

Lotus

White Paper

Understanding Domino for Linux
Includes Step-by-Step Installation Guide

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Contents

| | |
|---|----|
| Adding Domino for Linux to your server strategy | 1 |
| What is Linux? | 1 |
| Why businesses are adopting Linux servers | 2 |
| Where Domino for Linux can enhance your environment | 2 |
| Planning your Domino for Linux servers | 4 |
| Choosing a Linux distribution | 4 |
| What's the difference? | 4 |
| Currently supported distributions | 5 |
| Other distributions | 6 |
| Choosing hardware | 6 |
| Domino for Linux scales to the operating system | 9 |
| Considerations for implementing Domino on Linux | 11 |
| Installation issues | 11 |
| Step-by-step installation | 11 |
| Other Domino for Linux install resources and articles | 17 |
| Connecting to enterprise systems | 18 |
| Tools for integrating your applications | 18 |
| Security considerations | 20 |
| Locking down Linux | 20 |
| Tip on cleaning up after a server crash | 21 |
| Tips for improving Domino server performance | 22 |
| Appendix: Step-by-step Domino for Linux install | 23 |

Adding Domino for Linux to your server strategy

Lotus Domino provides maximum flexibility and choice by embracing as many server platforms as possible. As the newest addition to formally supported platforms for Release 5, Domino for Linux offers an exciting and unique platform. With its rapidly growing user base, renowned security and reliability, and powerful remote administration tools, the Linux operating system has made remarkable progress in the corporate world. The Lotus Domino servers, with their built-in cross-platform support, take advantage of this new and powerful operating system to provide impressive performance and reliability — and new options for affordable application design and deployment.

This paper explores ways to make the best use of the Linux operating system for Lotus Domino servers, and provides important information for Lotus Domino administrators.

If you are considering installing Lotus Domino for Linux servers, be sure to read the README file that is distributed with the software for the most up-to-date information and system requirements.

What is Linux?

Linux is an implementation of the POSIX specification with additions from both System V and BSD. It is available under the GPL (General Public License), meaning that its source code is open and freely available to all without commercial constraint as long as the individual or company adopting its use abides by the GPL. See <http://www.linux.org> for more details.

Linux looks and runs like UNIX, but was built from an entirely different source code base. It is very different from other operating systems available today, not only because it is free, but also because the complete source code is distributed to anyone who wants it. It is actually illegal, as defined in the GPL, to distribute changes to the operating system without providing the source code to those changes.

One feature that makes Linux so compelling is that it is developed and maintained by a community of software developers around the world. These developers, both amateur and professional, revel in the idea of producing a stable and powerful alternative to expensive, closed operating systems. Rather than trying to hide problems, these developers enjoy openly discussing them and then teaming to implement the solutions as quickly as possible.

The operating system itself and an entire set of tools, utilities, and applications are available complete with source code. To many, this represents a level of security and stability unmatched by any commercial operating system. System problems, security issues, and future enhancements are discussed openly. Every user of Linux has access to every aspect of the software. For more information on Linux, see <http://www.linux.org>

Why businesses are adopting Linux servers

Businesses are deciding to adopt Linux primarily because of its powerful economics. For many solutions ranging from high-availability Web applications to replicated business solutions, the program only needs to be designed once, then deployed many times and efficiently managed from a central location. Linux fits this task in unique and powerful ways. But that's not all: as an open source software environment, Linux lends itself to customization and special purpose tasks for which no other operating system offers a form as malleable. Until recently being embraced by Lotus and IBM, among other industry giants, some business people objected to the lack of applications for Linux.

"Linux has experienced dramatic growth as an operating environment for functional servers," says Dan Kusnetzky, International Data Corporation's Director of Operating Environments and Serverware Research. Kusnetzky adds, "Linux has not yet experienced the same level of interest as a platform for important business applications. Lotus Domino for Linux is expected to address this issue by bringing hundreds of business applications to the platform." He concludes, "IDC expects to see Lotus Business Partners move rapidly to capitalize on this new platform."

Indeed, the Lotus Business Partner community will spearhead the introduction of Linux-based applications into the enterprise. Their skill and expertise in designing and supporting business critical applications based on Lotus Domino and Lotus Notes has created the "Notes Industry" and a worldwide installed base of greater than 50,000,000 users. Many Lotus Business Partners are expected to offer Domino solutions for Linux to smaller size companies due to the dramatically lower costs involved.

Where Domino for Linux can enhance your environment

Remote offices with limited support staff

No matter how large the infrastructure, there is always that remote site with just a few users. Those users require the same kinds of services as those in your largest corporate offices, and that's the challenge. To duplicate those services for so few users can be expensive and difficult. Often, small offices and remote sites simply cannot justify the kind of high-end hardware and full-time support personnel required to maintain a complex data center. Many organizations are adopting Linux as a solution for this need. With Linux, a single low-cost server can provide many or all of the key network services such as DHCP and DNS, file and printer sharing, and message routing, firewall, and tunneling required to keep the small office connected to the head office. In these situations, using that same server as the delivery platform for mail and intranet applications is directly in line with cost-savings objectives, and provides a powerful alternative to purchasing additional equipment, software license costs, and support staff.

Another Linux advantage in these remote locations, is the ease with which it can be remotely managed. Linux has the built-in ability to log in using a terminal emulator (telnet) at very low connection speeds, transfer files (FTP), and share the use of graphical applications (X-Windows). Thus Linux offers a very manageable alternative to operating systems that are entirely graphical in nature and require physical presence at the server console to perform maintenance, with their higher attendant costs and complexity.

Note: You can perform the administration of your Linux server via telnet. However, the Domino server cannot be managed with telnet.

Economical clustering solutions

To provide truly high-performance solutions that involve virtually no downtime, Lotus Domino servers come with the ability to work together in a cluster. Mail, database, and Web server functionality can all be clustered with the Lotus Domino server. Together, the servers in a cluster provide workload balancing and automatic failover.

Much like RAID (Redundant Array of Inexpensive Disks) for storage solutions, Linux servers provide a low-cost way to have multiple servers arrayed in a fault-tolerant cluster. Lotus Domino servers running on Linux make excellent nodes in a cluster of their own, or can be used to add nodes to an existing Lotus Domino cluster comprised of servers running on a different operating system. In this way, an attempt to deny access to a site by exploiting the well-publicized security difficulties in one operating system cannot take down all of the servers in the cluster. This provides an added benefit to site administrators.

As an evaluation or development server

One word: Cost. If you've ever been through a software license audit, or if you've ever had to delay or cancel your plans to build a development or evaluation server because of the cost of hardware or operating system licenses, then you understand the need for a low-cost, quickly deployable server. A Linux server, especially one that is going to see limited concurrent use, can typically be set up on much less expensive equipment than is required by other operating systems, and perform acceptably. Often, out-of-service desktop computers meet the requirements to build a functional prototype or development server. A Lotus Domino server can run quite successfully on an i486 100Mhz desktop computer with 64MB of RAM using Linux. Although this is well below the minimum requirements for a production server, it does illustrate the ability to run on very inexpensive equipment. Add to this the free Linux operating system itself, and prototyping becomes much more affordable.

Outside the firewall

Most implementations of Lotus Domino communicate with users who are not solely on-site employees. Serving users from other companies and replication with other organizations are two of the many reasons why a server may need to exist outside the corporate firewall or in the less-secure part of your company's network. Servers in this environment are increasingly at risk of security problems from simple denial of service attacks, as well as unauthorized usage and alteration of data (see <http://www.theiia.org>). Even organizations that have tried to standardize on a single operating system for servers have had to reconsider their choices when faced with frequent bulletins about security and stability problems in their current operating system choice. Linux has become the platform of choice for many of these firms because its open source and vast developer network reduces the number of hidden trouble spots to worry about. With Linux, networking security is built directly into the operating system kernel itself. When considering a Lotus Domino server in a potentially hostile environment, you may find that Linux can provide a low-cost, stable, and secure alternative.

Planning your Domino for Linux servers

The sections below provide the critical information you need to get started with Domino for Linux.

Choosing a Linux distribution

Getting your hands on a copy of Linux is a little different from purchasing a conventional software package. You could download a few megabytes of kernel source code from the Internet, compile it, and have Linux, but this won't get you very far. You need utilities that set up your hard disk, installation scripts to create the directory structure, and packages of software that make the system complete. Several companies have created what are referred to as commercial Linux "distributions." These are analogous to purchasing a CD install for your favorite application or conventional operating system. There are several options for obtaining a distribution. You can download a distribution CD in ISO format — an industry standard that gives you a file ready to write onto a blank CD-ROM. You can download an install disk (or disks) that starts the installation process and then connects to a remote host for the required software over the Internet; or you can purchase a boxed set of CDs complete with installation manual. Most new Linux users choose the latter option, ordering a distribution from an on-line vendor or purchasing one that has been packaged for retail sale. The vendors of these distributions charge for the packaging and shipment of the software, and post-sales technical support, but not for the software itself. The following sections discuss some of the distributions that have been tested with the Lotus Domino server.

What's the difference?

Linux is Linux. No matter what the distribution, what really makes one installation different from others is the version of the kernel (the core operating system) and the various software packages that are installed. Each commercial Linux distributor takes a slightly different approach to the installation of Linux on your machine. Some have completely scripted the installation process, providing first-time users with an up and running system very quickly. Other distributors focus on more flexible, but less easy to use routines. Further differences include the file structure once installed, although this is rapidly becoming standardized by the use of package managers that automate the process of adding and removing software. In theory, anything that runs on one distribution can be made to run on them all. This is true as well for the Lotus Domino server. The main difference is the way each distribution loads the software onto the machine. If a program is built to look for files that it depends on in a specific place or by a specific name, then distributions that use a different naming convention may be more difficult to configure to make your software run.

A solution to this issue is in the works. An initial group, the Linux Standards Base (LSB) Project has merged with a second effort called the Linux Compatibility Standards Project (LCS). Together, these projects are working toward specifications for software manufacturers to follow. Lotus and IBM have committed to these standards once they are released.

The commercial Linux distribution companies are experiencing wrenching growth. Most notable to date has been the 1999 Initial Public Offerings of Red Hat, Inc., and VA Linux, Inc. Caldera, TurboLinux, and other Linux companies are lining up for their IPOs in 2000. With astronomical market capitalization and minimal revenue streams in place, these companies are expected to forge new, differentiated offerings. Retail editions of their Linux distributions are already being priced and packaged at entry price points targeting consumer desktops, while Professional Editions are priced and packaged for the system integrator and developer market, where the use of Linux as a server operating system is the primary objective. Extending this trend, companies like Red Hat and TurboLinux are now offering application server bundles. Red Hat + Oracle and TurboLinux + IBM DB2 are just two examples of this trend. Look for this to continue to expand in 2000 and beyond, as these distributors vie for market success.

Currently supported distributions

The distributions below were supported at the time this paper was written; however, the list is constantly being updated. Keep an eye on <http://www.lotus.com/dominolinux> for the most current list of supported distributions.

Red Hat

Red Hat Linux is currently the leading brand for commercial Linux distribution, and is well known for being very user friendly in both its installation process and its package manager, RPM (Red Hat Package Manager). The Lotus Domino server has been certified to run on the Red Hat 6.0 distribution. For more information about this distribution, see <http://www.redhat.com>

Caldera

Caldera Open-Linux is a favorite of VARs, ISPs, and Resellers and is very much focused on Linux for Business. The Lotus Domino server is supported on Caldera OpenLinux version 2.2 and higher. For more information about this distribution, see <http://www.calderasystems.com>

Other distributions

SuSE

According to the company's Web site, SuSE stands for "Gesellschaft für Software- und Systementwicklung mbH," which can be roughly translated as "Company for Software- and System-Development." The company is located at Nuremberg in Bavaria, Germany. SuSE is very popular in Europe, and the version 6.2 distribution will run the Domino server with the appropriate libraries installed (see the section on library structure below). For more information about SuSE, visit <http://www.suse.com>

TurboLinux

TurboLinux has been very successful in Japan and China due to its thorough support of DBCS (double-byte character set) languages. TurboLinux is a complete distribution, available in the major Asian languages. TurboLinux 3.6 will run the Domino server with the appropriate libraries installed (see the section on library structure below). TurboLinux has released a product called TurboCluster Server which allows up to sixty Linux servers to act as a single virtual server. TurboCluster promises to add high reliability and performance to the Linux community. For more information on TurboLinux, visit <http://www.turbolinux.com>

Others

Several other distributions remain popular. Both Debian (<http://www.debian.org>) and Slackware (<http://www.slackware.com>) are very much in use. Both of these should work provided the proper libraries are installed and linked (see the section on library structure below); however, they are not yet supported.

Choosing hardware

Not the same as choosing an NT server

The first thing to be aware of, when choosing hardware for Linux, is that it is not quite the same as choosing hardware for a Microsoft Windows NT server. Linux handles support for hardware quite differently, and hardware may or may not be compatible.

Optimized Linux servers

For a production Linux server, take a look at one of the servers being produced specifically for the Linux operating system. These machines often come pre-loaded with Linux, and are sold with hardware that the manufacturers have fully tested, optimized, and support under Linux. A list of vendors selling servers specifically for Linux is maintained at <http://www.linux.org/hardware/index.html>

Generic servers and clones

Linux runs on a wide variety of systems. As a general rule, the more generic the system, the easier Linux will be to install. A simple 586-class machine with an IDE hard drive will require almost no customization. Special attention should be paid, however, when

more elaborate and high-performance hardware will be used. A list of Linux-friendly hardware vendors is maintained at <http://www.linux.org/hardware/index.html>; however, this is by no means an indication that ONLY those vendors' hardware will work. If you have specific questions about a hardware component, here are some places to check:

- Check the manufacturer's Web site. Many hardware manufacturers provide information about getting their products to run with Linux, even if they do not fully support the use of the operating system.
- The Linux "How-To" online help files at <http://www.linux.org/help/howto.html> provide valuable information on obtaining third-party drivers and utilities to manage your equipment.
- The Support List at <http://www.linux.org/help/index.html> is updated regularly and acts as a clearinghouse for Linux hardware support.

General considerations for choosing hardware

Even if you are choosing hardware for a prototype or development server and plan to spend as little money as possible, there are some decisions you can make that will greatly impact overall performance. These considerations are essentially the same on any server that is PC based.

Multi-disk vs. Single disk

When considering mass-storage options, consider the way the server will be using the space. Four basic functions will be performed:

- *Loading executables and libraries* — This generally happens infrequently, and only as needed. Application files are typically loaded once and stay in memory for as long as the application is in use. The speed at which this occurs will not greatly impact the overall performance of the system.
- *Data access* — Specifically, reading and writing your Lotus Domino databases on the disk. This is a constant activity, and performance of this task will greatly affect the overall performance of the system.
- *Swapping memory* — Linux, like other operating systems, uses disk space for additional memory. This is typically done using a separate hard disk partition optimized as swap space. Linux will use this sparingly; however, on a busy system, the speed at which this can be accessed will greatly affect the overall performance of the system.
- *Logging* — The Lotus Domino server will be writing frequently to its transactional log files and to its historical log files (e.g. log.nsf, domlog.nsf). While designed to have as little impact as possible on overall performance, this activity can increase the time it takes to read user data, and thus impact overall system performance.

In a perfect world, a separate physical disk would be used for each of these activities. This is due to a combination of buffering (each drive has its own internal buffer) and the physical time it takes to perform the reading and writing. For example, if in the same operation the server must write data to both a user database and to the transactional log,

then the read/write head of the drive must move to two totally different places on the same drive. Moving the read/write head of course takes time. If instead, the transactional logs are on their own physical drive, then the read/write head of that drive can stay exactly where it is needed most over the spot on the drive that contains the transactional logs. Less waiting for the drive means increased performance. This example can be further applied to memory swap files especially on busy machines or those machines with less than optimal RAM. In the case of machines equipped with RAID arrays, consider using a drive that is not part of the array (or a separate array) for transactional logging and another for the memory swap file.

RAM vs. Cycle speed

When funds are limited, should you spend the money to get the fastest processor, or the most RAM? The answer is not clear cut. A faster processor will definitely help with tasks like view indexing and database searches; however, RAM is truly critical to performance. A machine with a slower processor is going to do physically the same things as one that is using the newest, fastest processors. It's just going to do them more slowly. On the other hand, a machine with less RAM becomes more and more dependent on the memory-swap file using hard disk space to make up for a lack of RAM. Hard disk access time is measured in milliseconds, while memory access time is measured in nanoseconds. With too little RAM, you slow down, trading nanoseconds for milliseconds on each and every cycle of a fast processor. Even on the fastest hard disks, where access time is measured in the single-digit milliseconds, this is MUCH slower. All that data you are now moving is blocking the same path that the server must use to access the user data itself. If you cannot purchase optimal equipment, and must make a choice, always fill your requirement for RAM first.

SCSI vs. IDE

Here is another decision that can have a profound impact on performance. IDE hard disks offer the attraction of a very low cost when compared to their SCSI counterparts of the same capacity. Is it worth the complexity of configuration and the additional cost to move to the SCSI drives? If you've already satisfied your need for RAM, then yes, it is definitely worth the expense. It is not the IDE interface itself that tends to slow the IDE drives down, but the relatively simple controllers that make them so inexpensive. IDE drives use a simple drive controller based on the old ST-506 standards from the early 1980s (see MFM and RLL). This controller is embedded in the drives themselves and cannot be changed. The ports on the system board or the PCI card we connect the drives to are actually simple port interfaces with very little onboard technology. SCSI controllers are able to take advantage of the most powerful features of the systems architecture through bus-mastering and many even have onboard processors of their own.

There is another complication to choosing an SCSI interface for your Linux system, especially for the novice Linux user. The SCSI controller you choose must be supported by the operating system, and in some cases, this could mean a few complex configuration steps. Before choosing your SCSI controller, find out from the manufacturer if the card is supported directly or through a third-party driver. Do not be put off by third-party

support, many of the drivers in Linux are written by the same people who use them, and work quite well. You may want to review the installation steps for a given controller to make sure you are comfortable with this integration step before deciding to purchase it.

What about X-Windows?

While X-Windows is a great tool, it has nothing at all to do with the Lotus Domino server for Linux at this time. If you don't need it for something else, you may not want to install it, as it uses up valuable system resources. At this time, there is no Lotus Notes client for Linux.

Multi-home Linux systems

Assigning more than one IP address to a single network interface is called “multi-homing” the interface. This can be done to have a single machine that answers to many different IP addresses. Most services, including the Lotus Domino server services, can be configured to listen only to one of these IP addresses. This is one way to have multiple implementations of the same service on a single machine. This is also required to use “virtual servers” on your Lotus Domino server. An excellent resource for configuring a multi-home Linux server is the “How-To” located at <http://www.linux.org>

Domino for Linux scales to the operating system

At this time, the Lotus Domino server on Linux is subject to limitations in the Linux operating system itself. These are rapidly being addressed by the Linux development community because they affect many other operating system intensive applications as well. These are normal growing pains, and do not affect the overall stability of Linux, only its current scalability. Many of these are the same issues that had to be addressed in other operating systems as they grew. Thus far, the people who develop Linux are addressing these issues.

Concurrent usage limitations

Linux and multiple processors

At the current kernel version (2.2.x), support for SMP is still considered to be fairly simple. It does work — and with good reliability. However, performance at present is not what it will eventually be. A great deal of additional work is being done for the version 2.4 kernel. For more information, see the Linux SMP FAQ at <http://www.uk.linux.org/SMP/title.html>

Current Linux kernel internal limitations

The current Linux kernel (2.2.x) supports a relatively low number of critical resources required for the Lotus Domino server (or other servers doing similar multi-session processing). This reduces the total number of concurrent users of the system, regardless of available memory and processor power. The actual number of users who can use the system at the same time varies greatly depending on several factors, including the number of other processes running and which client the users are using.

For a Notes mail system, assume that, at any given time, about one third of the total user base is likely to have active sessions on the system. For example, if your own servers seem to be able to handle around 50 concurrent Notes mail users, then you should be able to support a user community of up to about 150 Notes mail users. Obviously, user community characteristics vary greatly. If your own users are highly active e-mail participants, or if you have mission-critical applications constantly in use, then the number of users a single server can handle may be smaller. At this time, the Red Hat Linux 6.1 distribution has the most up-to-date modifications required to provide Domino as many resources as possible. As each update to the Lotus Domino server and the Linux distribution you are using is released, check the installation notes for any changes to these limitations.

Why Web applications are much less likely to be impacted

Web-based user sessions are inherently shorter. A session for a given user is only open for the time it takes the user's page request to be read by the server, and for the server to stream the resulting output to the user's browser. Once this is done, that thread is quickly available for the next user or session. From a practical standpoint, this means that even the limited kernel resources are enough to serve large numbers of concurrent Web users. In general, you will face other limitations of scalability if you try to use a single PC-based Web server long before reaching the limit of available threads.

What's being done?

The kernel developers working on Linux are working with representatives of Lotus and other vendors to increase the capability of the kernel. Some distributions are already doing this experimentally, and initial results are quite positive.

Considerations for implementing Domino on Linux

Installation issues

For the Lotus Domino administrator not used to working with Linux, some of the configuration steps may be slightly more difficult than with a windowed operating system, since some command line knowledge is required. Make sure to read the installation instructions provided. This section will help you get your server up and running quickly by providing a few tips from the field.

Prepare the kernel

Your Linux distribution should come with a pre-compiled kernel that supports most of the options you are likely to use initially. If you choose to implement any of the advanced options supported by your Linux distribution, you may need to recompile the kernel to take advantage of options which are not enabled by default. This may sound like a huge deal. But in truth, it's not hard at all. While you are running a compiler and recompiling the kernel, you are not altering the source code of Linux. You're just turning on or off specific built-in options. The kernel "How-To" which is available at <http://www.linux.org/help/howto.html> provides all the instructions necessary to easily choose the options you want in your kernel, and to then implement the new configuration. You should consider, however, that if you do modify the kernel options from the default set in your distribution, you will not be able to use the troubleshooting and bug-reporting services provided by Lotus. This may change in the future. You may want to make use of the Domino for Linux mailing list (dominolinux@lyris.nipltd.com), or the discussion forums on <http://www.notes.net>

Verify library structure and availability

The Lotus Domino server requires kernel version 2.2.5 or higher, glibc 2.1.1 or greater, and libstdc++ 2.9.1 or greater. More importantly, the distribution must follow the libstdc++-libc6 naming convention. Please review the README file which comes with your Lotus Domino server for Linux for more detailed information.

Note: Commands and file names are case sensitive in Linux.

Step-by-step installation

This section will detail the basic steps required to get your Lotus Domino server up and running. If you're new to Linux and UNIX, you may want to walk through this with someone who has administered such systems before. You'll need to perform tasks that require a high level of system access.

I am..the super user..and I can do anything!

Several of the steps you need to take during the installation process require that you have "super user" access. Typically, this is done either by logging in with the "root" username and password, or preferably by logging in with your normal user ID and typing the

command “su”. When you type this command, you’ll be prompted for the root password. This level of access, called “root access,” allows you to bypass virtually all levels of security within your system. As a general rule, you should spend as little time as possible logged in as the super user. You can exit the super user access, by typing “exit”. That said, you will need to change to the super user now to continue the installation.

At any time, you can find out who the system sees you as, by typing “whoami” at the prompt. It is very easy to accidentally be logged in with higher access than you need, and this can cause difficulties later on. A common mistake is to type the “su” command twice or more. The result is that you exit one shell but remain the super user. It is important to get in the habit of using the “whoami” command.

Get the installation kit where you need it

There are two ways that most users get the software to install the Lotus Domino server: by CD, or by downloading the files from the Lotus Web site. This section will tell you how to get the files onto your Linux system so that you can run the install script.

If you have a CD

If you have the Lotus Domino server for Linux on a CD, you’ll need to “mount” that CD file system before you can use it. Some Linux distributions are set up to automatically mount the CD-ROM drive if there is a CD placed there. If your distribution is not set up to do this automatically, use the command “mount /dev/cdrom /mnt/cdrom”. This works for most systems. It requires that a directory exists on your system called “/mnt/cdrom”. If your system does not have this directory set up this way, refer to the documentation that came with your Linux distribution.

Once you mount the CD-ROM, you change to the location of the installation files, and execute the install script from there. To do this, use the command “cd /mnt/cdrom/linux”. This will make the installation directory your current directory.

If you download the .tar file

If you download the file from the Web site, it is in tar format. In “Linux speak,” it’s a “tarball.” This is analogous to a Zip file in the DOS world. The .tar file contains the entire directory structure needed to run the install script. You’ll need to move this file to your Linux system, and place it in a temporary location. Generally, your home directory is the first place you arrive when you log in so this is a good location. To unpack the file, simply type “tar xvf <filename>” where “<filename>” is the name of the .tar file. This tells tar to “eXpand” the “File” using the “Verbose” method of displaying the names of the files its working on. This will create a directory called Linux. You’ll need to change to this directory using the command “cd linux”.

Pick the active listening ports

Server services like Internet mail and news, connect through TCP/IP using “ports.” Each service has a standardized port number associated with it. The Domino server can handle several of the services that are installed on the Linux server by default on many distributions. SMTP is a good example. The standard port number assigned to SMTP is 25. By default, most Linux distributions load a process which “listens” for connections on this port and provides SMTP services to incoming connections. This Lotus Domino server also provides SMTP services using the same port. While there are ways to make these processes work together, they can be fairly complex. As a general rule, only one service can listen to a given port on a given interface. (You can create multiple interfaces, or have the service listen to other ports, however, that lies outside the scope of this document.) For each of the services below, you’ll need to determine whether you want the Lotus Domino server to handle the service, or you want the program that came with your Linux distribution to handle the service. The sections below list some of the common conflicts, and some suggestions on what to do with each. You should make any needed changes prior to starting the Lotus Domino server for the first time, because unresolved port conflicts may cause the server to terminate abnormally. A great place to start this process is in the server document itself. Open a server document, look in the “Ports” tab, then in the “Internet Ports” section. You’ll find a location where you can see what ports Domino uses by default.

SMTP

This is the service that listens for inbound Internet mail. In Release 5, the Lotus Domino server uses this port for mail transfer as well. Unless you have specific reasons not to, disable any programs on your Linux server that are listening on this port. In general, this is likely to be “sendmail.” Each Linux distribution loads sendmail in a slightly different way, so disabling it will require you to check the manual that comes with your distribution. You can use your distribution “Package Manager” to uninstall the sendmail software. Sendmail can also be configured to listen for inbound requests on an alternate port.

POP3 and IMAP

These are services that allow users with standard Internet mail software (e.g., Eudora, Microsoft Outlook Express, Netscape Mail) to connect to the server and download their mail. If you plan to enable this feature on your Lotus Domino server, disable this service in Linux. The POP (Post Office Protocol) software is usually loaded through a program called “inetd” and is managed through a file called “/etc/inetd.conf”. If this is how your distribution is configured, disable the protocol by editing that file and placing a comment mark (usually a pound sign (#)) in front of the lines that indicate POP3 and IMAP. These can also be configured to listen to a different port if you want to run (multiple instances of one service) both at the same time; however, in most cases, your users will need to be aware that you made this change and the applications which use the port may be affected.

NNTP

This protocol is used to transfer Internet News. Internet Newsgroups are roughly analogous to Lotus Notes discussion databases. Unless you plan to enable NNTP on your Lotus Domino server, let your Linux server handle this task.

HTTP

If you installed the Apache server or another HTTP server when you installed your Linux server, you will need to disable it to use your Lotus Domino server with HTTP clients. Alternately, these can be configured to listen on different ports, if you want to run two different HTTP servers.

Running the install script

Once you change to the directory containing the install script, running the script is quite easy. Just type `./install`. The reason you type the `./` is to tell the operating system that you want to reference a file which is “right here.” Some Linux distributions will not require this by default; however, including it is a good idea. The install script will ask a number of questions. In each case, the on-screen instructions clearly define which keystrokes manipulate the menu options. Choose the default options unless you have a specific reason to make a change. In general, it is easier to set up a default server and make changes to it than it is to re-install a server after making an invalid installation choice.

Moving data from an existing server

Chances are, if you already have an existing Lotus Domino server on another platform, you’ll want to move data files from that machine to your new one. Instead of using a simple copy command, you’ll want to make sure that the files are still readable by the server from both an integrity and a security standpoint. Here are a couple of things to remember.

Binary FTP only

UNIX based systems and MS-DOS based systems handle files differently. When you transfer files using some FTP programs, including the ones built into Microsoft Windows 95, 98, and NT, the default is to transfer the files as ASCII text files. When you do this, the FTP software attempts to “Fix” the files as they move. The result is that an extra character gets added to the end of each “Line” of the original. This is perfect when you’re sending a text file but not suitable for this task. Make sure to set the transfer type to “binary” before transferring the file.

Setting file attributes

First, set the security mode of the file. Most of the time, you do this with the `“chmod”` command. (The command name derives from the idea that you’re changing the security mode of the file.) You need to set the files so that the “owner” of the file has read-write access, other members of the same group have no access, and other users of the system “everyone” have no access. Each file also has an “owner” and a “group” attribute. The

command to change owners is “chown” and the command to change groups is “chgrp” on most systems. The files used by the Lotus Domino server should be assigned to the owner and group that you established when installing the server (usually “notes”). Use the commands:

```
chmod 600 <filename>
```

```
chown notes <filename>
```

```
chgrp notes <filename>
```

where <filename> is the specific file you are working on. Linux administrators need to be familiar with the chmod, chown, and chgrp commands.

Running setup through a browser

There is no Notes client for Linux. Instead, you’ll be using a browser from another workstation to navigate through the setup screens. The sections below will give you some tips to make your installation much easier.

Make sure the server document is fully configured

When creating an additional server in an existing domain, take the time to fully configure the server document for the new server from the same workstation that you used to create the new server. Specifically, make sure to configure the server administrator field and the security section in advance. You’ll want to bring up the server and have access to add and remove databases. Since there is no local client, you cannot use that shortcut to make the changes.

Note: If the server document isn’t fully configured, you’ll need to copy the “names.nsf” file to another workstation to make your edits, then copy it back.

Change the default IIOP port

If you plan to enable IIOP during installation, change the default port setting in the server document. By default, the port that Domino uses for IIOP is beyond the range that is supported by Linux. To avoid problems loading the Domino server for the first time with IIOP enabled, change the default port setting in the server document. It is a good idea to change this setting even if you do not plan to use IIOP. This will prevent any issues in the future. For additional information on this topic, read the Installation Notes that come with the Domino server.

Prepare your ID files in advance

You will not be at the server during the part of the installation where you point to the ID files. Rather, you’ll be sitting at another workstation, using a Web browser to fill out the form. Place the ID file or the files you need to use on the server in the data directory and set the attributes prior to running the install script. Doing this will ensure that you can type in their file names during the install, and the server will be able to retrieve the files. If you plan to remove the password from your server file, do this before you copy it to the new server because you will not have local access to the file through a workstation.

Details on starting up the first time

Before starting the server, make sure you are NOT the “super user” by typing the “whoami” command. The server will start many other processes, create and modify files, and conduct other activities that must be done under the authority of the user name you specified during the setup process. If you are logged in with a different user name, you can change to that user name by typing “su username”. To start the server, make sure you are in the Notes data directory (by default, its “/local/notesdata”) and use the command “/opt/lotus/bin/server”. The first time you start the server, it should launch the setup program and tell you to access the server through a browser on port 8081.

Note: If this doesn’t happen, try this command instead: “/opt/lotus/bin/http httpsetup”. This process assumes that you accepted the default path names during the initial installation. If you did not, then you will need to use the path names you set.

Start the server

Start the server with the command “/opt/lotus/bin/server” and use the Domino server console commands just like you would on any supported Domino platform. For additional information on these steps, read the Installation Notes that come with the Domino server.

Resetting the setup program

When you are using the browser to set up the server for the first time, and it fails to load, you can restart the setup as described above. If you have already saved the configuration document and you want to start completely from scratch, the file used is “websetup.nsf”. Replace this file with one that has not yet been updated to start over. If you do not remove this file, then re-installing to the same directory does not remove the changes you have already made.

Other Domino for Linux install resources and articles

“A quick and easy guide to installing Domino for Linux”

by Mark Lawson of *Domino Power Magazine*

<http://www.dominopower.com/issues/issue199911/linux001.html>

“The Lowdown on the Domino for Linux Install”

by Libby Ingrassia Schwarz of *DominoPro / DCI*

<http://www.dominopro.com/linuxinstall>

“How to get started with Lotus Domino R5 Server 5.0.2a for Linux”

by Nicholas Petreley of *Linux World*

<http://www.linuxworld.com/linuxworld/lw-1999-12/lw-12-domino.html?12-14>

“Installing and Configuring Domino for Linux ”

by the Lotus Technical Support UNIX Team: Technical Note number: 17760

<http://www.support.lotus.com>

Connecting to enterprise systems

Tools for integrating your applications

When you create large-scale workflow applications, you may want to access data that resides in an enterprise system. The Lotus Domino server for Linux provides the following tools for quickly adapting your applications to this kind of data.

Enterprise data connectivity

The Domino server achieves enterprise data connectivity through Domino Connectors. These discreet Domino server system files allow Domino applications to connect, authenticate, translate, and transfer data between Domino and RDBMS, ERP, TP, and text/file sources. At this time, Domino for Linux ships with Domino Connectors for IBM DB2/UDB, Oracle, and ODBC. Access to MySQL database on Linux is available via ODBC.

Developers can call Domino Connectors non-programmatically, through the Domino Enterprise Connection Services (DECS) or programmatically via LotusScript using the Lotus Connector LSX.

Domino Enterprise Connection Services

The Domino Enterprise Connection Services (DECS) enable developers to seamlessly incorporate relational and enterprise data directly into Domino applications by simply and visually mapping that data to specific Domino application fields.

The DECS wizard-based interface walks developers through identifying the data source, mapping individual source fields to application fields, and specifying events that trigger the access.

DECS manages persistent, parallel connections from Domino to external data sources, resulting in extremely high data access performance. Data is served to the application transparently and in real-time, regardless of the source; the application operates with the data as seamlessly as if it were stored in a Domino database. Since all connectivity is managed at the Domino server, no client side code installation is required. More information about DECS can be found at the Enterprise Integration Zone on the Lotus Web site at <http://www.lotus.com/dominoei>. DECS will be available in the Lotus Domino server for Linux with version 5.03 which is due soon.

Lotus Connector LSX: Programmatic control of enterprise data connections

The Lotus Connector LSX extends the Domino Connectors to LotusScript, permitting highly controlled, highly customized data connectivity between Domino Web applications and enterprise data. The Lotus Connector LSX is ideal for integrating data access and transfer operations with process-specific, customized business rules.

Like DECS, the Lotus Connector LSX is included in the Domino server for Linux.

LotusScript Data Object

The LotusScript Data Object (LSDO) provides full read and write access to external ODBC data sources using LotusScript. The object model is similar to the ODBC API, which is an industry standard for data connectivity.

Open Database Connectivity (ODBC)

ODBC is the industry standard for relational database connectivity. Lotus has partnered with Merant, formerly Intersolv, to provide an ODBC driver manager and ODBC drivers for Oracle, Sybase, and MySQL on the Linux platform for Lotus customers. An ODBC driver for DB2 on the Linux platform is available from IBM. The ODBC driver manager and ODBC drivers is available via the Lotus Enterprise Integration Zone on the Lotus Web site at <http://www.lotus.com/dominoei>

Security considerations

The Lotus Domino server comes complete with one of the most thoroughly thought through and implemented security models on the market. For complete information, take a look at the Lotus Web site at <http://www.lotus.com>. In brief, security in a Lotus Domino server environment is handled in five distinct layers:

Physical machine or operating system level file access — If a user gets direct access to the files herself/himself, bypassing the Lotus Domino server, then security can be enforced only by using encrypted databases.

Authentication access — This is handled through encrypted certificates for users with Lotus Notes clients, and via public key certification or name and password authentication for other types of access. If a user cannot be authenticated, then access will be only as anonymous (or not at all for users of Lotus Notes clients).

Server level access — Once a user is authenticated, he is checked for authorization to use the particular server. See the *Lotus Notes Administration Guide* for information on these settings. If the user is not allowed server access, no further action is taken.

Database level access — Through the use of Access Control Lists, each database has its own security settings. See the *Lotus Notes Administration Guide* for information on these settings. Databases can be encrypted for an added layer of protection.

Document level access — Once access to a database is determined, each document can have its own list of readers and editors. Documents can also be encrypted for an added level of protection. See the *Lotus Notes Administration Guide* for information on these settings.

Locking down Linux

In the sections above, you'll notice that paramount to the entire Lotus Domino server security model is limiting access to the files themselves. Linux is a multi-user operating system designed to be accessed over the Internet. It can be made very secure, but care should be taken to validate proper configuration. There are several help files and "HOW-TO" documents on the subject. Take a look at the security documents at <http://www.linux.org>, before deploying your Lotus Domino server on the Internet. Lotus has a Web page designed to be a clearinghouse for updated information on security for Lotus Domino. Be sure to check <http://www.lotus.com/security> on a frequent basis for new articles and updates.

Tip on cleaning up after a server crash

If, for any reason, your server fails during operation and you do not want to restart the entire machine, you can attempt to halt all of the Notes processes that are running by using the “/opt/lotus/bin/nsd -kill” command. NSD is a utility script provided in your server executables directory for this purpose. At the time this document was written, the version of nsd provided needed to be run two or more times to be sure you removed all of the system processes. Verify that all the processes are gone by typing “ps -ef | grep notes”. This will list any processes still running related to the Lotus Domino server.

Tips for improving Domino server performance

Performance issues on a Linux server are no different from those on any other operating system. These sections can be applied to nearly any Lotus Domino server. They are included here because many Linux installations will be subject to the limitations of less-powerful equipment. More detailed information about improving performance can be found in the IT Central Performance Zone at <http://www.lotus.com/performance>

What slows down a server?

Memory allocation

Memory allocation is the primary performance driver for a Lotus Domino server. When there is too little memory in a system, performance will suffer dramatically. Eventually, when memory is limited and not enough swap space is available, a server can become unstable. In general, you want at least 128MB plus about 1MB for each concurrent user or process you plan to run. Take the total amount of RAM memory, multiply it by two, and make sure you have at least that much swap space available. For more information, see the article “Does More Memory Really Help” by Bret Swedeen. This article is online in the “WebZine” at the Iris Associates Web site, located at <http://www.notes.net>

Too many tasks

A good way to increase performance on a Domino server is to reduce the number of tasks running on the server. Each task that you run on the server takes up valuable threads and memory. If you don't use a task that is being loaded, remove it from use. The “show tasks” command at the Domino server console displays the tasks currently loaded by the Domino server.

Allocation of disk space

Allocation of disk space can be a real factor in performance. See the section entitled “Multi-disk vs. Single disk” for a complete explanation and suggested allocation.

INI Variables

Probably the most overrated method for improving performance on a server is the manipulation of various “INI” variables. The article by James Grigsby, Carol Zimmet, and Susan Florio Barber called “Port Encryption & Buffer Pool Settings” shows clearly how little good comes from altering these settings without specific reason. This article is online in the “WebZine” at the Iris Associates Web site, located at <http://www.notes.net>

Appendix: Step-by-step Domino for Linux install

This guide explains how to install the Domino server on the Linux operating system. Refer to the release notes for this product and the Domino manual *Administering the Domino Server* for more details about configuring your server.

System requirements

The minimum system requirements for a Domino server for Linux installation are:

- Processor: 486 or later
- RAM: 64MB or larger (128MB is recommended)
- Swap file: 3 times the physical RAM or greater
- Hard drive space: 750MB free space or larger (1GB is recommended)
- Operating system: Linux kernel version 2.2.5. This installation has been certified on Red Hat 6.0+.

Note: You must have selected the following packages during the Red Hat Linux install and setup:

- C Development
- Development Libraries
- C++ Development

These packages provide the libraries that are required by Domino.

To install Domino for Linux and administer it, it is recommended that you use separate machines for the Notes client and the Domino Administrator client. Both machines must run TCP/IP on the same network or on the Internet. You can confirm connectivity by pinging each from the other before proceeding.

Note: You can configure the server using a browser on the same machine, but you will need the Domino Administrator or Domino Designer (a Notes client) on a Windows machine if you plan to create new users and server IDs or design databases.

Release notes

See the release notes shipped with this product for the latest information.

Installing more than one server

You can install more than one instance of Domino on a Linux server on separate partitions. Each data directory will contain data specific to each server, such as databases, templates, bookmarks, ID files, etc., but all the program files reside in a single shared program directory. Each server must use different UNIX user names, to distinguish between processes for the different servers. Each user will be made the owner of the files in each

data directory and the processes run by that server. If the user name is not changed for additional servers, you will not be able to start the server, because the operating system will only detect server processes that are not already running for existing user names.

Note that many of the steps detailed in this installation must be repeated for each additional server you install.

See *Administering the Domino Server* to review all your options before you begin.

Creating a notes user and group

Before you start the installation, you must add a user and group on the Linux machine.

1. Log onto Linux as “root.”
2. Open a terminal session.
3. At the command prompt, enter a user name. For example:

```
adduser notes
```

This adds a user and group to your system called notes.

4. Give this new user a password by entering:

```
passwd notes
```

See “Installing more than one server,” if you plan to install more than one server.

Downloading Domino for Linux

1. Create a temporary directory for the Domino download at the command prompt:

```
cd /tmp  
mkdir Domino
```

Note: Make sure that this space is large enough to accommodate the install file as well as the expanded files for the install (at least 20MB).

2. From a Web browser, open the Notes Web site (<http://www.notes.net/linux>)

Note: You must be a registered user to download this software.

3. Download the .tar file into the directory you’ve just created, (/tmp/Domino). If you do not have Internet access or X-window installed on your Linux machine, download the file and then transfer it to the Linux machine using FTP or some other tool.

4. Change to the correct directory by entering the following at the command prompt:

```
cd Domino
```

5. You should now be in the directory /tmp/Domino. You can verify your current location by entering `pwd` at the command prompt.

6. Unpack the installation files by entering the following (assuming the .tar file is called “linux.tar”):

```
tar xvf linux.tar
```

Starting the install program

1. Change to the correct directory by entering the following at the command prompt:

```
cd linux
```

You should now be in the directory `/tmp/Domino/linux`. You can verify your current location by entering `pwd` at the command prompt.

2. Start the installation by entering:

```
./install
```

The install program displays a series of screens about the Lotus license agreement. Use the TAB key to accept a setting and advance to the next screen, use the ESC key to back up to the previous screen, use the space bar to toggle through possible choices other than the default, and use ENTER to edit a text field.

3. Select a setup type. Choose Domino Mail Server, Domino Application Server, or Domino Enterprise Server and press TAB.
4. Select the program file location. The default is `/opt/lotus`. Make sure you have enough space. The installed files in the program directory are approximately 51MB.

Note: If you select a program directory other than `/opt/lotus`, then a soft link will be created from your program directory to `/opt/lotus` so that commands may be executed from that path.

5. Indicate if you plan a number of Domino servers on the current physical machine. The default is No.
6. Select the data file location. The default is `/local/notesdata`. Make sure you have enough space. The installed files in the data directory are approximately 60MB.
7. Select the user and group for this server. Choose the default that you set up earlier (“notes” in the example).
8. The install program displays the settings you selected. Use the TAB key to accept these settings and begin the installation, or press the ESC key to back up to change any settings. The install program will then begin installing the files.

Run the server setup program

1. Log onto Linux as the user you established earlier (“notes” in the example).
2. Change the directory to /local/notesdata by entering:

```
cd /  
cd local/notesdata
```

and then enter the following:

```
/opt/lotus/bin/http httpsetup
```

3. A series of messages indicates the start of the Domino server. For example:

```
02/18/2000 10:49:35 AM Created new log file as  
/local1/6.0_0218_Ent_dom/lotus/notesdata/log.nsf  
02/18/2000 10:49:35 AM
```

```
*****
```

```
* Lotus Domino Server Setup *  
* To setup this server, please connect *  
* your web browser to port 8081 *  
* Example: http://this.server.com:8081 *
```

```
*****
```

```
02/18/2000 10:49:36 AM JVM: Java Virtual Machine initialized.  
02/18/2000 10:49:38 AM HTTP Web Server started
```

Continuing setup and configuration

1. You begin the configuration process by connecting to your Linux server with a Web browser, either from an external machine, or from the Linux machine.

To perform setup from another machine, enter:

```
http://mycompany.linux.server:8081
```

To perform setup from the Linux machine, enter:

```
http://localhost:8081
```

where mycompany.linux.server is either the IP address or DNS name of your Linux server. At this point, the standard Domino configuration screens are displayed in your browser. Follow the instructions on these screens and click the Finish button on the final screen to complete the initial configuration. Online help is available on each of these screens.

2. The HTTP Setup program will have created SERVER.ID and CERT.ID files in the /local/notesdata. The USER.ID file is attached to a person document in NAMES.NSF.

Starting the server

Before starting your Domino server, make sure no other Web server is running because it will block the Domino HTTP task from operating correctly and you will be unable to use a Web browser to administer your server after the initial setup.

1. Log onto Linux as the user you established earlier (“notes” in the example).
2. From the /local/notesdata directory, enter:

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

The server starts and the usual server console messages appear. See “Installing more than one server,” if you have installed more than one server.

Extracting your administrator ID file

Before you can perform any more administration on your Domino for Linux server, you will need to extract the administrator ID file and move it to the machine you plan to use for administration.

1. After the HTTP Web Server task has started, switch to your administration machine and use a Web browser to connect to your new server:

```
http://mycompany.linux.server
```

where mycompany.linux.server is either the IP address or DNS name of your Linux server. The default Lotus Domino navigator screen displays.

2. Now open the address book by entering:

```
http://mycompany.linux.server/names.nsf
```

3. Click the People view, open the Person document for the administrator you created earlier, and download the USER.ID file to your administration machine.

Note: If you are using a Netscape browser, you may have to rename the ID file to “USER.ID.”

Connecting a Notes client to the Linux server

Many administration functions can be performed using a Web browser, but you need the Domino Administrator client to perform many other tasks such as creating IDs or designing new databases.

1. Open a Notes client and switch to the ID you downloaded earlier.
2. Choose File - Database - Open, enter the Server name or IP address of the new server and click Open. After a few seconds, the Notes client displays the databases available for the new server.

