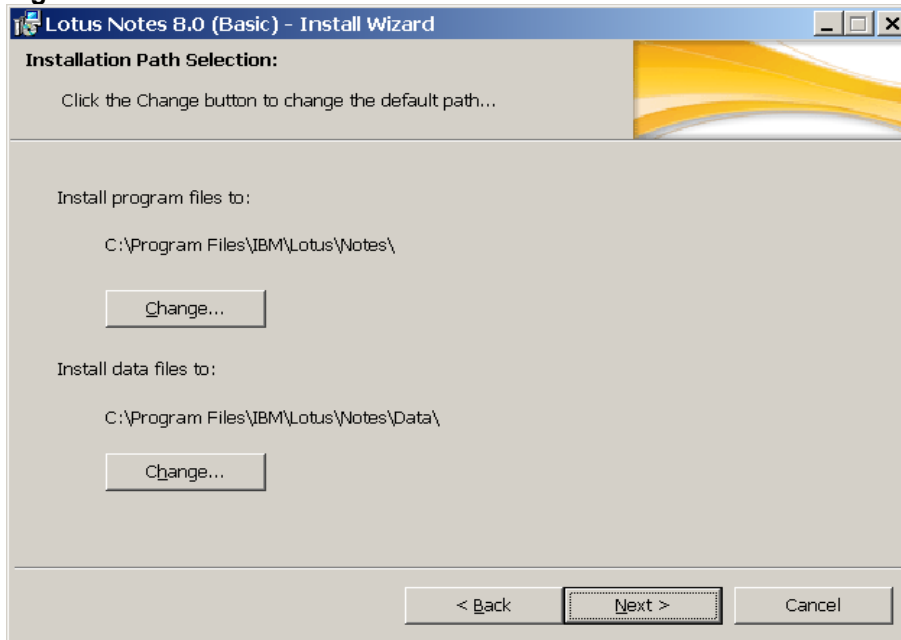
8. In the Customer Information screen, provide the information requested and record your values in a table such as shown figure 5. Click Next.

Figure 5. Customer Information data



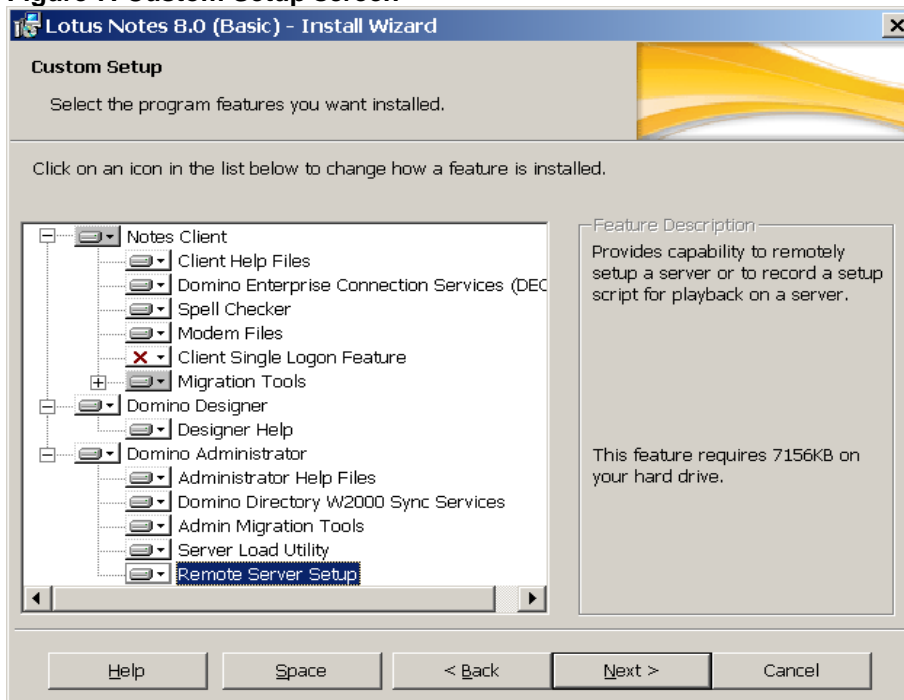
9. Keep the default values in the Installation Path Selection screen (see figure 6) and Click Next.

Figure 6. Installation Path Selection screen



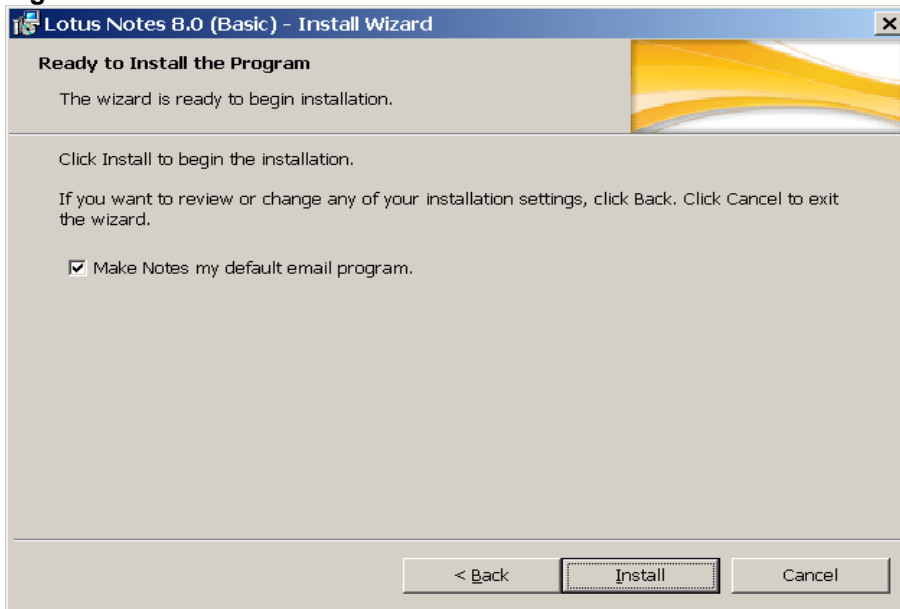
10. The Custom Setup screen appears (see figure 7). Ensure that you select all features, except "Client Single Logon Feature," by clicking the icon next to the feature. These feature will be installed on the local hard drive. Click Next.

Figure 7. Custom Setup screen



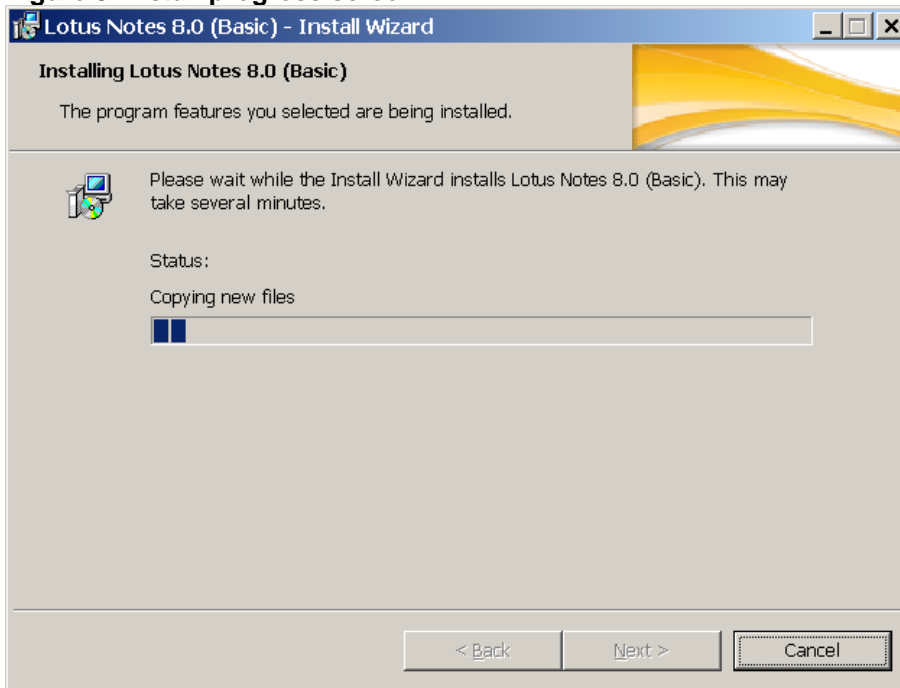
11. The installation wizard now has all required information and is ready to be installed, as shown in figure 8. Click the Install button.

Figure 8. Start install



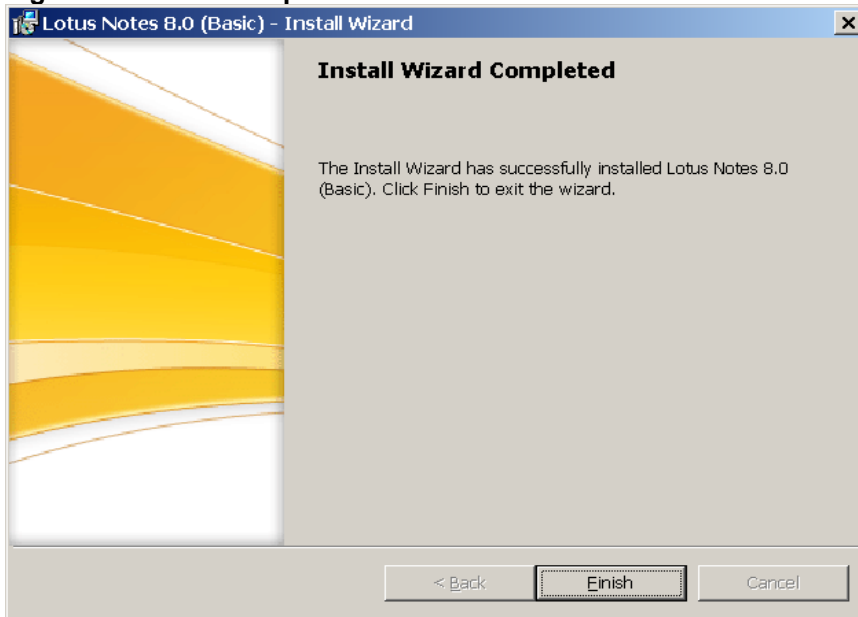
12. The Lotus Domino Administrator installation begins (see figure 9). This may take a few minutes.

Figure 9. Install progress screen

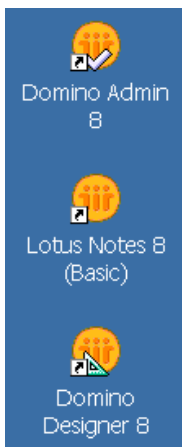


13. The Install Wizard Completed screen displays (see figure 10). Click Finish.

Figure 10. Install Complete screen



You should see three new icons on the desktop; Lotus Notes 8, Domino Designer 8, and Domino Admin 8, as shown below:

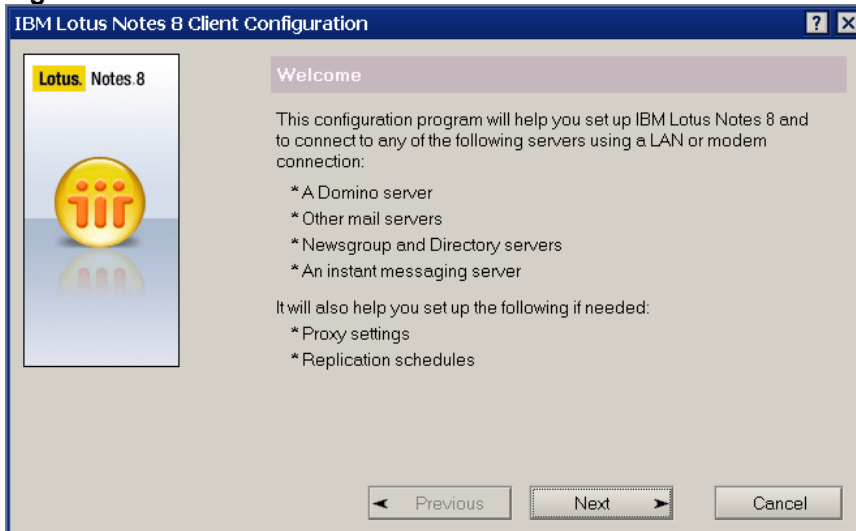


4.1.2 Configuring the Domino Administrator

In this section we configure the Domino Administrator, following these steps:

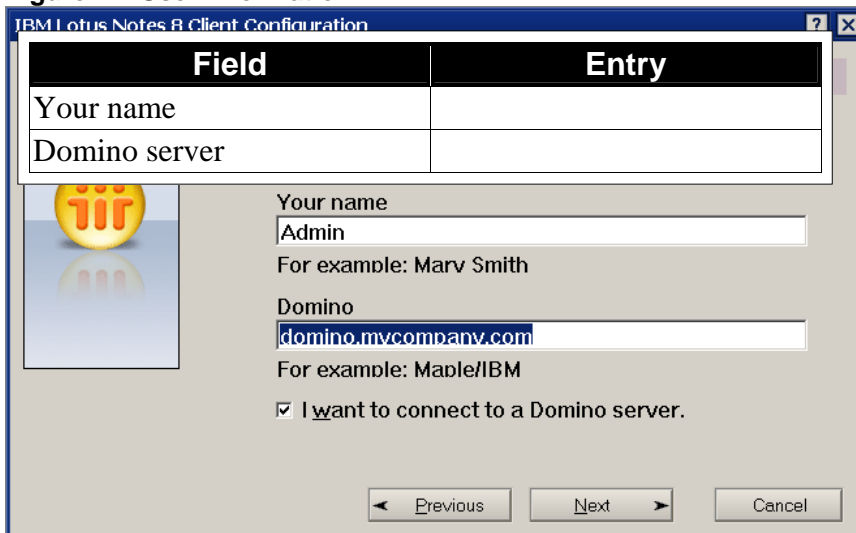
1. Double-click the Domino Admin 8 icon on the desktop to start the Lotus Domino Administrator. The Welcome screen displays (see figure 11); click Next.

Figure 11. Welcome screen



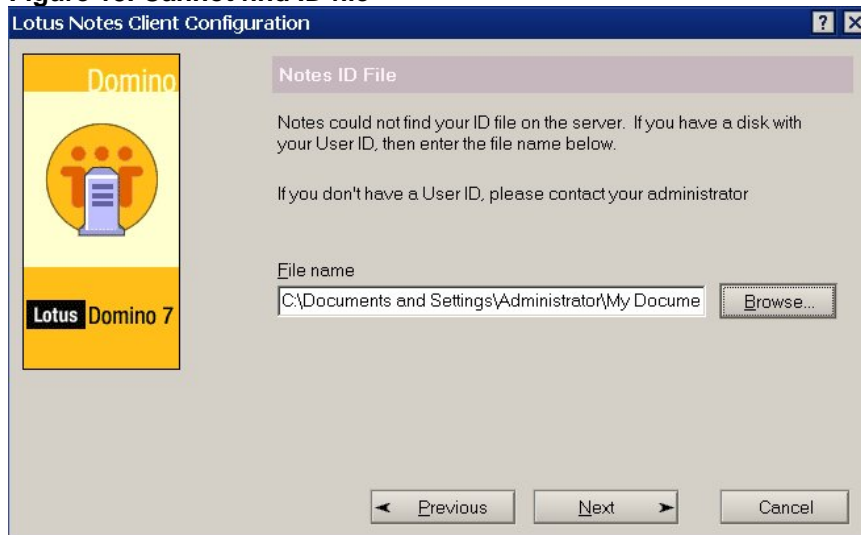
2. Provide information about the user and the Domino server you'll be administering (see figure 12). This is the server that will be the target of your Server.Load test. In the Your name field, enter the name of the Domino Administrator used to Install Domino. Keep "I want to connect to a Domino server selected"; click Next.

Figure 12. User Information



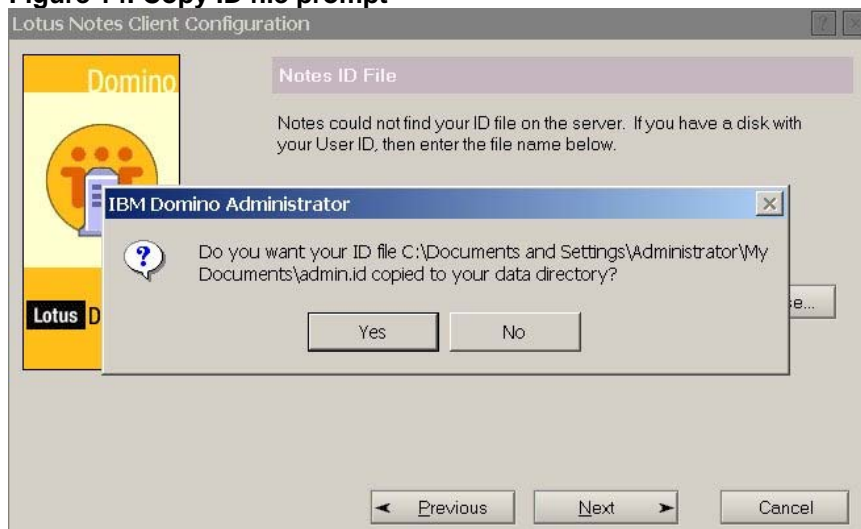
3. The configuration wizard attempts to find your Notes ID file in the Domino Directory. If your ID file is not found, a window displays (see figure 13) in which you must provide the location: C:\Documents and Settings\Administrator\My Documents\admin.id. Click Next.

Figure 13. Cannot find ID file



4. You are then asked if you want to copy the ID file to the Data directory of Lotus Notes (see figure 14). Click Yes.

Figure 14. Copy ID file prompt



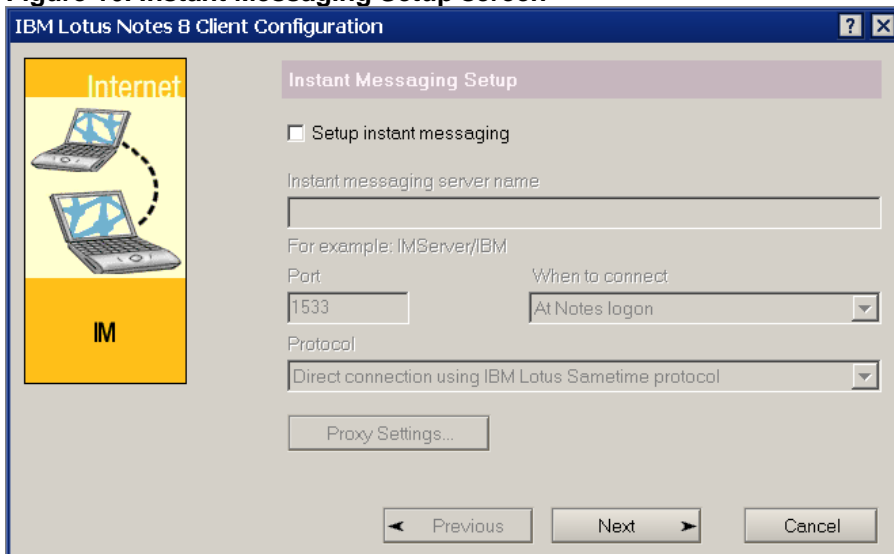
5. The password prompt appears (see figure 15). Type in the password for the Domino user admin; click OK.

Figure 15. Password prompt



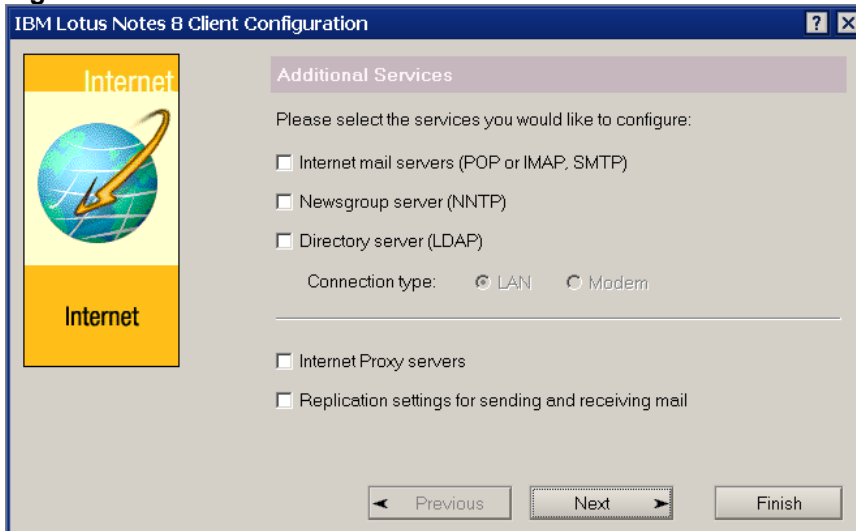
6. In the Instant Messaging Setup screen (see figure 16), deselect "Setup instant messaging" as we do not have a Lotus Sametime server configured. Click Next.

Figure 16. Instant Messaging Setup screen



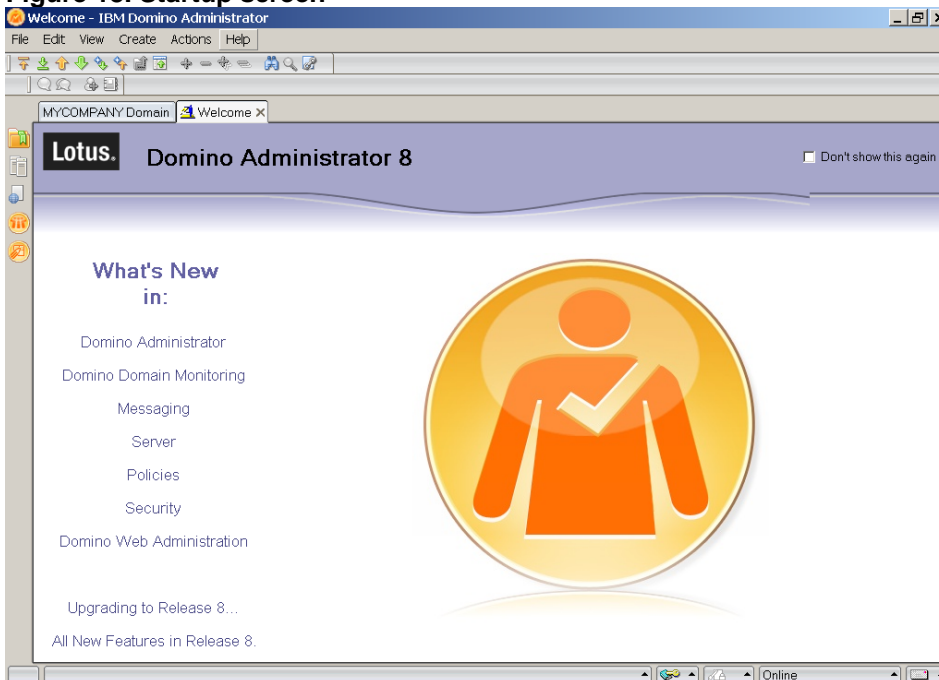
7. In the Additional Services screen (see figure 17), leave everything unselected and click Finish.

Figure 17. Additional Services screen



The Setup is completed. Click OK. The Domino Administrator will start (see figure 18).

Figure 18. Startup screen



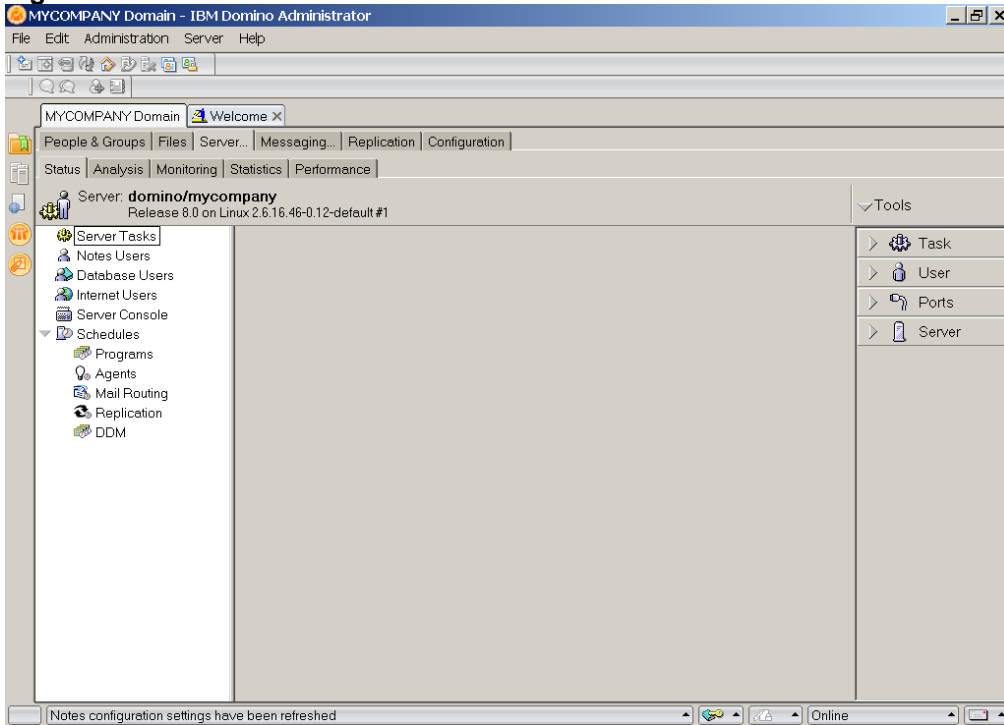
4.1.3 Testing the Domino Administrator

To test the installation of the Domino Administrator, we access the server console to see the runtime messages generated by the Domino server:

1. If not started, start the Domino Administrator by double-clicking the Domino Admin 8 desktop icon and then select the Domain tab.

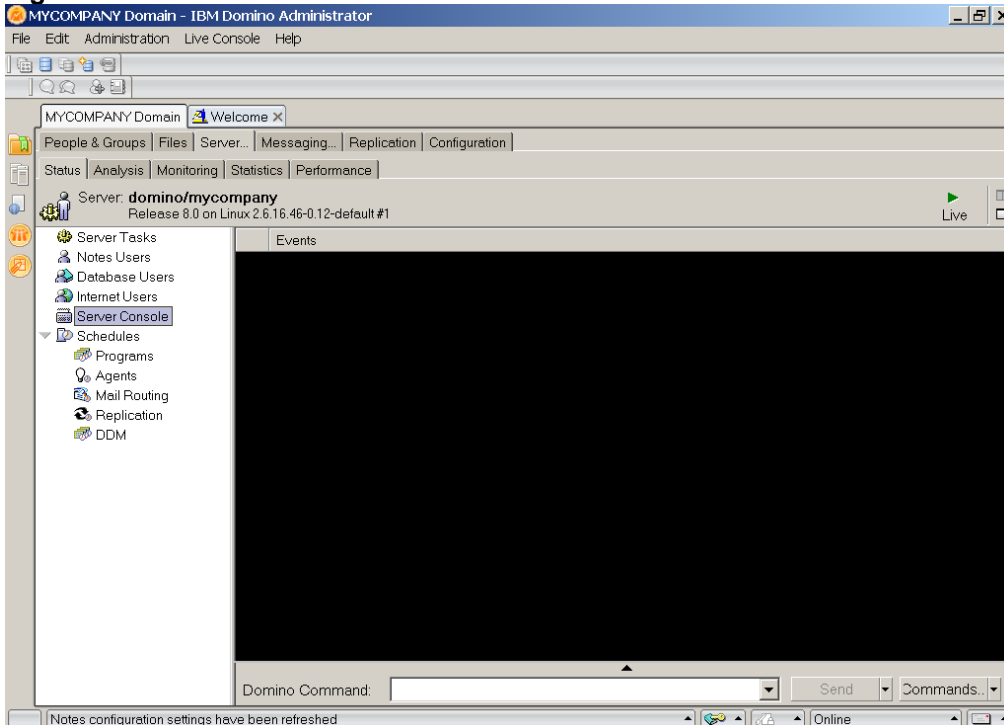
2. Within the Domain tab, select the Server tab (see figure 19).

Figure 19. Server tab



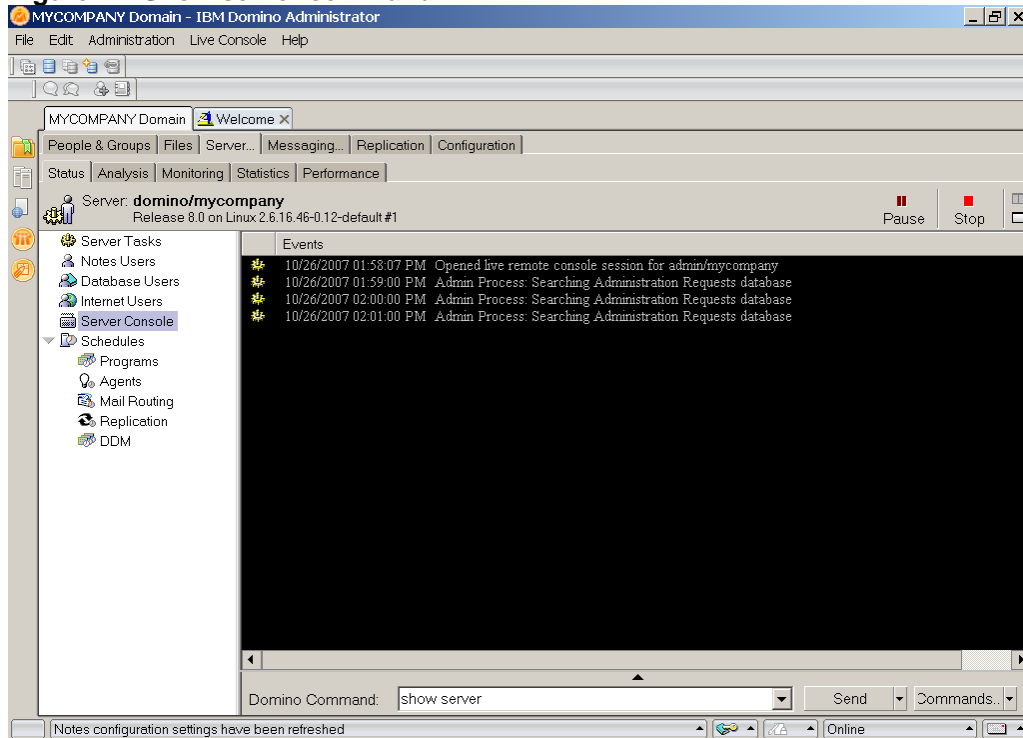
3. In the left-hand navigation bar, select Server Console (see figure 20) and then click the Live button in the upper right-hand corner to connect to the Domino server.

Figure 20. Server Console screen



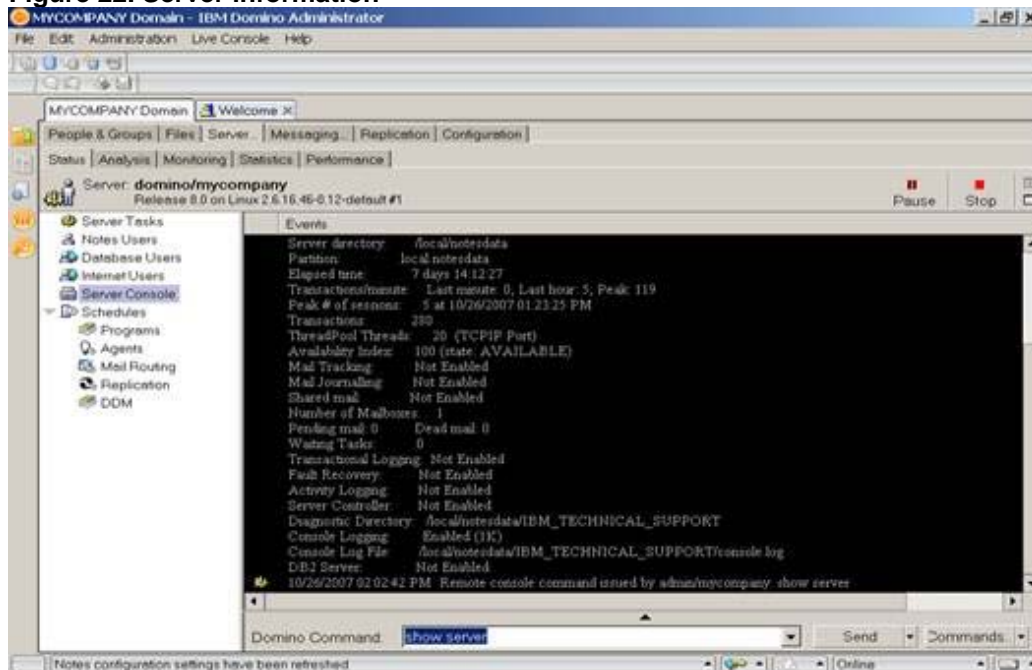
4. Type the command “show server” in the Domino Command field at the bottom of the screen and click the Send button (see figure 21).

Figure 21. Show server command



5. You should see information about the server scroll by, as shown in figure 22.

Figure 22. Server information



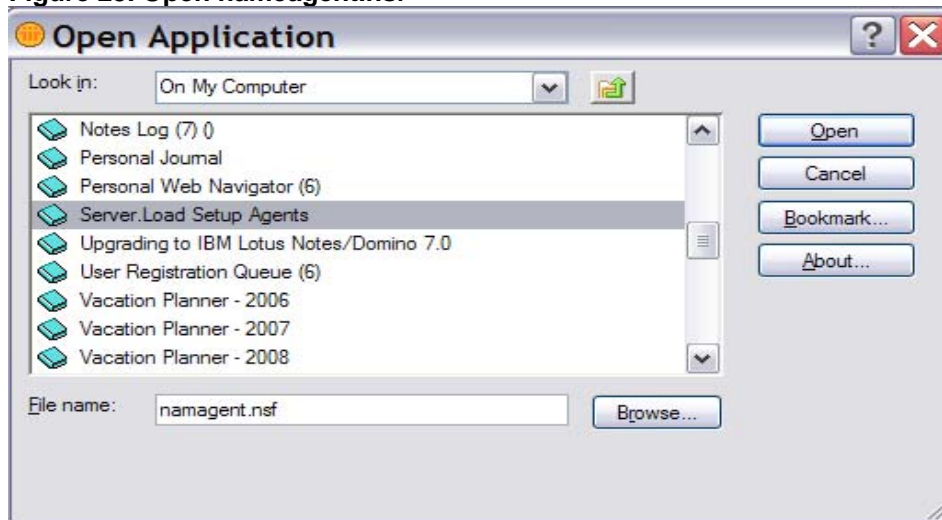
You have successfully installed and configured Lotus Domino Administrator!

4.2 Copying agents required by Server.Load to the SUT

Nameagent.nsf is provided by the Server.Load feature. It includes the agents required to set up the test environment for running the Server.Load workloads, and these agents must be copied to and run on the SUT:

1. Launch Domino Designer and from the menu bar select File > Application > Open; then select Server.Load Setup Agents (nameagent.nsf; see figure 23). Click Open.

Figure 23. Open nameagent.nsf



2. Open the Domino directory on the SUT. From the menu bar select File > Application > Open and click the "Look in" drop-down menu. Select the SUT and then select the SUT's directory (Names.nsf).
3. Navigate to the Server.Load Setup Agents > Shared Code > Agents view. Select all the agents in the right-hand pane and press CTRL + C to copy these agents.
4. Navigate to the SUT's directory > Shared Code > Agents view, and press CTRL + V to paste the agents into the SUT's Directory (names.nsf).

4.3 Registering the simulated users on the Domino server

In the previous section we copied the agents required to run a workload to the Domino SUT. In this section we run the Create NotesBench mail Person Document agent on the SUT to create 1200 mail users:

1. Launch the Lotus Notes Client and open the SUT's Directory and select Actions > Other.
2. In the pop-up, select the "Create notes Bench Mail Person Documents" agent and select Run.
3. You are presented with a series of Dialog boxes, with values as recorded in table 1.

Table 1. Dialog box values

Dialog name	Value
Starting Values to Create Mail Users:	1
Number of Users to Create	1200
Number of Mailn.NSF Files to Use:	1200
Starting Mailn.NSF File	1
Location of Mail Databases (relative to Notes Data directory, blank = root)	mail\
Mail Domain (example: mycompany)	Enter the name of SUT's Domain.
Number of Mail Servers	1
Mail Server #1 (example: domino/mycompany)	Enter the name of the SUT plus its Domain.
Internet Host Name #1?	Enter the fully qualified TCP/IP Hostname of the SUT.
Message Storage Format (0=Notes, 1=Keep in Sender's Format, 2=MIME)	0
Mail System (1=Notes, 6=POP or IMAP)	1
Percentage of These Users with Local Replicas (0 – 100)	0

4.4 Verify creation of Person documents

Prior to running the Mail Initialization workload, verify that the necessary Person documents have been created on the Domino SUT:

1. Launch the Domino Administrator Client and log in using the ID of the Domino Administrator for the SUT.
2. Open the SUT Domain and navigate to the People & Groups tab.
3. Navigate to the Domino Directories > SUT's Directory > People view.
4. Press CTRL + A to select all the document in this view. You should see 1201 documents selected; the 1200 Mailn.NSF documents you created plus your administrators Person document.

NOTE: If you don't see these documents, Press F9 to refresh the view. If the documents are still not available, an error occurred. Retrace your steps and correct the problem before you continue.

4.5 Run the Mail8 Initialization workload

The N8 Mail Initialization is used to prepare for the N8 Mail workload and the N7 Mail workload. This workload creates and populates the mail databases needed to run both workloads.

As with all workloads, you can collect performance metrics with this one; however, the metrics will not be meaningful as this workload is designed only to create the mail databases required by the N8 Mail workload. You should not use the metrics gathered with this workload as a guideline for tuning Lotus Domino.

NOTE: Before running any workload, ensure that the SUT and the Driver Client systems can communicate, are synchronized with respect to date/time, and the admin.id and cert.id are correct.

1. Set Notes.ini settings on each client driver that will run Mail8 Initialization Workload. For example, the setting Domain=mycompany would be "SUT's Domain".
2. Launch the Server.Load utility, select Start > Run from the menu, and enter C:\Program Files\IBM\Lotus\Notes\sload.exe. The Lotus Server.Load graphical user interface opens.
3. In the Test Type section, select Built-In and the Select N8Mail Initialization Workload from the drop-down menu.
4. Select the Test Parameters tab and complete the fields show in table 2.

Table 2. Values for Test Parameters tab fields

Field	Value
Number of Users/Threads	0
Script Loop Count	1
Thread Creation Interval	5
Starting Thread No.	1
Test Time Parameter	No time limit
Build Recipient List using Name and Address Book (for example: domino/mycompany!!NAMES.NSF)	sut/domain!!names.nsf
Storage test output to	C:\results\n8initworkload1.txt

5. Select the Script Variables tab and complete the fields in table 3.

Table 3. Script Variables tab values

Value	Variable Name
CN=domino/O=mycompany	MailServer (example: domino/mycompany)
mail\	nb_dbdir
domino\mycompany!!mail8.ntf	MailTemplate
3000	NumMailNotesPerUser
1	BlockSenderOFF
0	ColorProfile

6. Select File > Save Setting to save these settings and click Execute to open the Server.Load Metrics window.
7. For each metric you want to collect, select it from the Script Metrics or Server Stat Metrics pull-down list and click the Add Metric button. To delete a metric, select it and click the Delete Selected Metric button.
8. Verify that the Server to receive Console Commands field matches the SUT (for example, CN=domino/O=mycompany); if it doesn't, enter the correct value.
9. Enter the location of the file in which to store metrics (for example, c:\results\n8initworkload1metrics.csv)
10. Click Start Test, to initiate the workload. Note that the N8Mail Initialization workload may take several hours to complete.
11. To verify that databases are being created, log in to the SUT and change to the mail directory located in the Domino Data directory on your server. The default location on Linux is /local/notesdata/mail.

12. Issue the command to list the contents of this directory. You should see a series of mailn.NSFs, where *n* is a number between 1 and 300.

NOTE: You should not issue this test for more than 300 users at a time; if the script fails for any reason, you will have to clean up the databases already created and restart the test.

13. Once the Initialization workload completes, close all open Server.Load windows to exit from the program.
14. Repeat Steps 1 – 13, replacing the Starting Thread No in Step 4 with the next mail box number (e.g., 301, 601, 901), and then change the output file names accordingly, until you have created the desired number of databases.

4.6 Gather operating systems statistics

The workloads included with the Server.Load utility simulate user load and query statistics from the Domino SUT. To gather additional OS statistics you must run an external performance monitoring tool like Microsoft Management Console (*perfmon.exe*) on Windows-based servers or *nmon* on Linux.

Note that you must set up these tools before running the N8Mail Workload, as they should be run concurrently with the N8Mail Workload.

4.6.1 Gathering OS statistics on Red Hat Enterprise Linux 5

There are many performance monitoring utilities available for Linux. Here we explain how to use *nmon* to gather Linux OS statistics.

Nmon is a free tool designed for AIX and Linux performance specialists to monitor and analyze performance data, including CPU utilization; memory use; disk I/O rates, transfers, and read/write ratios; network I/O rates, transfers, and read/write ratios; and much more. For further details on *nmon*, refer to the developerWorks article, "[nmon performance: A free tool to analyze AIX and Linux performance](#)."

To use the tool:

1. Download the correct version of [nmon](#) for your platform.
2. Log on a root and extract the nmon executable:

```
unzip nmon_x86_11f.zip
```

3. Ensure that the file's permissions are set to executable:

```
chmod +x nmon_x86_fedora5
```

4. Start *nmon* just before launching the Domino Server.Load Workload and set the parameters to gather information so that it completes shortly after your last workload. The example below will run for 4 hours and 1 minute, collecting data once per minute:

```
./nmon_x86_fedora5 -ft -s 60 -c 251
```

where *-f* instructs *nmon* to start in data collection mode. This mode launches the tool and background processes, writing the results to a file named

hostname_yymmdd_hhmm.nmon

-t = include top output

-s = interval to capture statistics in seconds (60 = once/minute)

-c = number of times to collect data

The file produced by initiating *nmon* in data collection mode is a CSV file, which can be opened with most spreadsheet editors. You may need to rename the file to have a .csv extension.

Alternatively, if you have Microsoft Excel 2002 or later, you can use the [nmon analyser tool](#) to view the data in spreadsheet form and produce graphs for presentations, based on the *nmon* output. For more information on using *nmon* analyser see the developerWorks article, "[nmon analyser -- A free tool to produce AIX performance reports](#)".

4.6.2 Gathering OS statistics on Windows 2003

There are many performance monitoring tools available for Windows, but here we focus on how to use the Microsoft Management Console to set up a counter log to gather statistics:

1. Launch the Microsoft Management Console, by selecting Start > Run from the menu, and enter *C:\perfmon.exe*. The Microsoft Management Console opens to the Performance window.
2. In the left-hand frame, expand Performance Logs and Alerts, and select Counter Logs.
3. Select Action > New Log Settings from the menu.
4. The New Log Settings pop-up window displays. Enter a name for your log file (for example, DominoPerfmonData) and Click OK. The New Perfmon Log Setting window displays with the name you just entered.
5. Click Add Objects; the Add Objects window displays. Scroll down and select the objects you are interested in, such as PhysicalDisk or LogicalDisk, Memory, Network Interface, Paging File, Process, Processor. (To select multiple objects, hold the CTRL key as you select each object.) Once you've selected all the objects, click Add and then Close.
6. Verify the list of Counters you selected, adding or removing Counters as needed.
7. Take note of the current log file name and location, (for example, C:\PerfLogs\DominoPerfmonData_000001.blg). If you wish to change this value, select the Log files tab, click configure to change the Filename or Directory to which to save the file, and then click OK when complete.
8. Select the Schedule Tab. You will want to configure the Log to start manually and stop automatically at a time shortly after the last workload completes.
9. To start the Log, select the name of your log file (DominoPerfmonData) in the panel on the right-hand side, and then select Action > Start from the menu. The Database icon will change from red to green, indicating that the log is active.
10. Once the workload is complete, stop the Log. Select the name of your log file (DominoPerfmonData) in the panel on the right, and then select Action > Stop from the menu. The Database icon changes from green to red, indicating the log has stopped.

11. Create a filter file (filter.txt) to sift out the statistics that are of interest to you. (This is a text file listing the counters to select, one per line.) The sample text below demonstrates the format:

```
\Processor(_Total)\% Privileged Time
\Processor(_Total)\% User Time
\Processor(_Total)\% Processor Time
\PhysicalDisk(_Total)\Disk Reads/sec
\PhysicalDisk(_Total)\Disk Read Bytes/sec
\PhysicalDisk(_Total)\Disk Writes/sec
\PhysicalDisk(_Total)\Disk Write Bytes/sec
\Network Interface(Broadcom NetXtreme Gigabit Ethernet _3)\Bytes
Total/sec
```

12. Open a Command Prompt, click Start > Run, type **cmd**, and click OK.
13. Change to the location of your log file: `cd c:\PerfLogs`
14. Enter the following command to convert the .blg file to a .csv file with the Counters specified in the filter file created in step 11:

```
relog DominoPerfmonData_000001.blg -f csv -o dominoperfmon -cf
filter.txt
```

Note: for more information on relog, enter relog -?

15. Finally, open `dominoperfmon.csv` in your favorite spreadsheet editor.

4.7 Workload Data Collection script

The Workload Data Collection custom script, SHSTAT.SCR, allows test data from a group of test drivers and an SUT to be combined into a single data file for analysis. While a workload runs, the Workload Data Collection custom script collects performance data from the SUT and, when the workload is complete, the Workload Data Rollup script rolls up the performance data.

These scripts require a system other than the one that contains the test drivers that put the load on the SUT.

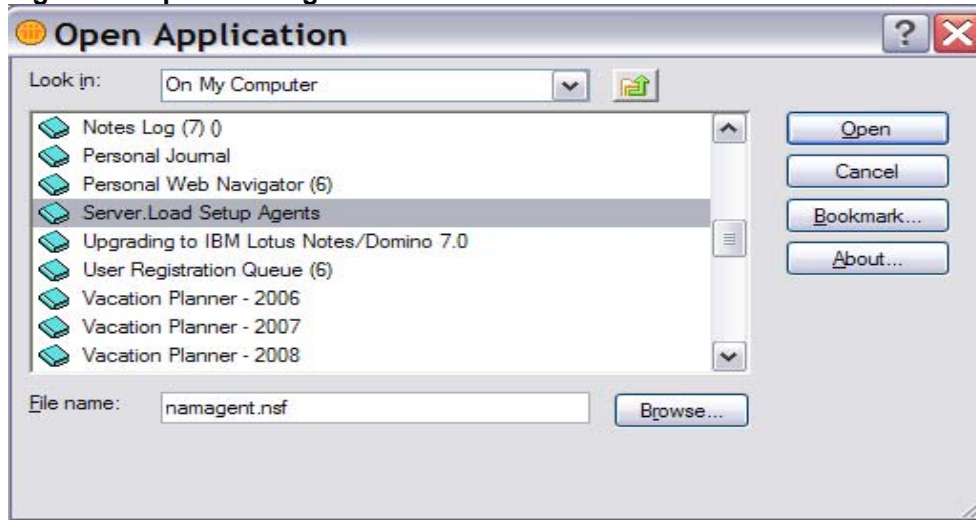
4.7.1 Setting up the Workload Data Collection script

The Workload Data Collection script should be started just prior to starting the first Workload driver, and it should not stop until all the Workload drivers complete their test. To set up the client that will run for workload data collection, perform these steps:

1. Create a folder to use as a Results directory and then set sharing privileges on that folder to allow the client drivers to write to the Results directory.
2. On each test driver, map a drive to the Results directory on a system that will collect the data from all drivers.
3. In the Workload Data Collection driver's Notes.ini, include the following settings:
 - **ResultsDirectory=Z:** where Z:\ is mapped to the Results directory created in Step 1.

- **NB_SaveCMDConsole=1** Tells the script to save results to a file. When we run the rollup script, we will change this setting to zero.
4. Launch Domino Designer and open Nameagent.nsf.
 5. From the menu bar, select File > Application > Open, select Server.Load Setup Agents (nameagent.nsf), and click Open (see figure 24).

Figure 24. Open nameagent.nsf



6. From the Domino Designer menu, select Help > Using this Application. The Using Server.Load Setup Agents page opens. Near the end of this page you will see the section labeled "Show Stats script used to collect server data during workload for Workload Data Rollup script".
7. Right-click the *showstat.scr* attachment located in at the bottom of this page, and select Save. The Save Attachment window opens.
8. Navigate to C:\Program Files\IBM\Lotus\Notes and click Save, to save *showstat.scr* to your Notes directory.
9. Launch the Server.Load utility, select Start > Run from the menu, and enter C:\Program Files\IBM\Lotus\Notes\slod.exe. The Lotus Server.Load graphical user interface (GUI) opens.
10. In the Test Type section, select Custom and then click Browse; the Open window displays. Navigate to C:\Program Files\IBM\Lotus\Notes, select *showstat.scr*, and click Open.
11. Select the Test Parameters tab and complete the fields as shown in table 4.

Table 4. Values for Test Parameters tab fields

Field	Value
Number of Users/Threads	1
Script Loop Count	1
Thread Creation Interval	1
Starting Thread No.	1
Test Time Parameter	Specify total test time (in minutes)
Total Test Time (in minutes)	Set to be greater than or equal to the total run of the workload drivers.
Build Recipient List using Name and Address Book (for example: domino/mycompany!!NAMES.NSF)	sut/domain!!names.nsf
Storage test output to	Z:\results\datacollection.txt

12. Click Execute to access the Metrics window.
13. Set the "Server to Receive Console Commands" field in the Metrics window to blank. Server.Load does not need to authenticate with a server for this script.
14. Before clicking Start Test, finish preparing the workload drivers before continuing. The data collection script should be started just prior to starting the first workload driver, and it should not be stopped until all workloads are completed.

4.8 The N8Mail workload

The N8Mail Workload models an active user on a Notes 8 client, acting on a Domino 8 server performing the same set of calendaring and mail operations. To learn more about this workload, visit the [IBM Lotus Domino 8 information center](#).

4.8.1 Preparing to run the N8Mail workload

Prior to running this workload you should have run the N8Mail Initialization workload to create the total number of users that you want to simulate and test. Each Client driver can handle from 500 to 1500 simulated users.

If you want to test a larger number of users, you must set up additional client driver systems before proceeding. Ensure that you've synchronized the time on all servers and clients before running this workload.

4.8.2 Running the N8Mail workload

1. On the SUT, do the following:
 - a. Start the Calendar Connector task (Calconn).
 - b. In the Configuration Settings document on the Router/SMTP Basics tab, set the "Number of mailboxes" field to 1 or higher.

NOTE: The server must be restarted for this change to take effect. We used two mailboxes, but one mailbox may be enough; it depends upon how many mail users you have and how high the mail waiting statistic gets.

- Set the Notes.ini settings (see table 5) on each client driver that will run the N8Mail Workload. **NOTE:** *MailRecipientBeginNumber* and *Mail RecipientEndNumber* should correspond to the *Starting Thread Number* and *Number of Users/Threads* in step 6 below.

Table 5. Notes.ini settings

Notes.ini setting	Description
Domain=mycompany	SUT's Domain
NB_PERCENT_ATTACHEMENTS_READ=25	What percentage should be read out of all attachments encountered.
NABENTRIES=1	Number of valid users on the server.
NB_MailRealFromField=1	The Notes ID file.
MailRecipientBeginNumber=1	Beginning range of users from which to choose a random recipient.
MailRecipientEndNumber=1200	End of the range of users from which to choose a random recipient.
ContextIteration1=24	Iteration interval to add a calendar appointment (24 = every 6 hours).
ContextIteration2=24	Iteration interval to send a meeting invitation (24=every 6 hours).
ContextIteration3=24	Iteration interval to respond to a calendar invite (24=every 6 hours).
RUNTIME=9999	How Long over all the entire test should run (9999=forever)
NB_MAIL_SAVE_MESSAGE=1	When sending a memo, save to the Sent folder.

- Launch the Server.Load utility. Select Start > Run from the menu and enter C:\Program Files\IBM\Lotus\Notes\slod.exe. The Server.Load GUI opens.
- In the Test Type section, select Built-in and the Select N8Mail workload from the drop-down menu.
- Select the Test Parameters tab and enter the values shown in table 6. (If you are running the test on multiple clients, increment the value of the Starting Thread No. parameter when you run the test on each client.)

Table 6. Values for Test Parameters tab fields

Field	Value
Number of Users/Threads	600
Script Loop Count	9999
Thread Creation Interval	1
Starting Thread No.	1
Test Time Parameter	Specify total test time (in minutes)
Total Test Time (in minutes)	240
Build Recipient List using Name and Address Book (for example: domino/mycompany!!NAMES.NSF)	sut/domain!!names.nsf
Storage test output to	C:\results\n8workloadDrivern.txt

6. Select the Script Variables tab and enter the values shown in table 7 for each variable listed.

Table 7. Script variables values

Value	Variable Name
CN=domino/O=mycompany	MailServer (for example: domino/mycompany)
mail\	nb_dbdir
domino\mycompany!!mail8.ntf	MailTemplate
0	NB_N8_NUM_READ_ENTRIES
0	%NUMCALETRIES%
1	N8_ENABLE_V801_TRANS
2	NB_ReplyNthIteration
1	NB_Memo1NumRecipients
1	NB_Memo1NthIteration
3	NB_Memo2NumRecipients
2	NB_Memo2NthIteration
3	NB_InvtNumRecipients
9999	ScriptIterationLimit

7. Click File > Save Setting, to save these settings.
8. Click Execute to open the Server.Load Metrics window.
9. For each metric you would like to collect, select it from the Script Metrics or Server Stat Metrics pull-down list and then click the Add Metric button. To delete a metric, select it and then click the Delete Selected Metric button.

NOTE: Do not select any additional metrics if you are running this workload in conjunction with the Workload Data Collection and Workload Data Rollup scripts.

10. Verify that the Server to receive Console Commands field matches the SUT (for example, CN=domino/O=mycompany); if it doesn't, enter the correct value.
11. Enter the location of the file in which to store the metrics, that is, Z:\results\RES1.

NOTE: If you'll be using the Workload Data Collection and Rollup scripts, these must be stored in files with the name **RESn**, where **n** is the number of the corresponding workload driver.

12. Before clicking Start Test to initiate the workload, you should prepare all your drivers, initiate any OS statistics collections using a tool such as perfmon or nmon, and start the Workload Data Collection test.

4.9 Workload Data Rollup feature

The Server.Load Workload Data Rollup feature is adapted from the NotesBench data rollup feature. It allows test data from a group of test drivers and an SUT to be combined into a single data file for analysis.

While a workload runs, the Workload Data Collection custom script, SHSTAT.SCR, collects performance data from the SUT. When the workload is complete, the Workload Data Rollup script rolls up the performance data.

1. In the Workload Data Rollup driver's Notes.ini file, include the settings shown in table 8.

Table 8. Notes.ini settings#

Notes.ini setting	Description
ResultsDirectory=Z:\	Where Z:\ is mapped to the results directory created prior to running the Workload Data Collection Script.
NB_SteadyStateTime=45	Enter the number of minutes that you want to disregard in order to ensure you are getting steady state data. If you do not set this variable, the default of 30 minutes applies.
NB_MeasureTime=60	Enter the number of minutes after steady state that the rollup should read data (length of the real test). If you do not set this variable, the default of 60 minutes is used. If you specify a test length value greater than that which is in the data file, Server.Load stops at the end of the file.
NB_SaveCMDConsole=0	Set this value to zero (0) prior to running the Workload Data Rollup script. <i>Note: If this value is not set then the default value of 1 is used, and the file will be overwritten during initialization.</i>
NB_NumOfClients=2	Enter the number of regular drivers in the run. The default is 20
NB_Rollup=1	Enter 1 to enable the Data Rollup Workload to run.

2. Launch the Server.Load utility. Select Start > Run from the menu and enter C:\Program Files\IBM\Lotus\Notes\sload.exe. The Lotus Server.Load GUI opens.
3. In the Test Type section, click Built-in and then select "Workload Data Rollup" from the Built-in scripts menu.
4. Select the Test Parameters tab and complete the fields with the values shown in table 9.

Table 9. Values for Test Parameters tab fields

Field	Value
Number of Users/Threads	1
Script Loop Count	1
Thread Creation Interval	1
Starting Thread No.	1
Test Time Parameter	No time limit
Total Test Time (in minutes)	Set to be greater than or equal to the total run of the workload drivers.
Build Recipient List using Name and Address Book (for example: domino/mycompany!!NAMES.NSF)	sut/domain!!names.nsf
Storage test output to	Z:\results\datarollup.txt

5. Click Execute to access the Metrics window.

6. Set the "Server to Receive Console Commands" field in the Metrics window to blank. Server.Load does not need to authenticate with a server for this script.
7. Click Start Test. The data rollup output resides in the data file *NB_Domstat.csv* containing the averaged client data, along with any relevant SH STAT data. This file is located in the ResultsDirectory specified in the Notes.ini setting.

5 Graphing and charting the results

Significant statistics for Domino server performance include CPU utilization, Disk I/O operations per second, network utilization, Domino server response time, and Domino server Availability Index. In this section, we examine the results of these statistics for a Domino 8.0.1 server running the N8Mail Workload at loads of 600 and 1200 users, on both Windows 2003 and Red Hat Enterprise Linux 5.2.

5.1 Linux results

The main sources of graphing and charting results from the Red Hat Enterprise Linux (RHEL) 5.2 Server Load Test are the Domino Server Load Workload Data Rollup file *NB_domnstat.csv* and OS statistics collected by nmon in conjunction with the nmon analyzer tool.

Table 10 shows a sample of the first few lines of *NB_domnstat.csv*. As with the Windows testing, each client driver simulated a load of 600 users. The first driver ran for 4 hours, and the second driver, which was started 2 hours after the first driver, ran for 2 hours.

Table 10. Sample *NB_domnstat.csv*

Client Drivers	1	2
Active Users	600	1200
Transactions per Minute	59	118
Response Time	0.20	0.22
Warnings	0	0
Errors	0	0
Failures	0	0
Start Time	9:43 AM	11:44 AM
End Time	10:43 AM	12:44 PM
Date	12/1/08	12/1/08
Workload_Name		
Server_Name	lin	
Platform.LogicalDisk.1.AssignedName	sda	sda
Platform.LogicalDisk.1.AvgQueLen	0.01	0.02
Platform.LogicalDisk.1.AvgQueLen.Avg	0.01	0.01

The start time of 9:43 above corresponds to the initial steady-state time. We actually started the N8Mail workload for the first client driver at 8:58 am, and set NB_SteadyStateTime=45 in the Notes.ini file before running the Workload Data Rollup script.

Again, these time frames are important because they represent the steady-state time from which you should compare results from the OS results, *dominoperfmon.csv*.

To graph and chart these results, we used Domino Server Load Workload Data Rollup output *NB_Domstat.csv* and the OS statistics collected by nmon in *lin_081201_0850.nmon*, in conjunction with the nmon analyzer tool.

Table 11 shows sample output from running nmon on the RHEL 5.2-based Domino server. (The output file *lin_081201_0850.nmon* was renamed *lin_081201_0850.csv* so that the spreadsheet editor would recognize it as a CSV file.)

Table 11. lin_081010_0818.csv

AAA	progname	nmon_x86_fedora5
AAA	command	./nmon_x86_fedora5 -ft -s 60 -c 280
AAA	version	11f
AAA	disks_per_line	150
AAA	max_disks	256
AAA	disks	10
AAA	host	lin
AAA	user	root
AAA	OS	Linux
AAA	runname	lin
AAA	time	08:50:08 AM CST
AAA	date	12/1/08
AAA	interval	60
AAA	snapshots	280
AAA	cpus	2
AAA	note0	Warning - use the UNIX sort command to order this file before loading into a spreadsheet
AAA	note1	The First Column is simply to get the output sorted in the right order
AAA	note2	The T0001-T9999 column is a snapshot number. To work out the actual time; see the ZZZ section at the end

Notice that nmon was started before the first Domino N8Mail Workload driver was started. The data that corresponds to steady-state time will correlate to the Start and Stop times in *NB_domstat.csv* above. To process this data we use the nmon analyzer, which sorts and plots all the information produced by nmon.

5.2.1 Linux charts and graphs

Tables 12 and 13 and figure 25 below show the significant performance statistics for our Linux testing. Although it is possible to use any spreadsheet editor that recognizes CSV format, the nmon analyser requires Microsoft Excel 2002 or later.

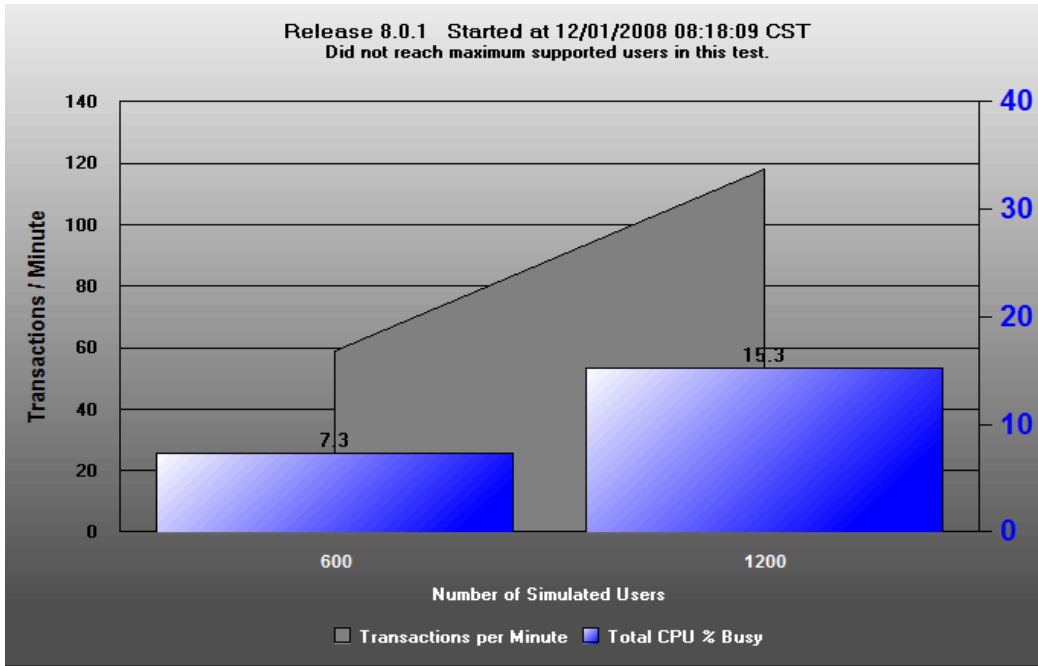
Table 12. Server configuration settings (Linux)

Server Configuration Settings	
Workload_Name	N8Mail
Server_Name	lin
Server.Version.Notes	Release 8.0.1
Server.Time.Start	12/01/2008 08:18:09 CST
Server.Version.OS	Linux 2.6.18-92.el5PAE #1 SMP Tue Apr 29
Server.CPU.Count	2
Server.MailBoxes	2
Database.Database.BufferPool.Maximum.Megabytes	512
Database.DbCache.MaxEntries	1536
Database.DBUCache.MaxEntries	2560
Database.RM.Sys.Logged	Disabled
Platform.Memory.RAM.TotalMBytes	4050.77
Domino.Config.ActiveThreads.Max	40

Table 13. Results (Linux)

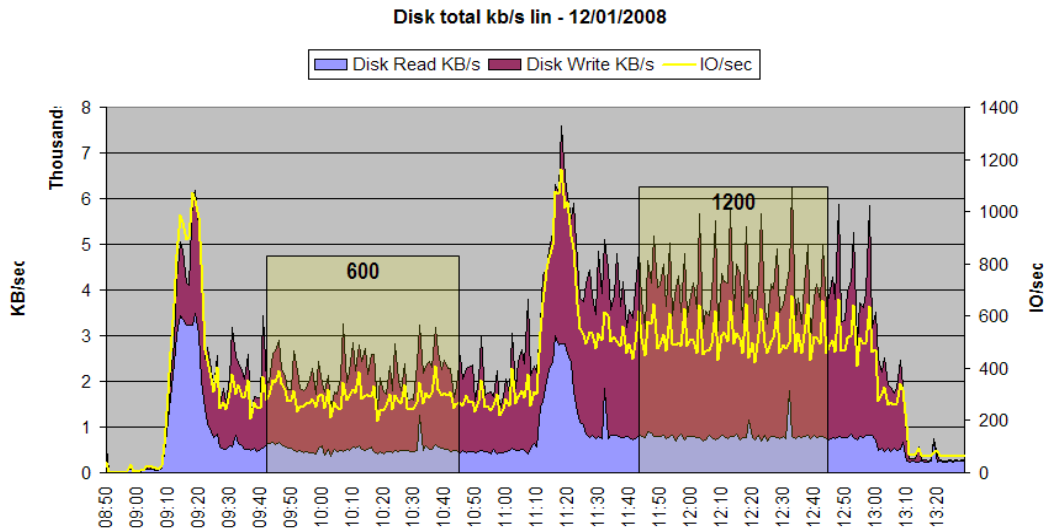
Results		
Active Users	600	1200
Transactions per Minute	59	118
Platform.System.PctCombinedCpuUtil	7.31	15.34
Response Time (milliseconds)	195.93	220.65
Platform.System.PctTotalPrivilegedCpuUtil	1.05	2.17
Platform.System.PctTotalUserCpuUtil	6.26	13.17
Platform.Network.Total.NetworkBytesPerSec	397761.46	812277.63
Server.AvailabilityIndex	44	32
Server.ExpansionFactor	10.331907.31	16.77314211
Platform.Memory.RAM.AvailMBytes	154.18	157.65
Platform.System.ContextSwitchesPerSec	1666.81	2676.84
Mail.Delivered	6558	35759
Mail.DeliveredSize.100KB_to_1MB	364	2012
Mail.DeliveredSize.10KB_to_100KB	3212	17448
Mail.DeliveredSize.1KB_to_10KB	2501	13668
Mail.DeliveredSize.1MB_to_10MB	16	102
Database.NSFPool.Used	19564128	25072512
Database.Database.BufferPool.PerCentReadsInBuffer	98.94	100

Figure 25. Transactions rate and CPU utilization



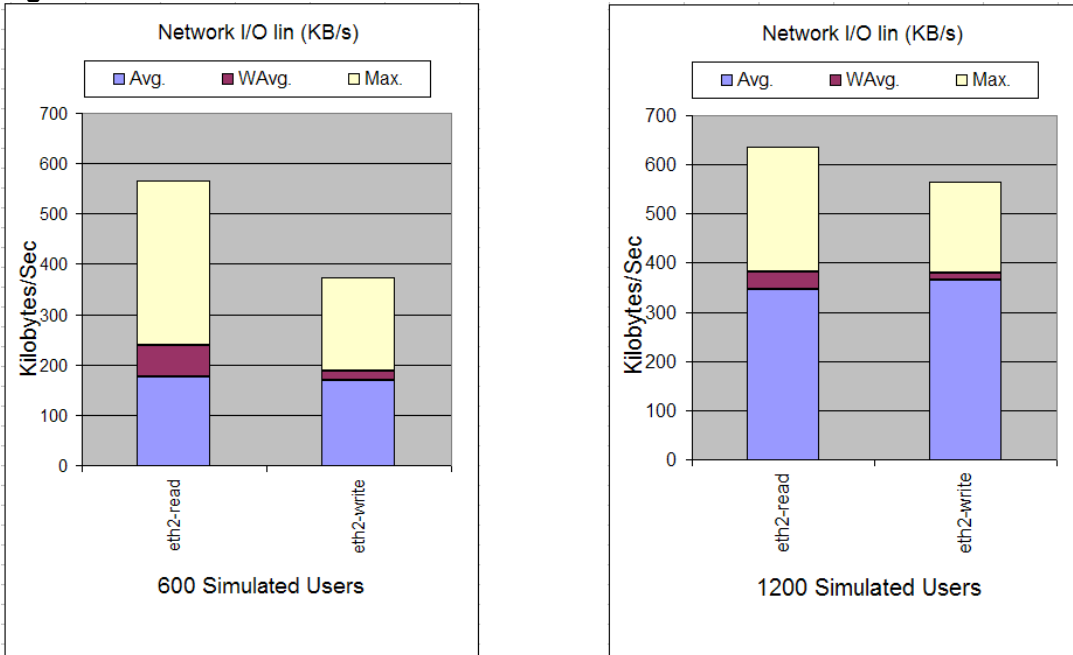
The graph in figure 26 was produced by nmon analyser and shows disk utilization statistics for the Domino server. The boxes labeled 600 and 1200 represent the corresponding steady-state time when the N8Mail Workload is running with 600 and 1200 simulated users, respectively.

Figure 26. Disk usage statistics



Finally, the two charts in figure 27 present the network statistics pulled from nmon analyser for the corresponding steady-state time with 600 and 1200 simulated users.

Figure 27. Network statistics



6 Conclusions

Domino Server.Load is a powerful tool for gathering performance data for the Lotus Domino server. It should be used in conjunction with OS-specific utilities, such as nmon on Linux and Perfmon on Windows, for gathering and charting performance data.

Tuning a Domino server for performance involves multiple variables, including the OS, the file system, the network, Domino Notes.ini settings, and Domino server tasks. Discovering what settings work best in your particular environment is a matter of identifying your system's weaknesses and correcting them.

The results published here should not be used to compare the performance of Lotus Domino on Linux to that of Lotus Domino on Windows, as we've not exhausted all the tuning options on either platform.

NOTE: The results presented in this paper are from benchmarks executed in a limited and controlled environment; they do not represent recommendations for a production environment. For assistance with Lotus Domino capacity planning, it is recommended that you consult your hardware vendor and IBM Techline, which handles capacity planning for new hardware.

7 Resources

- [IBM Lotus Notes and Domino information center](#)
- [developerWorks Lotus product page](#)
- [Introduction to Domino Performance Tuning](#)
- [IBM Lotus Domino v8 Server with the IBM Lotus Notes V8 client: Performance](#)
- [Quick start guide to IBM Lotus Domino Server.Load V8](#)

8 About the authors

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*The Linux Integration Center (LIC) is a part of IBM Software Group. It's a world-wide pre-sales technical support and integrated solution team supporting the IBM Sales team in bringing Linux technology into the marketplace.

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