IBM

Netfinity *White Paper*

Paul Branch — **Netfinity Technology Center**

paul_branch@vnet.ibm.com

Lotus Domino Clusters Installation Primer

Abstract

The Advanced Services option[1] of Lotus Domino server 4.5 adds server clustering, billing, and partitioning features to the Domino 4.5 server. These features address availability concerns of large Lotus Notes enterprises. This white paper focuses on clustering installation and configuration topics.

---

[1] Advanced Services is a separately priced Domino server feature. The code is available on the Lotus Domino Server CD-ROM.

Notice

References in this publication to IBM products, programs or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM product, program, or service is not intended to state or imply that only IBM's product, program, or service may be used. Any functional equivalent program that does not infringe any of IBM's intellectual property rights may be used instead of the IBM product, program or service.

Information in this paper was developed in conjunction with use of the equipment specified, and is limited in application to those specific hardware and software products and levels.

IBM may have patents or pending patent applications covering subject matter in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to the IBM Director of Licensing, IBM Corporation, 500 Columbus Avenue, Thornwood, NY 10594 USA.

The following terms are trademarks or registered trademarks of the International Business Machines Corporation in the United States and/or other countries.

MVS	RS/6000	AIX®
OS/2®	System/390®	Parallel Sysplex
AS/400®		

The following terms are trademarks or registered trademarks of Lotus Development Corporation in the United States and/or other countries.

Lotus	Lotus Notes	Domino

Microsoft, Windows, Windows NT, and the Windows logo are registered trademarks of Microsoft Corporation.

UNIX is a registered trademark in the United States and other countries licensed exclusively through X/Open Company Limited.

Other company, product, and service names may be trademarks or service marks of others.

Lotus Domino Server Clustering

The Advanced Services clustering option provides an *application* clustering solution for the Notes environment. Many non-Domino cluster solutions are based on specific operating systems (e.g., MVS, NT, or UNIX), meaning all servers must run the same operating system. Domino clusters are different. They are supported on any operating system which supports Advanced Services. A Domino cluster could consist of an OS/2-based Domino server, an NT-based Domino server, an RS/6000 AIX-based Domino server, and a Netware-based Domino server, or any combination of these. Depending on the operating system mix of your Notes environment, this feature could be a significant advantage. For example, in a mixed operating system environment, clustering could be used in operating system or hardware migration efforts.

In addition to operating system independence, Notes clusters provide other advantages:

- High availability—this comes in the form of failover protection for business-critical databases and Notes servers. A failover ensures that when a user attempts to access a database on a malfunctioning server, the Notes cluster servers redirect the database request to other servers in the cluster. When a clustered Notes Domino server fails, the Notes clients accessing the server continue to have access to the database through another functioning server in the cluster.

- Workload balancing—when a Notes client requests services from heavily-used Notes server, the client's request passes automatically to other cluster servers. This ensures that workload is evenly distributed across the cluster. Workload balancing helps you achieve optimum performance for your Notes servers.

- Cluster replication—this feature, unique to Notes clusters, ensures that all changes to a database or to the cluster membership itself are immediately passed to other databases or servers in the cluster. Replicas of critical Notes databases are maintained on two or more servers, and these databases are tightly synchronized to provide high availability of information. The major difference between cluster replication and traditional Notes replication is execution. While traditional Notes replication is scheduled or performed manually, cluster replication is *event driven.* For further information on cluster replication, see the following section.

- Scaleability—implementing Notes clusters provides an easy method to expand your network. This type of clustering lets you expand your processing resources effortlessly as the number of users or the workload grows. You can spread your user accounts across groups of servers, create multiple database replicas to maximize data availability, or move users to other Notes servers or clusters as you plan future growth.

- Hardware independence—special hardware configurations are not required to use Domino clustering. There is no requirement for special adapters, cables, or shared disk drives. In fact the servers can reside in different rooms, floors, buildings, even different sites.

In addition to the advantages listed previously, Lotus Domino server clusters have the following characteristics:

- Up to six Advanced Servers can be configured into one cluster.

- Any database on any of the clustered servers can be clustered two to six times. Databases can be clustered to reliably achieve a service level commitment or to support large scale database demands.

- Cluster servers can be in close proximity of one another or they can be geographically dispersed.

- Cluster servers have the option of all running the same operating system or running on different supported Domino Server Advanced Services operating systems to form a cluster. In addition to operating system independence this also translates into some platform independence.

Domino Cluster Planning Guidelines

Listed below are some guidelines for planning the setup of a Notes cluster:

- All cluster members must run the Lotus Notes Release 4.5 Advanced Server license. Notes clusters are available for R4 servers only. The Advanced Server code ships with Lotus Domino Server 4.5, and the Advanced Server license is separately purchasable for each server in the cluster.

- Only Notes R4 workstations can take advantage of the cluster failover feature. R4 workstations do not need a special license to use clusters. At this time, failover features are not available to Web Browser clients.

- All cluster members must use the same set of network protocols.

- In Release 4.5, Domino Advanced Services supports only TCP/IP environments for cluster and partitioned server configurations.[2]

- Notes clients can access clustered Domino servers from any protocol the server supports. However, the advanced automatic failover and workload balancing features are only available for TCP/IP clients connected to Domino servers.

- Servers with clustered databases must replicate across TCP/IP networks.

- All cluster members must be in the same Notes domain and share a common public address book.

- The address book for the Notes domain must have a specified administration server. If you do not specify one, the Notes Administration Process cannot change cluster membership. The server that is the administration server of the public address book does not need to be a member of a cluster or be running the Advanced Server license. It must, however, be running Lotus Notes Release 4.5.

- All cluster members must be connected using a high-speed local area network (LAN).

---

[2] Domino Advanced Services clusters and partitioned server configurations do *not* support IPX/SPX protocols in Release 4.5. At this time, Lotus does not plan to provide IPX/SPX network support for future releases of these features.

- Each server can be a member of only one cluster at a time.

- Each server must have adequate disk storage space to function as a cluster member. Because clusters usually require more database replicas, Notes servers networked in clusters require more disk storage space than non-clustered servers.

- Each server must have adequate processor and memory capacity. In general, clustered servers require more computer power than non-clustered servers.

- Each server should be set up for optimum failover capability and workload sharing.

Cluster Installation and Configuration Overview

The following sections explain the setup procedure for a Notes cluster on two servers running different operating systems—one running Microsoft's NT 4.0 server and the other running OS/2 Warp Server. In these setup procedures, you perform the following tasks:

1. Install and configure the NT Domino server called RACK325_NT.
2. Register an additional OS/2 Domino server called RACK325_OS2.
3. Add both servers to a new Notes cluster called DOMINOCLUSTER.
4. Install and configure RACK325_OS2 (the OS/2 Domino Server).
5. Replicate the CLDBDIR.NSF file on the two servers.
6. Replicate any Notes databases that you want to particpate in Notes cluster replication.

Installation of the NT Domino Server

The first task is to install Lotus 4.5 server code on RACK325_NT. The Domino Server installation program, INSTALL.EXE, is located in the \W32INTEL\INSTALL subdirectory of the Lotus Notes CD. For a complete description of the installation steps, refer to the *Lotus Notes Install Guide for Servers*; the following steps describe how the installation process differs for Advanced Services and clusters.

1. Proceed through the start of the Notes Server installation as documented in the *Install Guide for Servers* until you get to the Install Options screen. On this screen, you can select the location of your Notes program folder and Notes data folder plus three installation options. Select **Custom features - Manual install** to install Domino Advanced Services. Then click **Next>.**

2. The next screen that appears is the Customize screen. Notice that there are two tabs on the top—**Notes** and **Advanced Services**. The default choices on the Notes features screen are sufficient for Notes clustering. If you require any additional features listed, select them. After you have completed the Notes feature screen, select the **Advanced Services** tab. The Advanced Services screen appears.
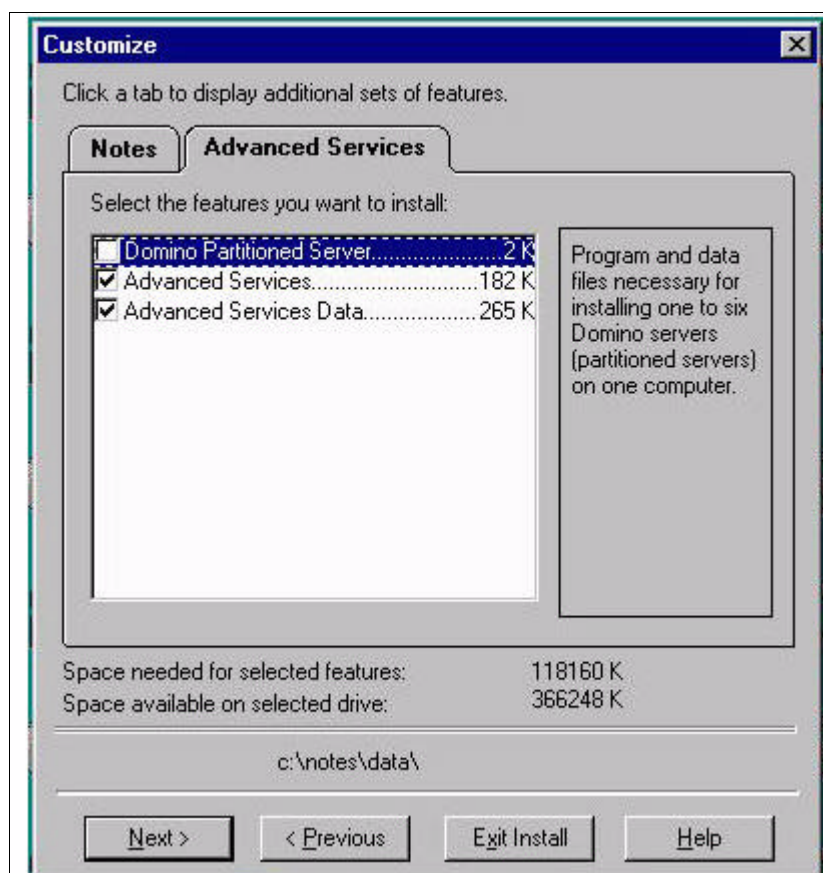
1. There are three options available on the Advanced Services screen. Select all three of these options:

   - Domino Partitioned Server—this contains the program and data files necessary to install one to six Domino logical servers (partitioned servers) on one computer. Each partitioned server is an independent Domino server with a unique name, address book, and security naming tree.[3]

   - Advanced Services—this contains the program files necessary to install Advanced Services, i.e., clusters, billing, and partitioned servers. When you install partitioned servers, use this option only on the first partitioned server.

   - Advanced Services Data—this contains the data files necessary to install Advanced Services.

   - You must select *both* Advanced Services and Advanced Services Data for clustering.

4. Click the **Next** button.

5. Select the folder in which to place Notes (for this scenario, choose the default folder—**Lotus Applications**). The code installs on the server.

---

[3] This feature can be useful for Internet Service Providers (ISP) and telecommunications communities, reducing the overall invenstment you need to make in a Domino application or mail hosting service. Partitioned servers allow service providers a cost effective way to host multiple independent services without dedicated hardware.

This completes the installation for the NT Domino Server. The next step is to configure this server.

Configuring the NT Domino Server

After you successfully install Lotus Domino 4.5 server code on RACK325_NT, you must configure the Domino server. During the installation phase, the installation program places the Lotus Domino Server and Notes Workstation icons in the program group specified—in this case, Lotus Notes. In the following steps, you add RACK325_NT as the first Domino server in the Notes domain. For those familiar with the server configuration procedure, note that there is nothing special required for clusters.

1. Start the Lotus Notes workstation program. Select **The first Lotus Notes server in your organization** and click **OK.** The First Server Setup window appears.
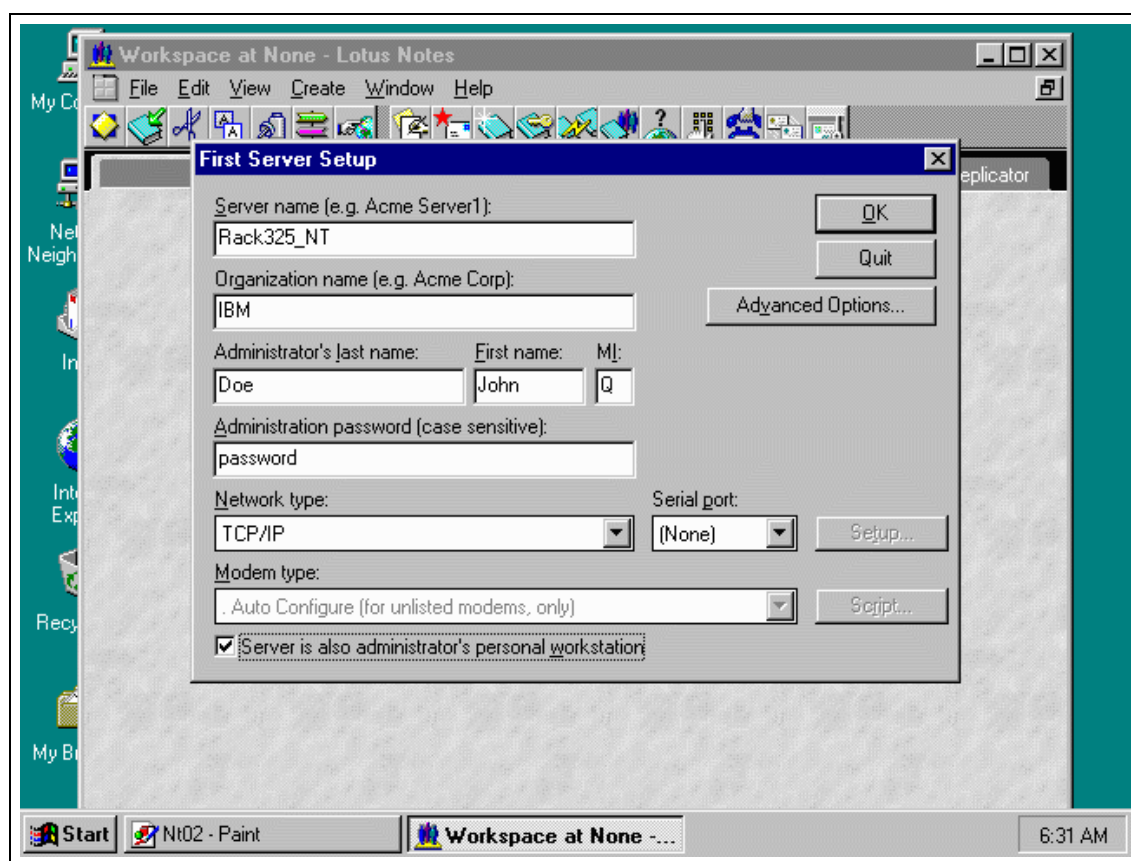
- Enter the name of the Domino server in the Server name box (***RACK325_NT***).

- Enter the name of the company in the Organization chart (***IBM***).

- Enter your last name, first name, middle initial in the administrator's boxes (***Doe, John***).

- Enter the Administration password (**password**). This password is case sensitive.

- Enter TCPIP as the network protocol used in the Network type box.

- If you plan to use the server as a workstation, select the **Server is also administrator's workstation** checkbox.

- Select **Advanced Options.** In addition to all default values, select the following:

    ❖ **Log all replication events**
    ❖ **Log all client sessions**

- Click **OK** on the Advanced Server Setup Options window. Click **OK** on the First Server Setup window.

2. Select the appropriate time zone and check the **Observe Daylight Savings Time** checkbox (if appropriate). Click **OK.**

3. Click **OK** when Notes setup is complete

4. Exit the Notes Workstation program.

This completes the initial part of the NT Domino server configuration. You must complete several other customization steps before you can start setting up the OS/2 Domino server. The first of these is to start the NT Domino server.

The First NT Domino Server Startup

Starting the NT Domino server and viewing the server's console listing provides several clues to the remaining required customization tasks.

1. Start the Lotus Domino Server program.

2. The console output during the initial server startup appears below. Note especially the highlighted lines, which indicate areas that require additional configuration.

Lotus Domino r Server, Release 4.5a, December 20, 1996
Copyright c 1985-1996, Lotus Development Corporation, All Rights Reserved

02/24/97 11:09:42 AM Informational: The registry value HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\Session
Manager\Memory Management\LargeSystemCache is currently set to 1. For better server performance, change the setting to 0
02/24/97 11:09:42 AM 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
02/24/97 11:06:26 AM Database Replicator started
02/24/97 11:06:30 AM Mail Router started for domain IBM
02/24/97 11:06:30 AM Router: Internet SMTP host rack325_nt in domain raleigh.ibm.com
02/24/97 11:06:35 AM Index update process started
02/24/97 11:06:41 AM Stats agent shutdown
02/24/97 11:06:45 AM Agent Manager started
02/24/97 11:06:48 AM AMgr: Executive '1' started
02/24/97 11:06:51 AM No Administration Server has been designated for the Public Address Book.
02/24/97 11:06:51 AM Creating Administration Requests database.
02/24/97 11:06:52 AM Administration Process started
02/24/97 11:06:55 AM Schedule Manager started
02/24/97 11:06:55 AM SchedMgr: Validating Schedule Database
02/24/97 11:06:56 AM SchedMgr: Done validating Schedule Database
02/24/97 11:06:56 AM SchedMgr: Calculating hourly statistics
02/24/97 11:06:56 AM SchedMgr: Done calculating hourly statistics
02/24/97 11:07:00 AM Calendar Connector started
02/24/97 11:07:05 AM Database Server started
**02/24/97 11:15:48 AM The Administration Request database - admin4.nsf - on RACK325_NT/IBM is
currently a wildcard replica**.
**02/24/97 11:15:48 AM The Administration Process on RACK325_NT/IBM will not work until an
Administration Server has been designated for this domain's Public Address Book.**

3. Start the Notes client workstation program. Before you can register additional servers or create additional certfiers you must create the certification log (CERTLOG.NSF) file. You need the certification log if you plan to use the administration process to rename, recertify, or upgrade users and servers.

- Choose **File - Database - New.**

- Select the name of the server you use to register users in the Server field.

- Type *Certification Log* in the Title field.

- Type *CERTLOG.NSF* in the File field. (You must name this file CERTLOG.NSF.)

- Click **Show Advanced Templates,** select **Certification Log** as the template, and then click **OK.**

- Assign **Editor** access to all administrators who will register users and servers and recertify IDs.

4. The next step is to designate an administration server[4] for the public address book. One of the cluster planning guidelines covered at the beginning of this document stated that the Notes domain must have a specified administration server. If you do not specify one, the Notes administration process cannot change cluster membership. The following is the procedure to setup RACK325_NT as the administration server for the public address book:

- Choose **File - Tools - Server,** then choose **Administration.**

- Click **Database Tools.**

- In the Server box, select the server storing databases (RACK325_NT) for which you want to select an administration server.

- In the Databases box, select the public address book database (*Acme's Address Book*) for which you want to select an administration server.

- In the Tool box, select **Administration Server.**

- In the Administration Server box, select an administration server (*RACK325_NT/IBM*) for the databases.

- Click **Update.**

- You should see the informational window stating "1 database processed - 0 errors". Click **OK,** then **Done.**

- Exit Notes.

---

[4] The administration process is a server task (adminp) that runs at server startup by default. You initiate specific administrative tasks and the administration process completes them for you.

- "Quit" the server.

5. Delete the ADMIN4.NSF file. This file is located in the **\NOTES\DATA** subdirectory. (Do **not** delete ADMIN4.NTF.)

6. Restart the server. During this server startup, a new ADMIN4.NSF is created. The following lines display on the console at the next server startup.

02/24/97 02:23:45 PM RACK325_NT/IBM is the Administration Server of the Public Address Book.
02/24/97 02:23:45 PM Creating Administration Requests database.

Continue with the next section to register the OS/2 Domino server RACK325_OS2.

Registering an Additional Server—the OS/2 Domino Server

Before you can install additional servers, you must register them. The server registration process accomplishes two tasks:

- It creates a server document in the public address book.
- It creates a server ID.

The registration server is RACK325_NT. It must be up and running on the network. Registration creates an entry for the new server in the certification log (CERTLOG.NSF) you created in the previous procedure. The following is the procedure required to register RACK325_OS2. To complete the procedure, you need a blank, formatted diskette.

1. Start the Notes workstation program.

2. Choose **File - Tools - Server Administration.**

3. Click the Servers icon and choose **Register Server.**

4. Click **Yes** if you purchased a server license.

5. Type the certifier password and click **OK.**

6. Choose applicable security type, North American or International, in the Security field. Click **Continue.**

7. Enter the name for the new server—*RACK325_OS2.*

8. Enter a password for the server. This password is case sensitive. Enter a number for the minimum password length.

   Each time you start the server, Notes prompts you at the additional server's console for this password. The server does not start up until the password is entered. If this is a problem, you can setup the server without a password (assuming the server is located in a secure location). To setup the server without a password prompt:

   - Type **0** for minimum password length.

- Click the **Other** icon, then store the server ID in a file and *not* in the public address book.

9. Ensure the default domain name *IBM* in the Domain field and the default administrator name *John Doe/IBM* in the Administrator field.

10. Select the **Other** icon in the left hand column.

11. In the Store Server ID field, select **In file** to store the server ID on the blank diskette (in addition to storing it in the public address book). Click **Set ID**. The filename *RACK325_OS2.id* appears as the default file name. Click **Save.**

12. Click **Register** and insert a blank, formatted diskette at the prompt.

Now two servers, RACK325_NT and RACK325_OS2, are registered and setup in the public address book. Continue with the next section to begin configuring the cluster.

Configuring a Notes Cluster

At this point, you have two options on how to continue the configuration process:

- Option 1—you can install and configure the OS/2 Domino server, and then begin configuring the cluster, or

- Option 2—you can configure the Notes cluster and add the servers to the cluster, then install and configure the OS/2 Domino server.

In this white paper we will use Option 2.

1. Open the server copy rather than local copy of the public address book, a file called **NAMES.NSF.**

2. Select the **Server - Servers** view. The following screen appears.
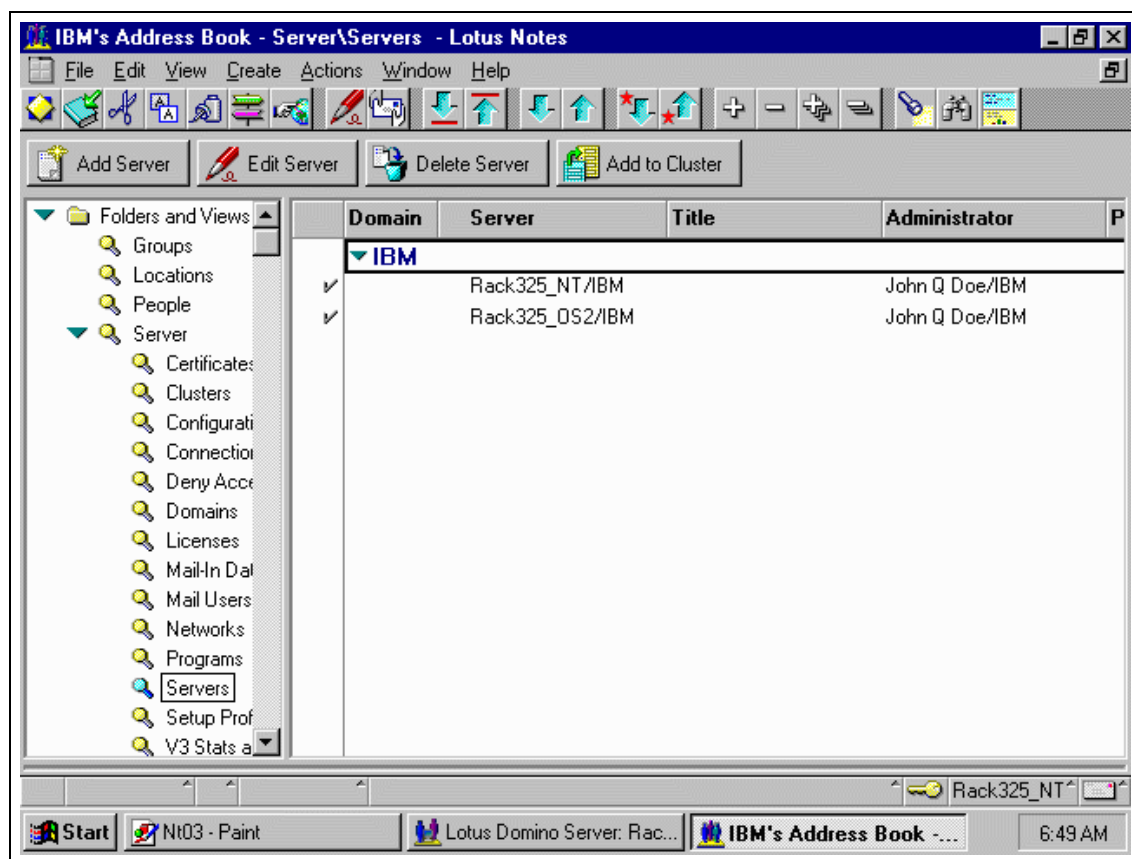
3. Select the two servers you want to add—**RACK325_NT/IBM** and **RACK325_OS2/IBM.**
    Click the **Add to Cluster** button.

4. A dialog box presents options to "Choose the cluster you want to add the server(s) to" or
    "Create New Cluster." Because this is new installation and a new cluster, select **Create New
    Cluster** and click **OK.** Enter the name *DOMINOCLUSTER* as the name of the new cluster.

    *   After other clusters also exist on the network, you can select the cluster name from the list
        to add servers.

5. You should see the following message:

    *Your request to add the server(s) to a cluster has been successfully submitted to the
    Administration Requests database.*

    Press **OK.**

6. Select the **Server - Clusters** view to verify the servers are members of the cluster. Close the
    public address book.

Continue with the next section to restart the NT Server and observe the changes in the console log.

Restarting the NT Server

Restart the NT server. The console output that appears during this startup is shown below. Note
especially the highlighted lines. Each of these has a number which corresponds to the number of an
explanatory statement in the following list.

Lotus Domino r Server, Release 4.5a, December 20, 1996
Copyright c 1985-1996, Lotus Development Corporation, All Rights Reserved

02/26/97 08:20:15 AM Begin scan of databases to be consistency checked
02/26/97 08:20:15 AM End scan of databases: 1 found
02/26/97 08:20:16 AM Informational: The registry value
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\Session Manager\Memory
Management\LargeSystemCache is currently set to 1. For better server performance, change the setting to 0
02/26/97 08:20:17 AM 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
02/26/97 08:20:18 AM Cluster Administration Process started ◀--------- (1)
02/26/97 08:20:18 AM Database Replicator started
02/26/97 08:20:23 AM Mail Router started for domain IBM
02/26/97 08:20:27 AM Index update process started
02/26/97 08:20:33 AM Stats agent shutdown
02/26/97 08:20:36 AM Router: Internet SMTP host rack325_nt in domain raleigh.ibm.com
02/26/97 08:20:39 AM Agent Manager started
02/26/97 08:20:44 AM AMgr: Executive '1' started
02/26/97 08:20:45 AM RACK325_NT/IBM is the Administration Server of the Public Address Book.
02/26/97 08:20:45 AM Administration Process started
02/26/97 08:20:49 AM Schedule Manager started
02/26/97 08:20:50 AM SchedMgr: Validating Schedule Database
02/26/97 08:20:51 AM SchedMgr: Done validating Schedule Database
02/26/97 08:20:51 AM SchedMgr: Calculating hourly statistics
02/26/97 08:20:51 AM SchedMgr: Done calculating hourly statistics
02/26/97 08:20:53 AM Calendar Connector started
02/26/97 08:20:58 AM Cluster Database Directory started ◀--------- (2)
02/26/97 08:21:03 AM Cluster Replicator was unable to configure using Cluster Database Directory
cldbdir.nsf: File does not exist ◀--------- (3)
02/26/97 08:21:59 AM Cluster Replicator started
02/26/97 08:21:07 AM Database Server started
02/26/97 08:21:50 AM Adding server to cluster DOMINOCLUSTER
02/26/97 08:21:59 AM Error processing request: No cluster mates found   ◀--------- (4)
02/26/97 08:21:59 AM Cluster Administration Process shutdown
02/26/97 08:22:05 AM Created database Cluster Database Directory: cldbdir.nsf   ◀--------- (5)
02/26/97 08:22:09 AM Finished initialization of Cluster Database Directory

1. The cluster administration (CLADMIN) process starts. This process is responsible for the correct operation of all cluster components. On clustered servers, the process runs automatically at server startup and whenever the cluster membership changes. When the added server detects a change to its address book, the cluster manager and the cluster administration process (CLADMIN) start.

2. The cluster database directory manager (CLDBDIR) process starts. This process keeps the cluster database directory (CLDBDIR.NSF) up to date with the most current database information. This process also manages databases with cluster-specific attributes such as databases marked as out of service or pending delete.

3. The cluster replicator was unable to configure using the cluster database directory, CLDBDIR.NSF. Because this is the first startup of the server as a cluster member, this database does not exist yet. You add this in a later step (see note 5).

   • The cluster database directory (CLDBDIR.NSF) database resides on each server in a cluster and contains information about all the databases and replicas within that cluster.

4. The RACK325_NT server is added to the cluster, but at this time there are not any other cluster (members) found. The RACK325_OS2 server is *registered,* but not *installed.*

5. The cluster directory database (CLDBDIR.NSF) file is created. It uses the CLDBDIR.NTF template.

Installing the OS/2 Domino Server

The next step is to install Notes 4.5 on the second server in the cluster, the OS/2 Server. The installation program is started as usual, except you use the INSTPM.EXE command for OS/2. Use the OS/2 Warp Server 4.0 with the required TCP/IP installed.

1. On the **Installation Method** screen, select **Advanced Services** and click **OK.**

2. Read the **License Warning** window. The Advanced Services license must be purchased for every Domino server using Advanced Services features. If you have proper licensing, click **Yes.**

3. On the **Install** window, update CONFIG.SYS and click **OK.**

4. On the **Install - Directories** window, place the \NOTES directory and \NOTES\DATA directory on the desired drive. On the Notes components section, click **Select All.** Click the **Install** button.

5. The installation program then loads the Lotus Domino for OS/2 Advanced Services code onto your server.

6. Test your TCP/IP configuration to make sure that TCP/IP is configured correctly on the two servers. From the OS/2 command prompt, try pinging the RACK325_NT server:

   C:> PING RACK325_NT

   If correctly configured, RACK325_NT should respond. If you do not receive a response, follow these steps:

   a. Open the **TCP/IP Configuration (LAN)** folder.

   b. Select the **Hostnames** tab. On screen 1, ensure that RACK325_OS2 is in the field labeled "This machine's hostname."

   c. Select screen 2, and make sure that there is an entry for RACK325_OS2 and RACK325_NT that includes their associated TCP/IP addresses.

   d. Save and exit.

   e. Try pinging RACK325_NT again. If RACK325_NT responds, ping RACK325_OS2 from the RACK325_NT server. If this ping fails, ping using only the TCP/IP addresses (i.e., ping 9.67.240.122) to ensure the basic TCP/IP and wiring is correct.

   f. When TCP/IP is correctly setup, continue with the next step.

7. Shutdown and restart the OS/2 server.

8. After the system has restarted, open the **Lotus Applications** window and start the Lotus Notes Workstation program. The first time you double-click the Notes workstation icon, the Notes setup program automatically starts. You must complete the server setup program before starting the server and working with Notes.

- If you try to start the Notes server without first completing the Notes server setup program, the server exits with the following message:

  You must first type "Notes" to set up your system.

  To restart the setup process, double-click the Notes workstation icon.

- Reference the online *Server Installation* document for complete instructions on the Notes setup program.

  After you complete the Notes setup program, exit the workstation program and start the Notes server.

9. When the OS/2 Notes Server successfully starts, you must replicate the administration database (ADMIN4.NSF) from RACK325_NT onto RACK325_OS2. When you complete this process, exit the workstation program and stop the OS/2 Domino server (type *QUIT* at the Domino server console). After the Notes server shutdown completes, restart the OS/2 Notes server.

10. Next, start the Notes workstation program. Replicate **CLDBDIR.NSF** with the **RACK325_NT** server.

- CLDBDIR.NSF is an important Notes cluster file. Each time you add a database to a server, the cluster database directory manager creates a document profiling that database. This document, which resides in CLDBDIR.NSF, contains information such as the database name, server, path name, replica ID, and other replication and access attributes. The cluster uses the cluster database directory file, which the server's cluster database directory (CLDBDIR) task updates regularly, to determine failover paths and to control access to databases.

  The best method for replicating CLDBDIR.NSF is from the NT workstation program, as follows.

  a. Open CLDBDIR.

  b. Select **Replicate - With options.**

  c. Select the server you want to replicate to and the server you want to replicate from.

  d. After replication, CLDBDIR.NSF should show entries for databases from both servers.[5]

---

[5] **Note:** If the CLDBDIR replicates in only one direction, (i.e., the CLDBDIR.NSF on the NT server shows entries for both servers while the OS/2 server shows entries only for itself), you must delete the CLDBDIR.NSF on the OS/2 server. After deleting the one directional CLDBDIR database on the OS/2 Notes server, create a **New Replica** of the CLDBDIR from the NT server onto the OS/2 server.
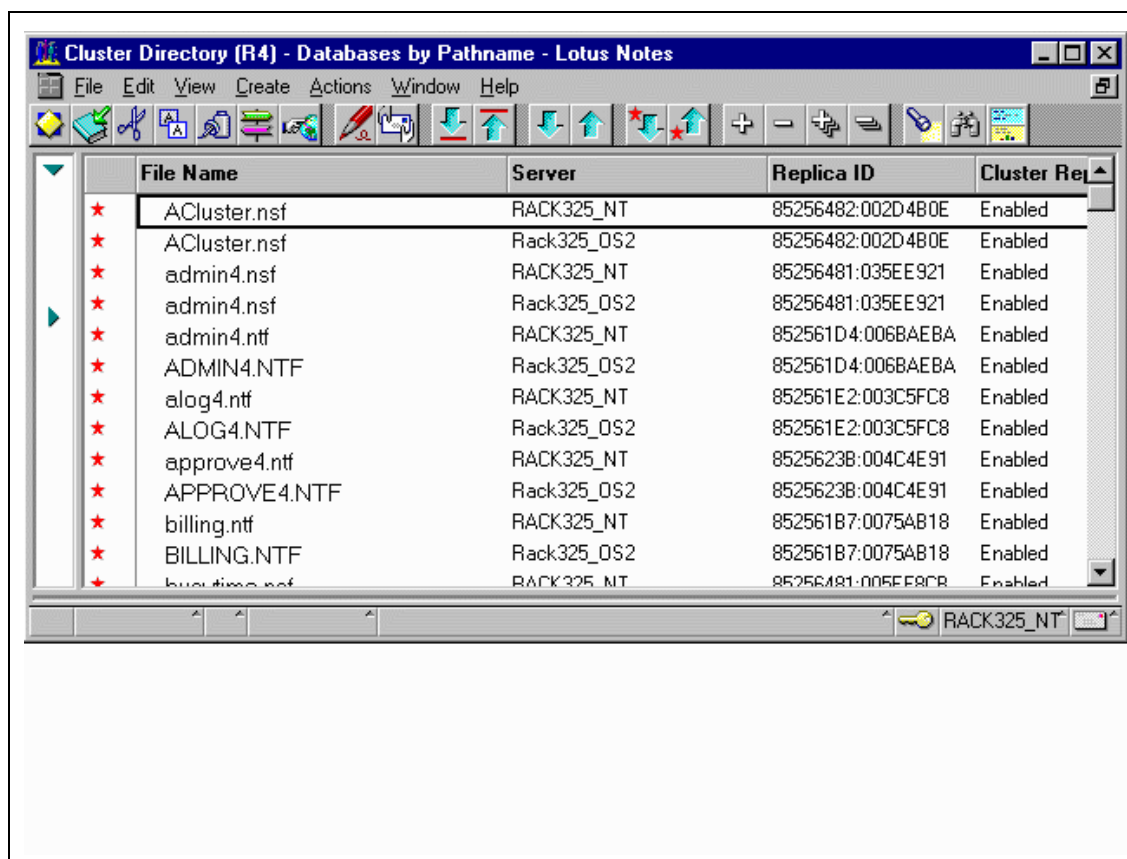
11. Next, select any files you want the cluster replication service to replicate. For testing purposes, you could create a simple Discussion database and replicate it onto the other server.

   a. From the RACK325_OS2 server, select **Replication.**
   b. Select **New Replica.**
   c. Select **With RACK325_OS2.**
   d. Select **Database,** then select **Immediate.**

12. To verify whether cluster replication is working, make some changes to the replicated database. You should see the changes replicated to the other cluster member almost immediately. In addition, review the console on both systems and at the database on the other system.

Changes to a Cluster Server's NOTES.INI file

After the server is added to a cluster there are new entries added to the server's NOTES.INI file. The next time the server starts, two new server tasks are automatically started—the Cluster Database Directory Manager and the Cluster Replicator tasks. The ServerTask statement in the NOTES.INI file of the server(s) is appended with two new task parameters, the CLDBDIR and the CLRERPL.

CLDBDIR

All Notes servers within a cluster run a Cluster Database Directory Manager (CLDBDIR) task. This task creates and maintains the cluster database directory. When you add or remove a database on a server, the CLDBDIR task immediately changes the information in the cluster database directory to show the addition or deletion of that database.

All members of a cluster share a common cluster database directory. When one server updates its list of databases, the cluster replicator replicates the changes to the other servers in the cluster. In this way, each cluster member has an up-to-date directory of databases in the cluster.

CLREPL

The Cluster Replicator (CLREPL) task is responsible for the tight synchronization of data among replicas in a cluster. Each server in a cluster runs one cluster replicator by default, although administrators may want to increase the number of CLREPL tasks on a server.

Whenever a change occurs to a local database, the cluster replicator pushes the change to the other replicas in the cluster. This behavior ensures that each time you access a database you are looking at the most up-to-date version. The cluster replicator also replicates changes in private folders that are stored in a database.

The CLREPL task only pushes replications to other servers within the cluster. The standard Notes replicator task (REPLICA) is still responsible for replicating changes to and from servers outside of the cluster.

In addition to these parameters that are automatically added, you may want to add another parameter. This parameter enables or disables Mail Router request failover, and is called MailClusterFailover. If users have replicas of mail files located on multiple servers, you can set this in the NOTES.INI file of all Notes Release 4.x servers in the domain. Once set, it enables users to receive mail from servers within and outside the cluster when their home servers are down.

The format of the parameter is: MailClusterFailover=value. There is no default value for this parameter. Use the following values to set the *value* variable:

- 0 disables Mail Router request failover
- 1 enables Mail Router request failover

Cluster Setup Strategies

After reviewing your Notes environment, you should plan a cluster strategy which tries to create a balance between your user's requirements for data availability and the physical ability of each computer in your cluster to manage additional workload. Based on your priorities, there are different strategies for optimizing database and server access.

High Failover

The first strategy you can consider is the *high failover* strategy. This strategy attempts to keep important databases highly available to the clients. One obvious type of database suitable for this strategy is a user mail database. You can make mail databases highly available by creating a

replica of the databases on another server in the cluster. If a user accesses the client to retrieve mail from the database and the server is unavailable, failover sends the client to the replica on another server.

The **MailClusterFailover** setting in the NOTES.INI enables this type of Mail Router request failover. If users have replicas of mail files located on multiple servers, you can set this variable in the NOTES.INI file of all Notes Release 4.x servers in the domain. This enables users to receive mail from servers within and outside the cluster when their home servers are down.

If the workload on your cluster is normally well-distributed, consider configuring the cluster for failover only.

Active Workload Balancing

The second strategy is *active workload balancing.* Notes clusters has an optional workload balancing feature that lets you distribute the workload of heavily-used databases across multiple servers in the cluster. Mail databases again provide an ideal illustratation for this work balancing concept. So that no single server has a significantly larger number of mail files than any other server**,** you distribute the user mail files equally across the cluster. There are two NOTES.INI parameters that assist in workload balancing: **Server_Availability_Threshold** and **Server_MaxUsers.**

- Server_Availability_Threshold specifies the acceptable level of system resources available to a server. By setting this value for each server in a cluster, you determine how the workload is distributed among cluster members. Notes compares this value against a server's availability index. When the availability index falls below the Server_Availability_Threshold value, the server's state becomes BUSY.

- Server_MaxUsers specifies the maximum number of user sessions allowed on a server. When the server reaches this limit, the server goes into a MAXUSERS state. The cluster manager then attempts to redirect new user requests to other servers in the cluster. You can also use the Server_MaxUsers setting for any Notes server; this setting is not restricted to clusters.

Combining High Failover and Active Workload Balancing

The third strategy to consider is a *combination* of the two previous strategies. When you have a database that users access continuously, such as a special discussion database, not only do you need high availability, but you also need to distribute within the cluster the heavy workload created by users accessing the database.

As the cluster administrator, you should closely monitor your system for usage patterns during peak periods and adjust cluster resources accordingly.Provide failover for databases by creating replicas on two or more servers. You can balance server workloads by adjusting the availability thresholds and maximum user limits of each server. The cluster manager then monitors each server in the cluster, triggers failover, and redirects requests accordingly. It also monitors the number of active users and indicates to other cluster servers when a server is in the MAXUSERS state and is not accepting new user requests.

To see how often requests are being redirected, check the Notes Log for failover events. If redirection of the user request is unsuccessful, the user receives a message, and is not allowed access to the server.

Summary

In summary, using the Lotus Notes clusters feature introduced in Lotus Domino Server 4.5 provides an application clustering solution for the Lotus Notes environment. This implementation combines the important basic clustering functions of high availability, scaleability, and workload balancing into one integrated package. With high availability, you can place multiple copies of databases onto multiple servers, allowing constant user access with few service interruptions. With scaleability, you can easily add and remove servers on the cluster. And with workload balancing, you can hand the distribution of the cluster's workload over to the clustering technology, ensuring the cluster dynamically adjusts to fluctuations in user demand.

In general, Notes clusters currently allow you to group up to six servers to form a cluster. Because Notes clustering is an application clustering solution, it provides you with a degree of operating system independence. Any operating system supported by Advanced Services can participate in the cluster. In addition, you can also run different operating systems within the same cluster. Notes clustering is also easy to implement. It does not require any special hardware or rewriting of your Notes applications. If you currently have Lotus Notes 4.5, basically all you have to do is install the Advanced Services code, configure the cluster, and replicate your important databases throughout the cluster.

One major benefit of using a Lotus Domino cluster instead of traditional Lotus Notes servers is that the replication of data becomes instantaneous and continuous to all functioning servers. Traditional replication is either run manually or triggered on a timed basis, a method that can leave gaps of time where all replicas of data are not synchronized. The Notes clusters' event-driven replication method eliminates this risk.

Implementing a clustering solution involves a careful evaluation of how your network can benefit most from the clustering. Considering your users' needs as well as the physical capabilities of your equipment is critical. Cluster setup strategies can concentrate on high availability of data, on balancing workload for the servers, or on a strategy that incorporates both these concerns.

Although many new Intel-based clustering solutions are being touted in today's marketplace, many of these provide only a subset of true clustering. For example, some solutions merely provide for high availability while ignoring scaleability and workload balancing. In comparison, Notes clusters provide a comprehensive and advanced clustering solution for the Lotus Notes environment. In many ways, Lotus Domino clusters lead the Intel-based server clustering pack.