Chapter 4. Installing and configuring a Domino cluster

This chapter will cover the installation and configuration steps for clusters using Domino Enterprise Server Release 5.0.4a. Initially, we discuss installing Domino servers running on Windows 2000. Then, in 4.4, "Installing Domino R5 for Linux on IBM Netfinity servers" on page 106, we cover the areas that are significantly different when your servers are running Linux as their base operating system.

We will focus on the following topics:

- Installing a new cluster
- Modifying the cluster configuration (by adding, moving, or deleting a server)
- Upgrading a standard server to a clustered server
- Configuring calendaring and scheduling in a cluster
- Configuring Internet Cluster Manager (ICM)
- Hints and tips for installation problems

We will also discuss specifics of the installation and configuration steps for the Domino Enterprise Server Release 5.0.4a on Linux.

4.1 Prerequisites

In order to install Domino Cluster features, you must have installed and configured a working Windows 2000 server environment. You must also have configured the network protocols that will be used in your Domino environment.

Lotus Domino Enterprise Server requires the TCP/IP protocol for communication between cluster members. You can install and configure other protocols to be used in the Domino environment and the clients can access the databases using those protocols. It is necessary for all servers in a cluster to be configured with a consistent set of network protocols.

> **Protocols**
>
> Although other protocols may be used in addition to TCP/IP, we recommend that you use TCP/IP for both client to server and inter-server cluster communications if possible. The Domino cluster solution is optimized for TCP/IP, and provides faster failover times for clients using it than with other protocols.

The minimum system requirements for Domino clustering are listed in the following table.

Table 5. Minimum system requirements for Domino clustering

Feature	Windows 2000	Linux
Operating system	Windows 2000	Red Hat 6.0 (and later) Caldera 2.2 (and later) SuSE 6.3 (and later) TurboLinux 6.0 (and later)
Processor types	133 MHz or higher Pentium-compatible	Intel x86
SMP Support	Yes	Yes
RAM	128 MB or more minimum (256 MB recommended)	64 MB minimum
Disk space	2 GB (with a minimum of 1 GB free space)	750 MB minimum (1 GB or more recommended)
Protocols	TCP/IP SPX SPX II NetBIOS, NetBEUI AppleTalk VINES X.PC	TCP/IP X.PC

System requirements may vary greatly depending on the number of concurrent clients accessing the server, the database sizes, the transaction rate per second, and the number of replicated databases in the cluster.

In general, Domino clustering will require more resources than a standard Domino server. The following list indicates the major factors that influence resource requirements.

- The more replicas you create, the more disk space you need and the more processing power you need for cluster replication.
- The more servers in the cluster, the more processing power each server uses to communicate with the other cluster servers.
- The more server tasks and CPU-intensive applications you run on a server, the more processing power you need.
- The more users a server has to handle concurrently, the more memory the server needs to keep performance acceptable.

All servers in a cluster must run the Domino Release 5 or Release 4.62 Enterprise server license, or the Domino Release 4.5 or Release 4.6 Advanced Services license. All necessary software is included on the Lotus Domino CD-ROM.

To install a Domino cluster, the following conditions must be met:

- All servers in a cluster must be connected using a high-speed local area network (LAN). You can also set up a private LAN to separate cluster traffic from client traffic.
- All servers in a cluster must use TCP/IP and be on the same Notes named network.
- All servers in a cluster must be in the same Domino domain and share a common Domino directory.
- You must specify an administration server for the Domino Directory in the domain that contains the cluster. If you do not specify an administration server, the Administration Process cannot change cluster membership. The administration server does not have to be a member of a cluster or be running the Enterprise Server license.
- Each server in a cluster must have a hierarchical server ID. If any servers have flat IDs, you must convert them to hierarchical IDs to use them in a cluster.
- A server can be a member of only one cluster at a time.
- Each server must have adequate disk space to function as a cluster member.
- Each server must have adequate processing power and memory capacity.

With these prerequisites in place, you can now install Domino.

4.2 Hardware setup

All of the examples discussed in this chapter use the same hardware. The configurations we discuss are genuine ones that we constructed in our server lab. We chose to run Domino on four IBM Netfinity servers: two IBM Netfinity 7000 M10 4-way servers and two IBM Netfinity 5500 servers. The IBM Netfinity 7000 servers were equipped with 2 GB memory, 18 GB disk space on ServeRAID-attached disks, and IBM Token-Ring and IBM Ethernet adapters for network connectivity. All of the hard disks on a particular server were configured as a RAID-5 array, then as a single logical drive within the array. This logical drive then appears to the operating system as a single physical drive. We installed Windows 2000 on the two IBM Netfinity 7000 M10 servers and partitioned the logical drive as shown in the following table:

Table 6. Disk configuration on Windows 2000 server

Drive letter	Space	Component
C:	2 GB	Operating system
D:	4 GB	Paging file
		Domino program files
E:	8 GB	Domino databases
F:	4 GB	Domino transaction log

The two IBM Netfinity 5500 servers were equipped with 256 MB memory, 18 GB disk space on ServeRAID-attached disks, and IBM Token-Ring and IBM Ethernet adapters for network connectivity. All of the hard disks on a particular system were grouped into a RAID-1 array and defined as one logical drive. This logical drive then appears to the operating system as a single physical drive. On these IBM Netfinity 5500 servers we installed two different distributions of Linux. For one server we used Red Hat 6.2, and, for the other, SuSE 6.4.

We partitioned the logical drive as shown in the following table:

Table 7. Disk configuration on Linux server

Mount point	Partition size
/	256 MB
<swap>	See accompanying text
/boot	50 MB
/home	512 MB
/data	4096 MB
/data/log	1024 MB
/opt	1024 MB
/tmp	512 MB
/usr	2048 MB
/var	512 MB

If your server has less than 512 MB of memory, the swap partition should be three to four times the size of your physical RAM. If your RAM size is 512 MB or more, then set the swap partition size equal to the amount of RAM you have in your system. For our configurations, we allocated 1 GB to the Linux swap partition.

Swap partition size limit

Note that the maximum supported swap partition size for the latest kernel 2.2-based Linux distributions is approximately 2 GB. Kernels prior to 2.2 limit swap partitions to 128 MB. For these earlier kernels, larger partitions can be allocated, but waste space, since only the first 128 MB are actually used. To provide more than 128 MB of swap space requires that you configure multiple swap partitions. These can be located inside a disk's extended partition.

The hardware setup used here is not intended as a recommendation. The actual hardware required to provide Notes or Web clients with acceptable response times varies greatly from one installation to another, depending upon many factors including network infrastructure, number of users, and the types of applications and services provided.

To keep our lab systems relatively simple, we used a single array/logical drive configuration as already discussed. You will want to pay more attention to organizing your disk subsystem to optimize performance. Deciding exactly where the various files used by Domino should be located is quite crucial for performance. See 2.3, "Planning cluster hardware" on page 21 to read more about hardware components considerations for your cluster, including a discussion about the disk subsystem.

Disk organization and performance

This scope of this book prevents a detailed discussion of disk organization and the potential impact it can have on server performance. It is, however, worth mentioning one or two items of particular relevance:

- Placing the swap partition on a dedicated drive or on its own RAID array can give performance advantages. Using an array gives the added advantage that multiple disk spindles are active simultaneously, providing greater throughput than for a single disk.
- A similar argument applies for Domino R5's transaction logs. Whenever possible, a separate dedicated disk drive or array should be used for these logs.

For more information about Domino performance, see the IBM Redbook *Netfinity and Domino R5.0 Integration Guide*, SG24-5313. A useful guide to improving server performance in general is another Redbook, *Tuning Netfinity Servers for Performance*, ISBN 0-13-040612-0.

Figure 15 illustrates the network and the Domino servers we installed in our lab environment:
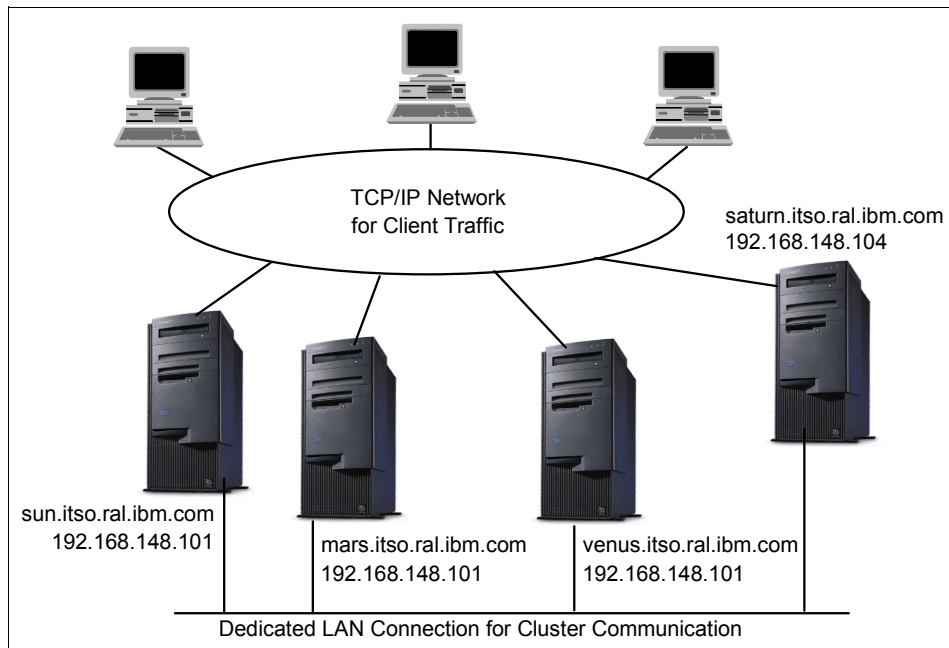
Figure 15. A four-node Domino cluster

All servers were connected using a dedicated Ethernet LAN connection.

We installed a 10/100 Mbps Ethernet adapter in each server, each connected to an Ethernet hub, to create a private network for the cluster traffic. Although this setup requires more hardware than would be necessary if the client network were used for cluster traffic, the resulting solution reduces traffic on the client network, and the additional cost is relatively small.

The network load that the cluster traffic will generate depends on the number of clustered nodes and number of update transactions between nodes. We therefore particularly recommend this approach for Domino clusters that provide service to large numbers of users or that will generate significant cluster traffic.

Lotus Domino Server can use any network topology supported by the underlying operating system.

4.3 Installing a new Domino cluster

In this section we will describe how to install Lotus Domino Enterprise Server and how to configure a cluster.

The installation steps can be summarized as follows:

1. Install the first Domino server.

2. Configure the first Domino server:

    a. Configure the server name, organization and domain.
    b. Configure the ports, protocols and named network.
    c. Start the server.

3. Prepare to install the remaining cluster servers:

    a. Create the certification log.
    b. Register additional servers.

4. Install and configure the remaining cluster servers. For each of them:

    a. Install the program files.
    b. Configure the server name, organization and domain.
    c. Configure the ports and protocols and named network setup.
    d. Start the server.

5. Create the cluster:

    a. Create the cluster using the Domino Directory.
    b. Verify that the cluster database directory file is replicated or replicate the file manually to all the servers in the cluster.
    c. Configure the communication port for the backbone communication between the servers participating in the cluster.

6. Test the cluster.

We now take you through each of these steps in turn.

4.3.1 Installing the first Domino server

Installing the first Domino server consists of the following simple steps. Note that TCP/IP is the only protocol stack used at this point of the cluster installation.

1. Insert the Lotus Domino CD-ROM and start the server installation program from an appropriate directory.

2. Read and accept the license terms.

3. Enter the user registration information.

4. In the Lotus Domino Installation window, select the program and data directories to be used for the Domino server.

   It is a recommended practice to install the Domino data directory on a dedicated partition. In our case we used the drives as defined in Table 6 on page 80.

5. Select the **Domino Enterprise Server** radio button to install a Domino server that includes Domino clustering as shown in Figure 16:
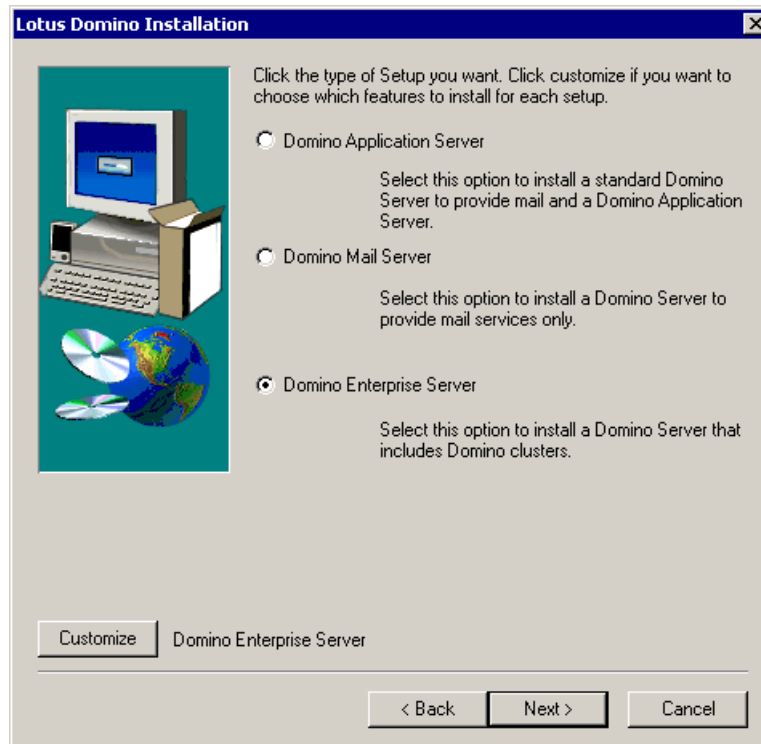

Figure 16. Domino Enterprise Server installation

6. Click **Customize** and select the components you want to install; Domino as an NT service, for example.

7. Installation will add program icons to the Lotus Applications folder. You may type a new folder name.

8. Click **Next** and the installation process will proceed to completion.

4.3.2 Configuring the first Domino server

This section, describing the configuration of the first server, is divided into two parts: the general configuration and the port and named network configuration.

4.3.2.1 General configuration

After the code installation phase has completed, the server must be configured in the same way as a standard Domino server. To configure the first server follow the steps below:

1. Select **Start -> Programs -> Lotus Applications -> Domino Server**. When you start the server for the first time after installation, the Domino setup client will run automatically.

2. Select the **First Domino Server** radio button in the first setup window.

3. Select **Advanced setup** in the second setup window.

4. Select the additional services that you want to run in the New Domino Server third setup window.

Web clusters

If you plan to provide failover benefits to Web clients, you will need to select Domino's HTTP service for installation. Remember to disable the Windows 2000 World Wide Web Publishing service provided by Microsoft's Internet Information Server (IIS) if this is installed.

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5. Enter the required information for the Domino server in the last setup window. Figure 17 shows the setup and naming conventions for our lab setup.
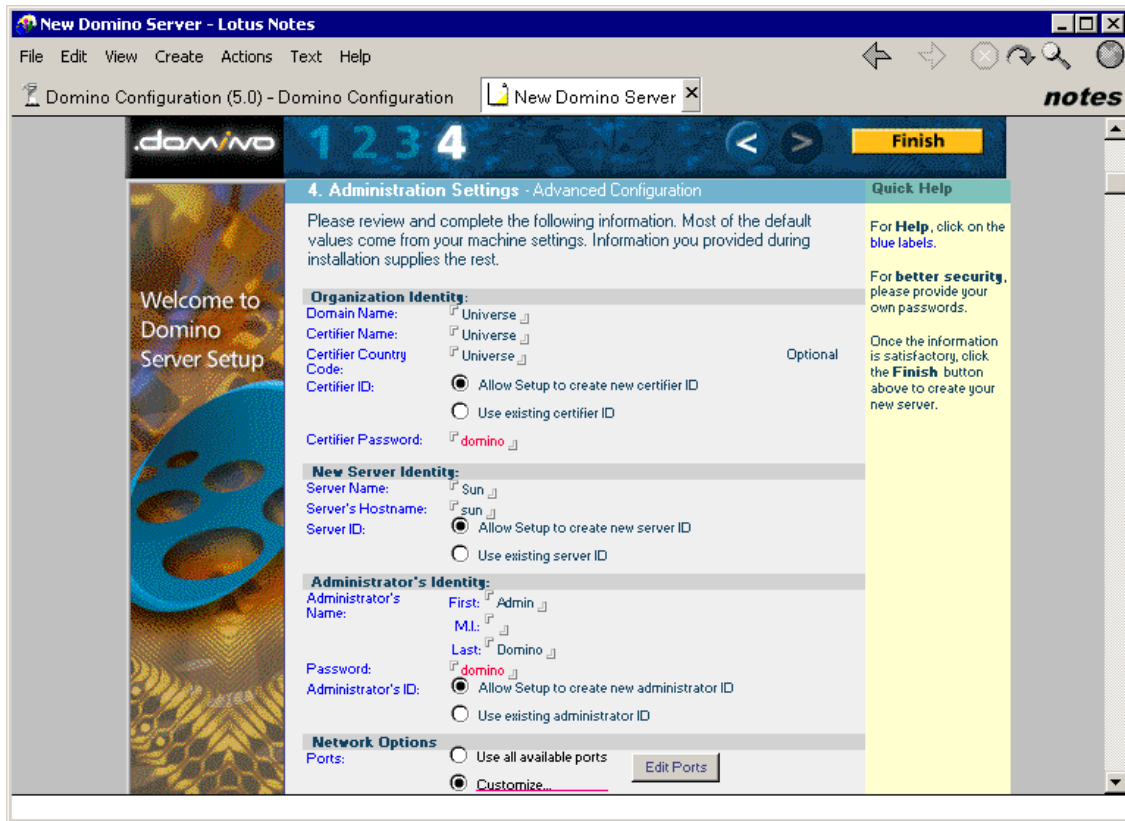
Figure 17. The first Domino server configuration

Note that we have opted to configure the ports manually. This is done so that all the unwanted protocols will be disabled.

6. To configure the ports during the initial configuration, select **Customize...** in the Network Options section and click **Edit Ports**. The Port Setup window is displayed.

7. Disable all but TCP/IP and verify that the settings for the port are correct, then click **OK**. The Port Setup window for the example setup configuration is shown in Figure 18:
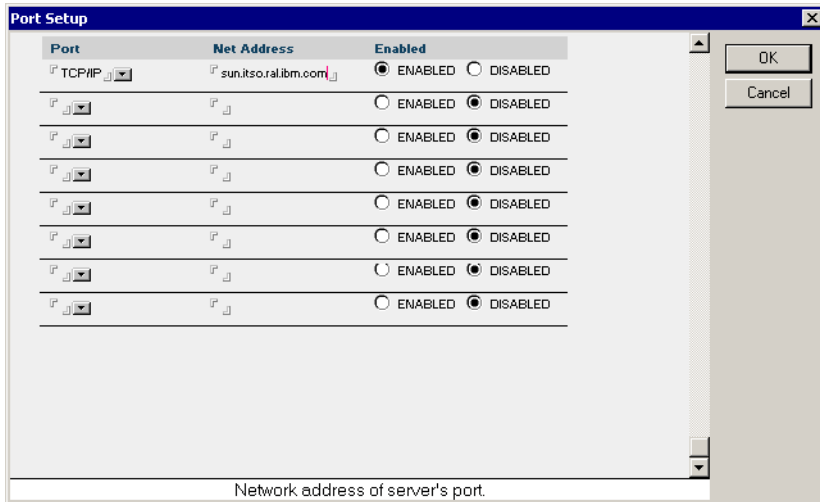
Figure 18. Modifying the port settings

8. After filling in the required configuration information, complete the setup process by clicking **Finish** (Figure 17).

9. After completing the Notes configuration, it is recommended that two settings are changed to optimize the Windows 2000 environment for the Domino server:

   - Select **Start -> Settings -> Control Panel -> System Properties -> Advanced** tab. Click **Performance Options** and select **Background services** as shown in Figure 19:
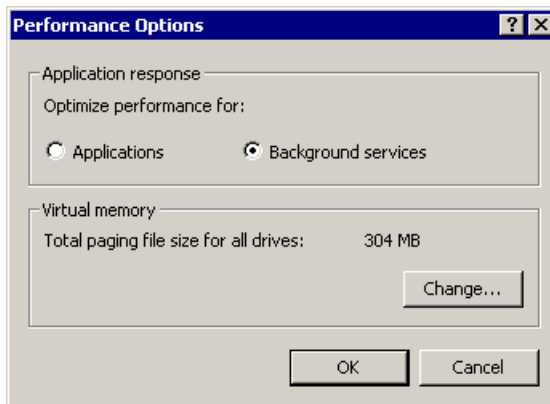

Figure 19. Changing Windows 2000 performance options

Click **OK** to close the dialog box.

Informational message

Using Windows NT 4.0, this setting eliminates the following
message, displayed in the Domino console during startup:

```
Informational: The registry value
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\PriorityControl\
Win32PrioritySeparation is currently set to 2. For better server
performance, change the setting to 0
```

Using Windows 2000, the setting changes the value from 38 to 24
and the message is still displayed. It can safely be ignored.

- Select **Start -> Settings -> Network and Dial-up Connections**.
- Double-click the icon for the network adapter being used by the Domino
  server, and click **Properties** in the Status window that appears.
- Select **File and Printer Sharing for Microsoft Networks**. Click
  Properties and select **Maximize data throughput for network
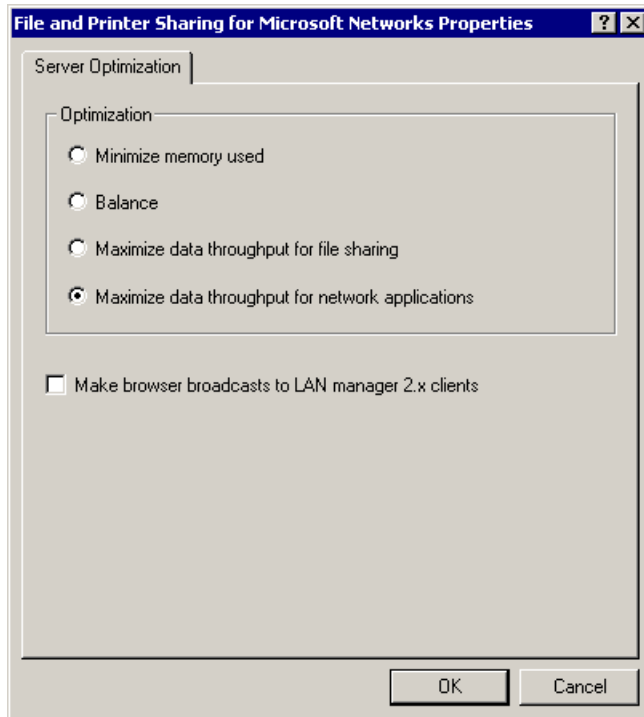 applications** as shown below:

Figure 20. Maximizing server throughput

4.3.2.2 Port and named network configuration on the first server

We have emphasized the benefits of using a private network for cluster traffic several times. In our lab environment we used a token-ring network for client traffic and Ethernet for the private cluster network.

In the initial Domino server configuration we enabled the TCPIP port for client traffic. Now we have to set up another port to handle the cluster traffic. These are the steps we used:

1. From the Domino Administrator, select the **Server** tab.

2. Choose the server from the Servers pane.

3. From the Tools pane, choose **Server -> Setup Port**.

4. In the Communications Ports box, click **New** to create a new port name. We chose TCPCLUST. Do not use spaces in the name.

5. Select the TCP driver.

6. Select the **Port Enabled** check box. You should now have the following information displayed in the Port Setup dialog box:
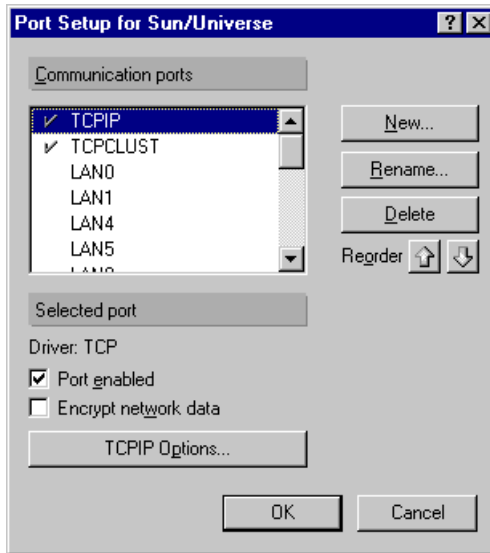
Figure 21. Creating a new port for cluster replication

Click **OK** to confirm your choices and close the dialog box.

7. From the **Configuration** tab, open the appropriate Server document in edit mode.

Select the **Ports -> Notes Network Ports** tab, and enter values for the new port as shown below:
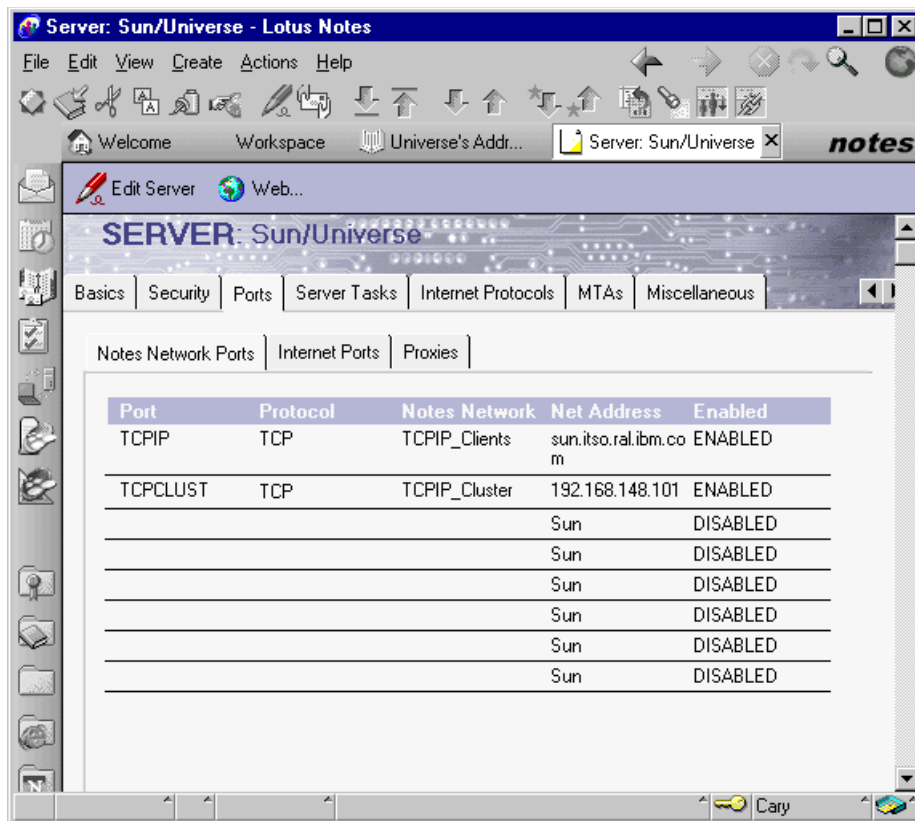
.

Figure 22. Defining a port for cluster traffic

Host name or static IP address?

If you are using host names instead of static IP addresses, make sure that the IP address can be resolved using DNS. If you are in any doubt about the reliability of DNS, use either static addresses or resolve the name in the server's hosts file. The hosts file is located in the \WINNT\system32\drivers\etc directory on Windows 2000 server and in the \etc directory on the Linux server.

---

8. Save and close.

9. Finally, you should modify the NOTES.INI file to assign IP addresses to these ports. You will add TCP/IP address parameters for each port:

   `<TCPIP PortName>_TCPIPAddress=0,IP,port`

Parameters are described in the following table:

Table 8. Setting TCP/IP port parameters

Parameter	Description
PortName	Port name as defined on the Ports tab in Figure 22.
IP	TCP/IP address for that port. Verify that it is the same address as defined in the Windows 2000 network configuration.
port	TCP/IP port number on which the Domino server listens. This value should be set to zero or to the default Domino TCP/IP port 1352.

Here is example of settings that we added to NOTES.INI file on one of our Domino servers in the cluster:

```
TCPIP_TCPIPAddress=0,9.24.104.198,0
TCPCLUST_TCPIPAddress=0,192.168.148.101,0
```

In our lab cluster, the `TCPIP` port was used for client connections and it used a real, registered TCP/IP address. `TCPCLUST` was the port we defined to provide a dedicated connection between servers in the cluster, our private LAN. We recommend that you use addresses from the TCP/IP address space reserved for private networks. According to the TCP/IP standard (RFC 1597), there are three private network address ranges, one for each address class:

- 10.0.0.0 to 10.255.255.255 (class A)
- 172.16.0.0 to 172.31.255.255 (class B)
- 192.168.0.0 to 192.168.255.255 (class C)

4.3.3 Preparing additional cluster servers

The next step is to create server IDs for the remaining servers to be added to the cluster.

4.3.3.1 Creating the Certification Log

Before creating IDs for additional servers or users, you need to create a Certification Log for your Domino domain. Select **File -> Database -> New...** to invoke the New Database dialog box as shown in Figure 23:
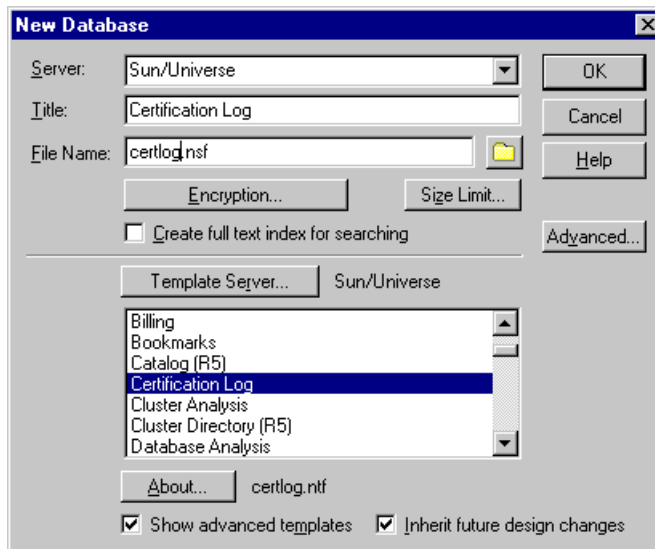
Figure 23. Creating the Certification Log database

The database name has to be CERTLOG.NSF. Also, remember that you need to select the administration server from the server list rather than the local server. Click **OK** to create the database.

4.3.3.2 Registering additional servers

Before you install additional servers, you must register them. In effect, registering a server adds the server to the domain. The server registration process creates both a Server document for the server in the Domino Directory and a server ID.

To complete this process, the following prerequisites must be in place:

- The registration server, that is the one from which you register other servers, must be up and running.

- You must have access to the registration server and have at least Author access with the ServerCreator role in the Domino Directory's ACL.

- You must have access to the certifier ID and its password.

To register each additional Domino server, follow the steps below:

1. From the Domino Administrator, click the **Configuration** tab.

2. From the Tools pane, click **Registration -> Server**.

3. Enter the certifier ID password and click **OK**.

Domino uses either the certifier ID specified in Administration Preferences or the ID specified in the CertifierIDFile setting of NOTES.INI. If you want to switch from one to the other, click **Certifier ID** and make your selection.

4. Choose the Administration server as your registration server by using the **Registration Server...** button.

5. Select the security type and enter the expiration date of the server certificate.
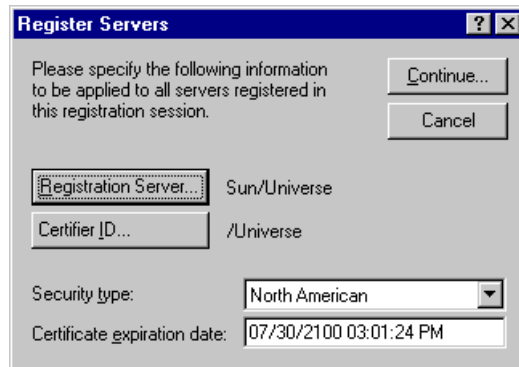
6. Click **Continue**.

Figure 24. Registering an additional Domino server

7. In the **Basics** window, enter values for the Domino server name, Password, Domino domain and Administrator.

Figure 25. Setting the server's name

8. Select the **Other** icon and enter values for Server title, Network, and Local administrator.

9. By default Domino stores the server ID file in the Server document of the Domino Directory. Instead of storing it in the Server document, you can store the ID in another location. To select another location, click **Set ID file** and select the name and path for the file. Click **Save**.

10. Finish the server registration by clicking the **Register** button.

Repeat the above steps for each server that you intend to add to the cluster. At the end of this step, all members of the cluster will be registered.

4.3.4 Installing and configuring additional cluster servers

This step includes information on how to install and configure the remaining Domino servers. Repeat the following process for each additional server.

4.3.4.1 Installation

Install the Domino server software in the same way as you did when installing the first Domino server. You must install Domino Enterprise Server on each server that will be added to the cluster.

4.3.4.2 Server configuration

After the Domino code installation phase is complete, the server must be configured. To configure the server follow the steps below:

1. Select **Start -> Programs -> Lotus Applications -> Domino Server**. The Domino setup client will be launched.

2. Select the **Additional Domino Server** radio button in setup window 1.

3. Select **Advanced setup** in setup window 2.

4. Select the additional services that you want to run on the New Domino Server in setup window 3.

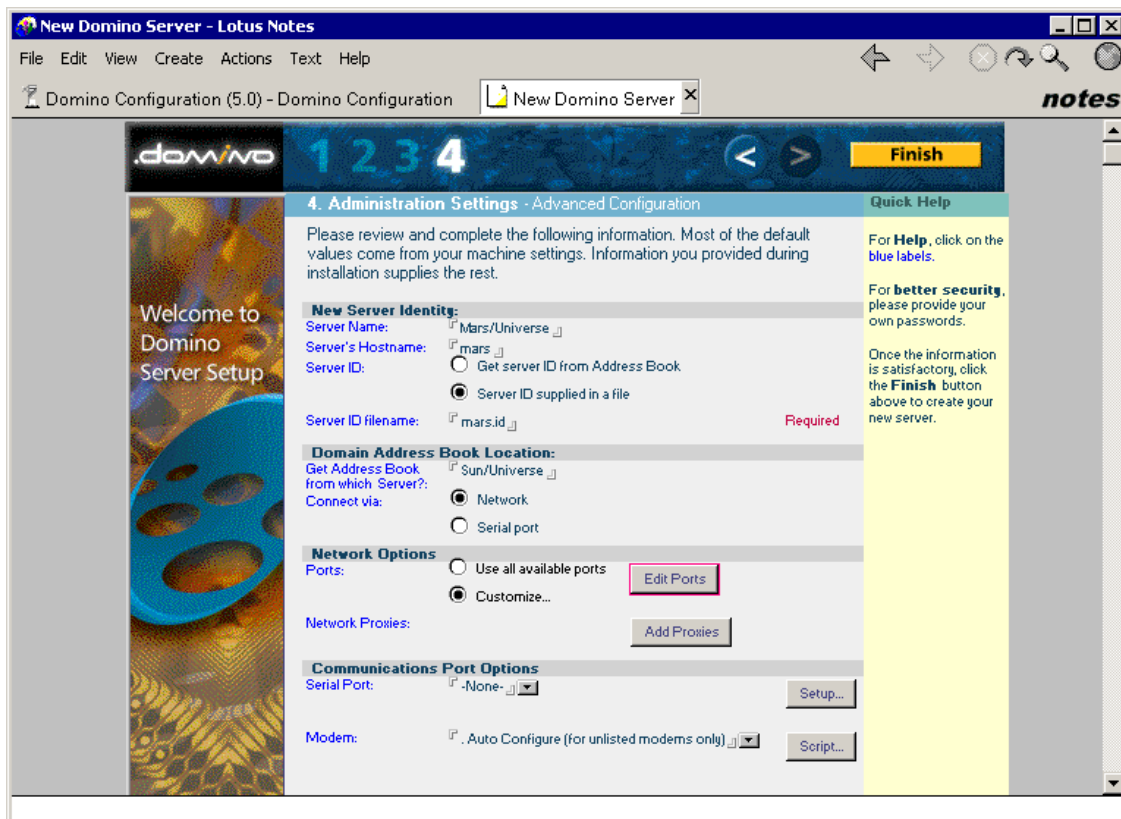5. The New Domino Server setup window 4 is shown in Figure 26:

Figure 26. Using the ID file created earlier for the new server identity

6. In the New Server Identity section, select **Server ID supplied in a file**.

7. As with the first server, disable all ports except for TCP/IP.

8. Finish the configuration by clicking **Finish**. Accept the offer to copy the server ID file to the Domino data directory when prompted.

4.3.4.3 Port and named network configuration

After configuring the server, you need to set up an additional port for cluster communication if you decided to use a dedicated port for cluster traffic.

The second port is set up in exactly the same way as we did for the first Domino server (see 4.3.2.2, "Port and named network configuration on the first server" on page 90).

The above installation and configuration has to be completed for each server that is going to join the cluster.

4.3.5 Creating a cluster

Now that all of the servers that you have planned to be members of the cluster have been installed and configured, it is time to add them to the cluster.

4.3.5.1 Adding servers to a cluster

When you add Domino servers to a cluster, use the administration server. The administration server does not have to be part of the cluster.

You must have at least Author access with Delete document rights and the ServerModifier and ServerCreator roles in the Domino Directory, and Author access in the Administration Requests database.

1. Using the Domino Administrator, make sure the administration server is current.

2. Select the **Configuration** tab.

3. Expand **Server** and click **All Server Documents**.

4. In the Results pane, select the servers you want to add to the cluster and click **Add to Cluster**. Figure 27 shows the resulting dialog box:
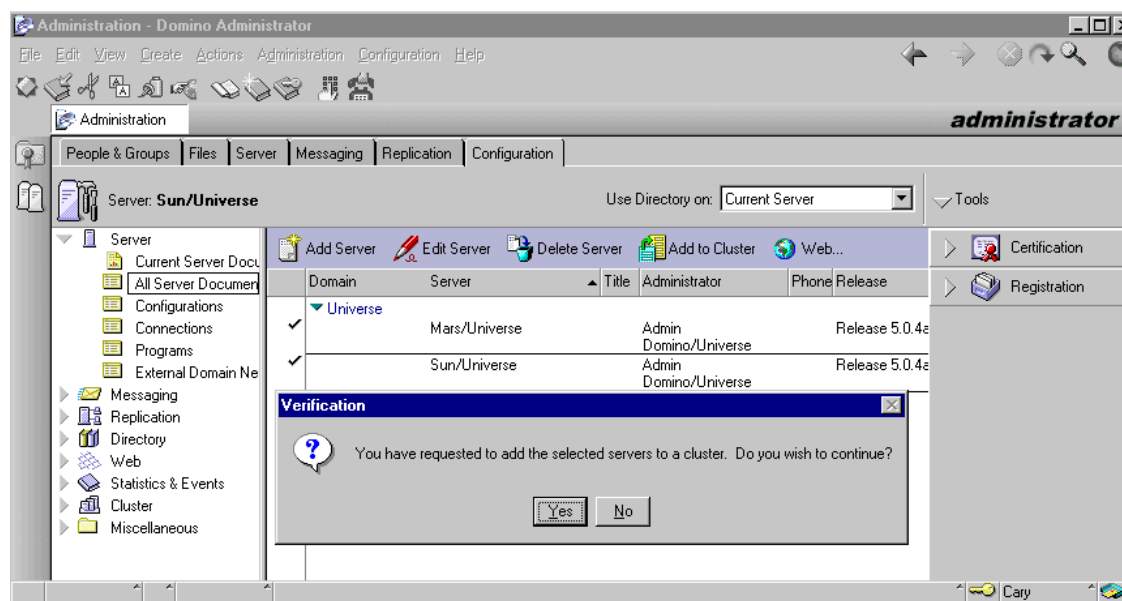

Figure 27. Adding servers to a cluster

5. You are prompted to confirm the addition of selected servers to the cluster. Click **Yes**.

6. The Cluster Name window is displayed. You can select either an existing cluster or, as in this case, select ***Create New Cluster** and click **OK**. You will be prompted to enter the name of the new cluster.
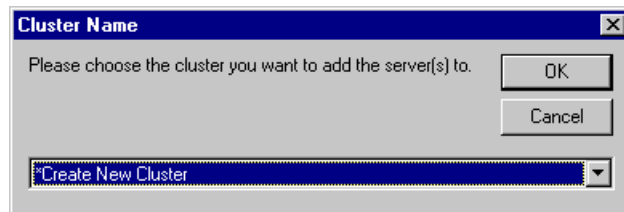

Figure 28. Entering name of the new cluster

7. Enter a name of your choosing and click **OK**.

8. In the next dialog box, you can click **Yes** to add your servers to the cluster immediately or **No** to submit a request to the Administration Process to add the server to the cluster.

   We recommend that you select **Yes** to add your servers to the cluster immediately. Their Server documents will be modified and, as soon as these changes in the Domino Directory are replicated to your new clustered servers, Domino clustering tasks will be initiated. The clustering tasks are Cluster Manager, Cluster Administrator, Cluster Database Directory Manager (CLDBDIR) and Cluster Replicator (CLREPL). Cluster Administrator adds task names CLDBDIR and CLREPL to the ServerTasks setting in NOTES.INI for each server so that these tasks start each time you start the server.

When you add servers to a cluster, there can be an initial performance impact due to the amount of replication that must take place to create the cluster replicas. Depending on the types of databases on the server and the number of replicas you create, adding a server can affect CPU performance, input/output and network traffic. Therefore, it may be a good idea to add only one or two servers at a time to a cluster, depending on the spare capacity of the systems in the cluster. If you set up a private LAN for cluster traffic, adding multiple servers at the same time will not be such a concern because it will not affect your primary network.

4.3.5.2 Dedicating the private port to cluster traffic

You should configure the TCP/IP port on the private LAN to be dedicated for the backbone communication between servers participating in the cluster. You can set it up either by editing NOTES.INI manually or by using a Server

Configuration document to update the NOTES.INI file on all servers in the cluster.

The following NOTES.INI entry controls the cluster traffic destination port:

`Server_Cluster_Default_Port=PortName`

where `PortName` is the port name defined in the Domino Directory. In our setup we added the line as shown:

`Server_Cluster_Default_Port=TCPCLUST`

You should also set the default port for cluster server probing. This port is used between the servers in the cluster to exchange information about cluster server status. The following NOTES.INI entry sets the probing port and should be added for all cluster members:

`Server_Cluster_Probe_Port=PortName`

where `PortName` is the name of the port to be used for server probing. Only a TCP/IP port should be used for server probing. This parameter is especially useful if the servers in the cluster are configured to run protocols other than TCP/IP. Using this parameter you can be sure that probing occurs on the TCP/IP port only.

To set the port for probing, we added the following setting on each Domino server in our cluster:

`Server_Cluster_Probe_Port=TCPCLUST`

After saving the changes to NOTES.INI, you should restart each Domino server.

4.3.5.3 Cluster Database Directory
The Cluster Database Directory (CLDBDIR.NSF) resides on every server in a cluster. The Cluster Database Directory contains a document about each database and replica in the cluster. This document contains such information as the database name, server, path, replica ID and database status.

The Cluster Database Directory and its replicas are kept up to date automatically by cluster replication. The quickest way to get an overall view of which databases are clustered and which servers are carrying replicas is to open the Cluster Database Directory and use the Databases by replica ID view as shown in Figure 29:
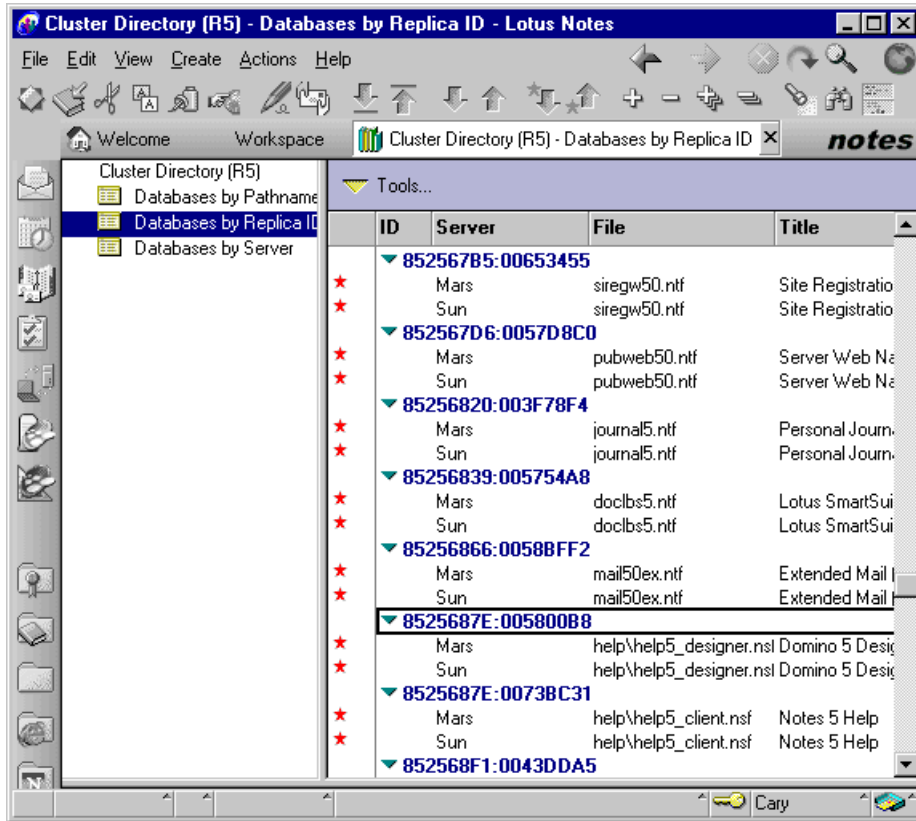
Figure 29. Cluster Database Directory

Because the Cluster Database Directory is so essential for the cluster's operation, make sure that database replication was successful by comparing the replica IDs on all the servers in the cluster. The replica IDs should be the same.

4.3.5.4 Configuring replication in a cluster

Both scheduled and cluster replication are necessary within a cluster. Cluster replication is used as the primary means of keeping database replicas up to date in a cluster and scheduled replication is used as a backup to cluster replication within a cluster, as well as to synchronize database replicas outside the cluster.

Because of the dynamic nature of cluster replication, and the fact that database updates are stored in memory, there is a possibility that database updates may be missing in the event of hardware or network failure. For this

reason, it is recommended that scheduled replication is configured across the servers in a cluster. A suitable scheduled replication repeat interval will depend on both the number and the sizes of the databases on your servers.

Traditional scheduled replication relies on administrator-defined Connection documents in the Domino Directory. An example of how to configure a Connection document between clustered Domino servers is shown in Figure 30:

Figure 30. Connection document for scheduled replication

Remember that for each clustered server you *must* create a Connection document.

To ensure that all the replicated databases are up to date when the server starts, you can define replication to take place at startup by defining a new Program document in the Domino Directory. Refer to 5.6.4, "Setting up scheduled replication at server startup" on page 154 for more details.

In contrast to the predictable nature of scheduled replication, cluster replication is event driven. Whenever a change occurs to a database in the cluster, the Cluster Replicator immediately pushes the change to the other replicas in the cluster. This ensures that each time users access a database, they see the most up-to-date version. The Cluster Replicator also replicates changes to private folders that are stored in a database.

Each server in a cluster runs one Cluster Replicator by default. This configuration is adequate if only a few moderately sized databases exist in a cluster consisting of two or three Domino servers. In typical high-volume clustered environments, we recommend that you should configure as many Cluster Replicator tasks on each server as there are total number of servers defined in the cluster, less one. This guideline suggests, for example, five Cluster Replicator tasks for a cluster composed of six servers. In this way, there will always be at least one CLREPL task available to handle replication requests to another server in the cluster.

To configure multiple Cluster Replicator tasks, append additional CLREPL instances to the ServerTasks parameter in NOTES.INI, as shown below:

```
ServerTasks=Router,Updall,Replica,AdminP,CLDBDIR,CLREPL,CLREPL,CLREPL
```

Make sure all CLREPL tasks are listed after the CLDBDIR task. The Cluster Replicator relies on information provided by the Cluster Database Directory Manager.

For more details about cluster replication, see Chapter 5, "Administering Domino clusters" on page 119.

4.3.6 Changing cluster membership

A server can easily be moved from one cluster to another, or removed from a cluster to be a standard Domino server.

To move a server from one cluster to another, you simply add the server to the new cluster. Domino automatically removes the server from the old cluster. For more information, see 4.3.5.1, "Adding servers to a cluster" on page 98.

You can remove a server from a cluster using the Administration Client.

1. Open the Domino Directory on the server specified as the Administration server for domain.
2. Select the **Configuration** tab.
3. Expand the Cluster section in the left pane.
4. Click **Clusters**.
5. Select the server(s) that will be removed from the cluster.
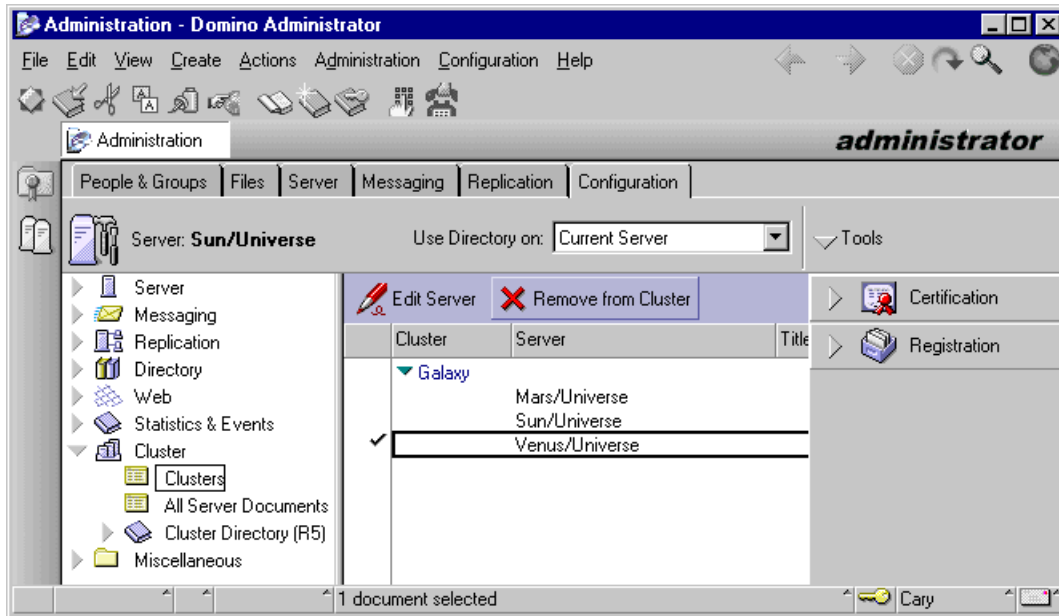6. Click **Remove from Cluster**. This can be seen in Figure 31:

Figure 31. Removing a Domino server from a cluster

7. Confirm that removal should continue by clicking **Yes** in the Verification dialog box.

8. Decide if the server should be removed immediately or through the Administration Process and click the appropriate button as shown in Figure 32:
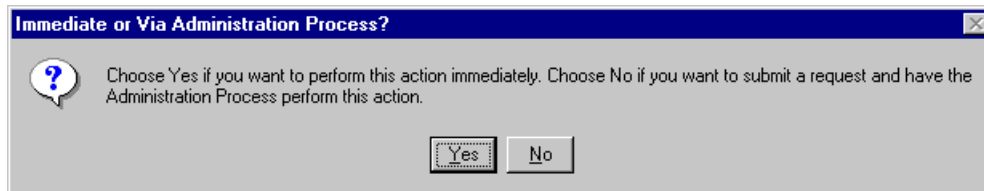

Figure 32. Choosing when to remove the server

9. If your choice in step 8 was **Yes**, then a confirmation dialog box will be displayed. Click **OK**.

10. If your choice in step 8 was **No** then the request will be submitted to the Administration Process.

11. The cluster processes CLREPL and CLDBDIR will be stopped on the server, and the relevant entries removed from the ServerTasks setting in NOTES.INI.

12. Entries relating to databases hosted by the server being removed will be purged from the replica copy of the Cluster Database Directory on the least busy of the remaining cluster servers.

13. The local Cluster Database Directory will be deleted from the server that is being removed from the cluster.

14. Schedule Manager deletes the clustered Free Time database (CLUBUSY.NSF) and creates the Free Time database (BUSYTIME.NSF).

4.3.7 Joining a cluster

Follow the steps below to upgrade a standard Domino server to a clustered server:

1. Upgrade the Lotus Domino software to Domino R4.61 or later, or if you are already running R4.61, install Lotus Advanced Services. If you are running Domino R4.62 and later or Domino R5 you need to install Domino Enterprise Server. The installation steps are described in 4.3.1, "Installing the first Domino server" on page 84.

2. Verify the Domino port configuration. You need to define at least one TCP/IP port for cluster traffic. The client traffic can either run on the same port or on another port, which can be running any protocol that Domino supports. If you are using only one port, then you *must* run TCP/IP on that port.

   The cluster traffic does not require a separate network link but, as stated previously, we recommend this due to the increased network traffic created by event-driven cluster replication.

   You can find details on how to define ports in 4.3.2.2, "Port and named network configuration on the first server" on page 90.

3. Edit the NOTES.INI file or create a Configuration document to make bindings between the port names and TCP/IP addresses as described in 4.3.5.2, "Dedicating the private port to cluster traffic" on page 99.

4. Now you are ready to add your server to a cluster. See 4.3.5.1, "Adding servers to a cluster" on page 98.

4.4 Installing Domino R5 for Linux on IBM Netfinity servers

In this section we discuss those Domino installation and configuration steps that are specific to Linux. In particular, we examine:

- Linux patch requirements for Domino R5
- Preparing Linux for Domino installation
- Disabling services on Linux
- Installing Domino on Linux
- Configuring Domino on Linux
- Starting and stopping Domino on Linux

4.4.1 Linux patch requirements for Domino

Identifying the required patches for Linux is difficult because there is no single defined Linux distribution. The various distributions, Red Hat, SuSE, Caldera, TurboLinux, and so on, are at different levels, with different combinations of code packages included and available. By setting requirements based on kernel and library levels, however, and then evaluating each distribution based on this, a set of requirements can be determined.

By certifying and supporting distributions, a certain set of patches is guaranteed. At the lowest level, Linux kernel 2.2.5 or greater is required, along with glibc 2.1.1 or greater, and libstdc++ 2.9.0 or greater. Each of the supported/certified distributions contains these levels or higher.

There is one exception to this rule: the version of glibc/libstdc++ installed must contain the libstdc++-libc6 naming convention. If it does not, you must make the appropriate link yourself. For example, in Red Hat 6.0, the file is /usr/lib/libstdc++-libc6.1-1.so.2. In Caldera 2.2, this naming convention is not used and therefore you must link /usr/lib/libstdc++-libc6.1-1.so.2 to the file /usr/lib/libstdc++.so.2.9.0 , which is the appropriate library. A distribution that meets these requirements should be able to accommodate the Domino server.

The upgrade from Red Hat 6.0 to Red Hat 6.1 contains patches to the Linux kernel that allow larger process/thread limits and increased file descriptor limits for greater utilization of server resources. Other distributions may offer similar changes from release to release.

4.4.2 Preparing Linux for Domino installation

Before you can install Lotus Domino for Linux you must ensure that the Linux server is correctly configured and ready for the installation. To run Domino for Linux you must create Linux user and group accounts to own and run the Domino server on Linux. To create a user account you must run the configuration utility for your distribution of Linux. For convenience, these are listed in Table 9:

Table 9. Linux configuration utilities

Distribution	Utility
Caldera	coastool
Red Hat	linuxconf
SuSE	YaST, command-line utilities and files
TurboLinux	turboservice

Select a user account name and a group account name that will be unique to your company. As a security precaution, we recommend that you do not use obvious names such as "notes", "domino", "lotus" or variations of these.

4.4.3 Disabling Linux services

Most Linux distributions enable services for the following by default: NNTP, SMTP, IMAP, POP3, and HTTP. In order to use the versions of these services provided by the Domino server, you must disable the corresponding Linux services. For IMAP and POP3, this is most easily done by editing the /etc/inetd.conf file and commenting out the entries for POP3 and IMAP. To disable SMTP, NNTP, and HTTP, you must use the appropriate utility for your particular Linux distribution.

For more details on how to disable or modify services, see the IBM Redbook *Lotus Domino R5 for Linux on IBM Netfinity Servers*, SG24-5968.

4.4.4 Installing Domino

Now that your Linux server is prepared, you need to obtain the Domino code for installation on the server. Lotus Domino for Linux can be obtained in two ways; you can download the code directly from the Web or purchase a CD-ROM from Lotus.

4.4.4.1 Domino code downloaded from the Web
You can download Domino for Linux from the World Wide Web at:

`http://www.notes.net`

The code you download is in the form of a .tar file. .tar files are Tape ARchive files and are similar to .zip files in that they contain a collection of other files and information about the directories that they reside in. They differ from .zip files in that the contained files are not compressed.

To be able to install Domino, you need to unpack the .tar file and place the files in their appropriate directories. This process is performed by the Linux utility called `tar`. From the command line enter the following command:

```
tar -xvf filename.tar
```

Upon completion of this command, a new subdirectory, named linux, will have been created in the current directory and the files from the .tar archive will have been extracted to it. Change directories to the linux directory by using the cd command:

```
cd linux
```

Then type:

```
./install
```

to invoke the text-based installation script for Domino.

4.4.4.2 Domino code on a CD

If you have the CD-ROM version of Domino for Linux, you will need to mount the CD-ROM and run the install script from there.

To mount the CD-ROM, insert the Domino for Linux CD-ROM and enter the following command:

```
mount /dev/cdrom
```

Once the CD-ROM is mounted, you install Domino for Linux by issuing the following command:

```
/mnt/cdrom/linux/install
```

Do not change directories to the CD-ROM device. Issue the command from a directory on the hard-disk drive.

The `install` command will invoke the text-based installation script for Domino.

4.4.4.3 Installation

Follow the on-screen instructions to install the Domino software to the Linux server. The same steps are used regardless of the distribution of Linux that you are using.

Make sure that you choose the Domino Enterprise Server option during the installation process, if you plan to add this server to a cluster.

If you need more detailed information to help you install Domino for Linux, we recommend the IBM Redbook *Lotus Domino R5 for Linux on IBM Netfinity Servers*, SG24-5968.

4.4.5 Configuring Domino

So far you have prepared the Linux server and installed the Domino software. As there is no Notes client for Linux and the configuration requires local access, a Web browser is used to configure the server.

You can use a browser locally on the Linux server, or use a browser from another computer that can connect to the Linux server using TCP/IP over the network. You must use a Web browser that supports graphics and Java.

To configure Domino, you will use the Lotus Domino Web server in initial configuration mode. The Web server is started from the Linux command line. First change directories to the Domino data directory:

`cd /data`

Then issue the following command:

`/opt/lotus/bin/http httpsetup`

This will launch the Web server and use the SETUPWEB.NSF database to complete the configuration. The Web server listens on port 8081 and will only provide access to the setup configuration database.

Using a Web browser, enter the following URL:

`http://<server>:8081`

where <server> is the TCP/IP address or DNS name of the Linux server. When your browser loads the page returned by the server, you will see the familiar windows that are used to configure the Domino server. Just as in all other Domino server platforms, you need to fill in the appropriate information for your Domino installation. This will be similar to any other additional Domino server installation. The installation process was explained earlier, in 4.3.4.2, "Server configuration" on page 96.

4.4.6 Starting and stopping Domino

To start the Domino server for the first time, issue the following command from the command line:

```
/opt/lotus/bin/server
```

For additional flexibility and security reasons, we recommend that you start the Domino server from a script. Some examples of Domino startup scripts can be found in the IBM Redbook *Lotus Domino R5 for Linux on IBM Netfinity Servers*, SG24-5968.

After starting the server, the Domino console appears and is identical to that found on all other supported platforms. You can now issue commands from the console as you would from any Domino server, or you can connect from another system by using the Windows Domino R5 Administration client.

There are several ways to stop your Domino server on Linux:

- From the foreground server console:

  Type `exit` or `quit` to shut the server down.

- From the Domino Administrator client, follow these steps:

  a. Open the Domino Administrator client.
  b. Click **Server -> Status**.
  c. Choose the server you wish to shut down and select **Tools -> Server -> Shutdown** from the Tools pane, or **Server -> Server -> Shutdown** from the menu bar.
  d. You will be prompted to confirm the shutdown. Click **Yes**.
  e. The Domino Administrator will confirm that the server has stopped by indicating that it no longer responds.

- From the Linux command line:

  To shut down the Domino server from the Linux command line, make sure you are logged in with the user account you created for running the Domino server. Type `server -q` to shut down the server. The directory containing the installation binaries, /opt/lotus/bin, must be in the user's PATH statement.

- With a stop script:

  You might decide to create a script file to stop a Domino server. An example of a Domino stop script can be found in *Lotus Domino R5 for Linux on IBM Netfinity Servers*, SG24-5968.

4.5 Setting up calendaring and scheduling

A Domino server that is not clustered contains a database that includes scheduling information for all users who use that system as their mail server. This database is named BUSYTIME.NSF and is known as the free time database. In a cluster, there is a single free time database for everyone whose mail server is a member of the cluster. This database is named CLUBUSY.NSF and it contains all the information that was in the individual free time databases of all the servers that became cluster members. Each server in the cluster contains a replica of this database.

When you add a server to the cluster, the Schedule Manager deletes the server's BUSYTIME.NSF database and creates its replica of CLUBUSY.NSF, which is synchronized with the other replicas in the cluster. When a user in the cluster requests free time information, the server looks in its own CLUBUSY.NSF first to find information for every user in the cluster. For users whose mail servers are outside the cluster, requests are sent to those servers for the free time information. Whenever there is a change to the CLUBUSY.NSF on any server in the cluster, the Cluster Replicator updates the other replicas in the cluster.

When you remove a server from a cluster, the Schedule Manager deletes CLUBUSY.NSF from that server and recreates BUSYTIME.NSF. The Schedule Manager on each server in the cluster removes the deleted information from its replica of CLUBUSY.NSF.

If there are Domino R4.x servers in a cluster, they maintain their BUSYTIME.NSF databases. These databases are not converted to CLUBUSY.NSF. Calendaring for these servers works the same as in a non-clustered environment.

If one of the clustered servers is unavailable, mail users will fail over to another server in the cluster that has a replica copy of their mail files. These users will then be able to continue using their mail as they usually do. In this situation, we discovered that free time search and group calendar-related operations are either not available or appear to be working but present incomplete information based on data entered by the user prior to the failover.

In our lab we were able to reproduce these problems with calendaring and scheduling in a clustered Domino R5 environment.

1. For example, user A has a home mail server (Server A) that is clustered. When his home server becomes unavailable, he fails over to the other server in the cluster that has a replica copy of his mail database (Server B). User A continues to work with his mail and schedules several meetings. User B now wishes to book a meeting with user A, and so wants to check user A's schedule. A free time search in this case returns incorrect information. It shows that user A is free for any time slot that he has filled since the failover. This occurs for all entries user A added to his calendar after his home server became unavailable. It appears that the Scheduler task on Server B does not update information in CLUBUSY.NSF for those users that have Server A as their home mail server.

   Once Server A becomes available, the Scheduler task on Server A updates Server A's copy of CLUBUSY.NSF, which is then cluster replicated to Server B.

   Figure 33 shows an inaccurate result from a free time search made while the user's home mail server was not reachable, and both chair and invitees had their mail databases on Domino servers in the same cluster.
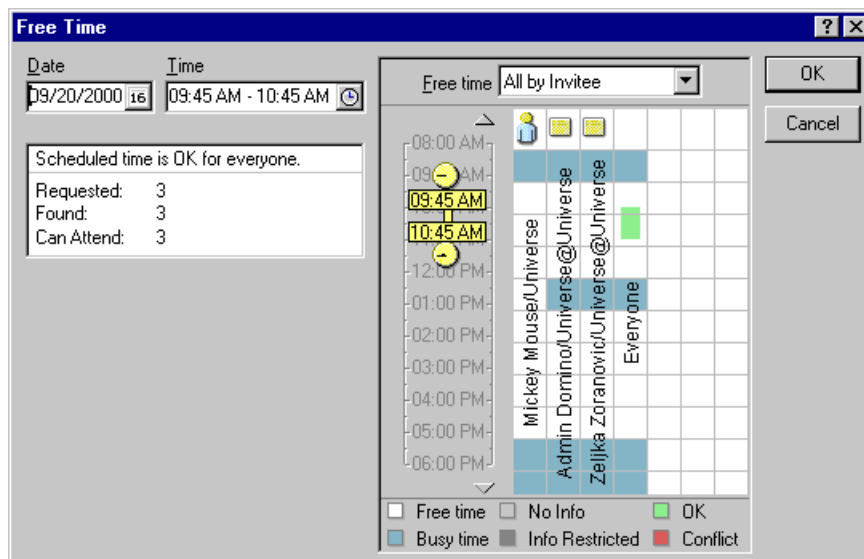

Figure 33. Free Time search in a clustered environment

Even though meetings were booked in the requested time slots, the free time search shows them as available.

2. User A has a clustered server as his home mail server, which we stopped. When user B (who is using another Domino server in the cluster as his home mail server) opens his/her own mail database and tries to open user A's calendar by selecting **Tools -> Calendar Tools -> Open Another Calendar**, failover does not occur. User B will get a `Server Not Responding` error message.

   This shows that the formula corresponding to the Open Another Calendar menu option, @Command([OpenCalendar]), does not support cluster failover.

3. When a user retrieves a group calendar for a group that has members whose home mail server is clustered and unavailable, he receives incomplete calendar data for these users. Information entered by group members prior to their home mail server failure is shown properly. Any schedule data entered after their home mail server failure is shown as free time. Also, when a user tries to display the calendar for a user whose home mail server was clustered but unavailable, clicking user B's name produces the following error message:

   `Unable to open user's mail database.`

4. When user A, whose home mail server resides outside the cluster, makes a request for free time information about user B, whose home mail server is a cluster member that is unavailable in the cluster, the request does not fail over. Free time information is shown as No Info.
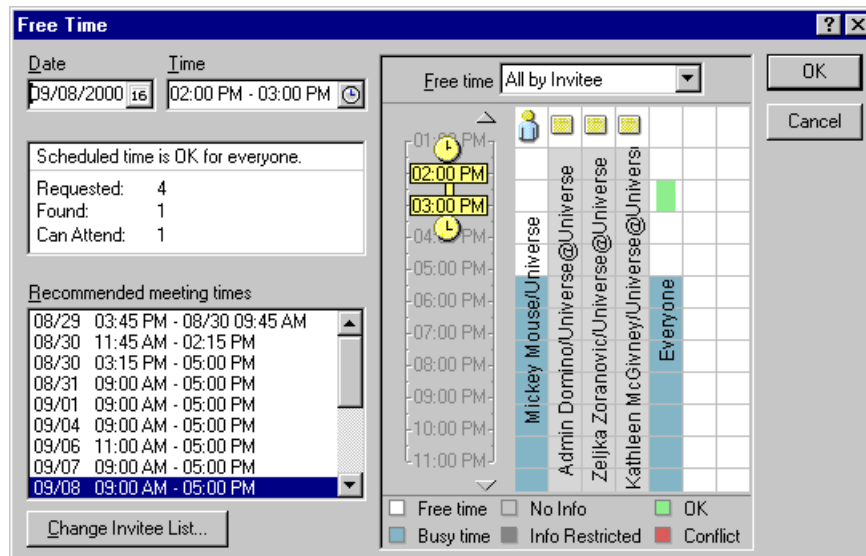

Figure 34. When Free Time search does not work

We have no firm information to indicate that this behavior will be modified, but Lotus is aware of the problem and we anticipate that correct operation will be incorporated into Domino in a future update.

4.6 Configuring Internet Cluster Manager

An Internet Cluster Manager (ICM) is dedicated to a single cluster. So, if you have two clusters, you must have at least one ICM for each cluster. The ICM needs to be in the same domain as the Domino cluster because the ICM always uses the local copy of Domino Directory.

The ICM is a Domino server task that ships as part of Domino R5 clustering. To install the ICM, you must install the Domino Enterprise Server. The ICM is automatically installed as a part of the Domino clustering support that ships with R5 Domino Enterprise Server.

Note

Be sure to include the ICM configuration information on every server on which you run the ICM, as well as on every Web server in the cluster.

You can configure the ICM settings on one server and have more than one server accessing these settings.

4.6.1 Setting up ICM

To configure the ICM, you make entries in the Internet Cluster Manager section of the Server document in the Domino Directory.

1. From the Domino Administrator, select the **Configuration** tab.

2. Expand Server and click **All Server Documents**.

3. In the Results pane, select the Server document for the server on which you want to run the ICM; then click **Edit Server**.

4. Select the **Server Tasks -> Internet Cluster Manager** tab and complete the following fields:

Table 10. Entering the ICM settings

Section	Field name	Description
Basics	Cluster name	The name of the cluster the ICM will service. If this field is blank, Domino uses the name of the cluster that contains this server.
	ICM Notes port	The name of the Notes port the ICM will use to communicate with HTTP clients. This field is blank by default, so that ICM can use any Notes port.
	ICM SSL keyfile	The name of the SSL key file that contains certificates to identify the ICM when communicating with HTTP clients.
	Allow users to browse databases in the cluster over HTTP	Allows HTTP clients to view a list of all databases in a cluster.
Configuration	Get configuration from	You can specify a different Server document from which to get the configuration data.
	Obtain ICM configuration from	This field appears when you select **another server document** in the field Get configuration from:
	ICM hostname	This is the fully qualified name of the host that clients should use to communicate with ICM.
ICM HTTP Port Settings	TCP/IP port number	The port number that ICM will use. If you run the ICM on the same server as the Web server, you must avoid address and port conflicts.
	TCP/IP port status	Choose **Enabled** to allow HTTP communication with the ICM.
	SSL port number	Enter the port number to use for SSL.
	SSL port status	Choose **Enabled** to allow HTTPS communication with the ICM.

If the ICM runs on the same system as the Domino HTTP server, you can configure either the ICM or the HTTP task to run on separate ports or to run with different TCP/IP addresses in order to avoid conflicts. We recommend that you assign the ICM its own TCP/IP address.

The Host name(s): field in the HTTP section of the Server document must match the entry found in the Fully qualified Internet host name: field on the Basics tab in the same document. The ICM fails if they do not match.

4.6.2 Starting ICM

If you want to start the ICM every time you start the server, append ICM to the ServerTasks setting in NOTES.INI:

```
ServerTasks=Router,Replica,AdminP,HTTP,ICM
```

If you want to start the ICM manually while the server is already running, use the following command at the server console:

```
load icm
```

4.7 Hints and tips for installation problems

The following sections include hints and tips to help you if you are experiencing problems with installing Domino clustering.

4.7.1 Check NOTES.INI

Check the ServerTasks and the Server_Cluster_On settings. The ServerTasks line in NOTES.INI should include the tasks CLDBDIR and CLREPL.

Make sure that CLDBDIR is listed on the ServerTasks line before the CLREPL command. The CLDBDIR is responsible for building and maintaining the Cluster Database Directory, CLDBDI.NSF. The Cluster Database Directory must exist for the cluster replicator to load.

Also make sure that the cluster is enabled with the following entry:

```
Server_Cluster_On=1
```

4.7.2 Cluster Database Directory

The Cluster Database Directory (CLUBUSY.NSF) contains an entry for each database within the cluster. Look in this database to make sure all databases within your cluster are listed. For example, if a database within your cluster is not pushing changes to a cluster member that contains a replica copy of this database, you can investigate by making sure the entry for each replica exists in the Cluster Database Directory.

A missing database entry within the Cluster Database Directory is usually due to the Cluster Manager failing to initially replicate with other cluster

members during that server's addition to the cluster. Forcing a replication with a cluster member rectifies this issue.

To help ensure that the Cluster Database Directory is kept up to date, you should also use a standard replication task as a backup to cluster replication.

4.7.3 Using the Server Web Navigator in a cluster

If you use the Server Web Navigator in a cluster, make sure that the Web database (WEB.NSF) on the cluster servers are replicas. Since the Web database is generated automatically when you start the Server Web Navigator task, it is a common error for the clustered servers to contain Web databases that are not replicas of each other. Therefore, these databases do not fail over to each other.

To be sure that the Web databases are replicas, start the Server Web Navigator on only one of the clustered servers. Then replicate the Web database to the other cluster servers before starting the Server Web Navigator on those servers.

4.7.4 Choosing a time zone on a Linux server

Linux uses GMT (Greenwich Mean Time) internally. All internal Linux operations are done using this one time setting. For example, file time stamps are stored based on GMT. Displaying times in "local time" is a user interface issue. This strategy allows meaningful data exchange over a WAN (over the Internet being an obvious example).

To show the time correctly, Linux must be told which time zone applies to the server's location, that is the difference between local time and GMT.

To change the time zone, you will need to run the configuration utility for your Linux distribution. The zone field allows you to select the zone/country code that reflect how the time is managed at your location. This selection also influences the deviation from normal time used in some countries (winter time versus summer time).

In the Domino environment, a setting called TimeZone is defined during the Notes workstation or Domino server setup procedure. Time zones begin at Greenwich and move westward around the world. For example, TimeZone=5 represents the US Eastern Standard Time (EST) while TimeZone=0 represents Greenwich Mean Time. This setting is held in the Local time zone field in a Location document for workstations and the Local time zone field in the Server document on a server.

Confusion can arise if you choose "numeric" selection while configuring time zones during a Domino for Linux installation. We made this error ourselves, so felt it worth pointing out. When we first configured the time zone on our Linux server we chose the following value:

`GMT-5`

This was because our location, Raleigh, is in the US EST time zone which is five hours *behind* (hence "-") GMT. Our Linux Domino server interpreted this as ZE5 (five hours east of GMT). So, we changed our Linux setting to a non-numeric value to avoid this confusion:

`US/Eastern`

Our Domino server then correctly reported its time and time zone.