Implementing A Microsoft Exchange Server Upgrade on a Windows NT Server 4.0 Environment

By

Brian Scott Acheson

Submitted to
the Faculty of the Information Engineering Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Engineering Technology

University of Cincinnati
College of Applied Science

March 2001

Implementing A Microsoft Exchange Server Upgrade on a Windows NT Server 4.0 Environment

By

Brian Scott Acheson

Submitted to
the Faculty of the Information Engineering Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Engineering Technology

Brian Scott Acheson — 03/02/2001
Author: Brian Scott Acheson — Date

Faculty Project Advisor — 3/07/01
Date

Department Head — 3/2/01
Date

Acknowledgements

I would like to thank the I.T. Department of Xerox Connect for allowing me to do this project with in the company. I would like to thank my Manager Dave Flagg for allowing me the opportunity to do this project. I would like to thank Bryan Pavy for assisting me and giving me the information that I needed to finish this project. I would like to thank my advisor Professor Shannon McClintock for her guidance and support on completing the documentation for this project. Finally, I would like to thank the IET Faculty for their continuous support throughout the entire program.

Dedication

I would like to dedicate this project to Sarah. Without your guidance this project would not have been possible.

Table of Contents

List of Figures

Abstract

This project involves installing and configuring a new Compaq Proliant 8000 server with Windows NT 4.0 Enterprise Server® along with Microsoft Exchange Server 5.5 Enterprise Edition® in an effort to upgrade Xerox Connects messaging environment for better reliability and management. This documentation explains the reason, process and methods used to accomplish this project. In addition, this documentation should act as a spring board for future upgrades to the messaging environment.

1.0 Statement of Problem

1.1 Xerox Connect's Networking Structure

Xerox Connect is currently implementing two network hubs to support numerous branch offices throughout the country. This implementation will allow Xerox Connect to grow and provide faster, more reliable service to its branches while also cutting infrastructure costs for the corporation. The first hub will be located at corporate headquarters in Exton. PA. The second hub will be located at the branch office in Cincinnati, OH. Each hub will provide each branch under its care with WAN[12], Internet, and E-Mail resources. The reason for creating two network hubs is for redundancy and to increase the efficiency of the company's bandwidth[3]. Should a hub go down the routers at the affected branch can be programmed to use the alternate hub.

Once the two hubs were identified a Frame Relay[4] circuit over a T1[5] line was put in to connect the Cincinnati branch to its respective branches. The next step was to convert every user in the Cincinnati branch to the Exton Domain. The smaller branches where also converted over to the Exton Domain. Cincinnati maintained its domain as a resource domain, but all of its users log into the Exton domain. The next step was to ensure that the Cincinnati network would be ready to handle the additional network traffic. With the Frame Relay circuit the bandwidth was there. However, it was discovered that the current Exchange Server hardware would not support the added network traffic that was expected.

Currently the corporate e-mail system is set up as one Exchange site with half the servers in Exton and the other half in Cincinnati. The mailboxes are also split with half of them located on the servers in Exton and the other half located in Cincinnati. Users

with mailboxes located in Cincinnati have to go through Exton and then to Cincinnati to get to their mailbox. Also, whenever a new user is added to the system, whether in Exton or Cincinnati, the information is instantly replicated to all the Exchange servers thus creating a large amount of network traffic.

Xerox Connect Cincinnati branch is required to solve this problem by upgrading the Exchange servers Hardware and Software, consolidate the user databases, provide larger mailbox space, and increase bandwidth efficiency. In addition they will implement a failover strategy to guarantee maximum availability of the servers for the branches and provide a backup solution to the Exton hub should they lose network connectivity. This solution should be compatible with current implementations and should not interfere with the day-to-day operations of the company. The money spent must benefit Xerox Connect as a whole. While being compatible with current implementations it should also employ the latest technologies to make the solution scalable[6] and keep the installation and configuration easy enough that a lot of time is not spent having to learn new software.

1.2 History

Xerox Connect is using Microsoft Exchange server 5.5 SP 2® on top of a Windows NT 4.0 SP 5® operating system. This is housed within three Compaq Proliant 2500 and one HP NetServer. Each of the Compaq servers has a Pentium Pro 200 Mhz processor with 320MB of RAM and 16GB of Hard drive space. These servers provide mailboxes for approximately 500 users. The HP NetServer is used to store the Public Folders.

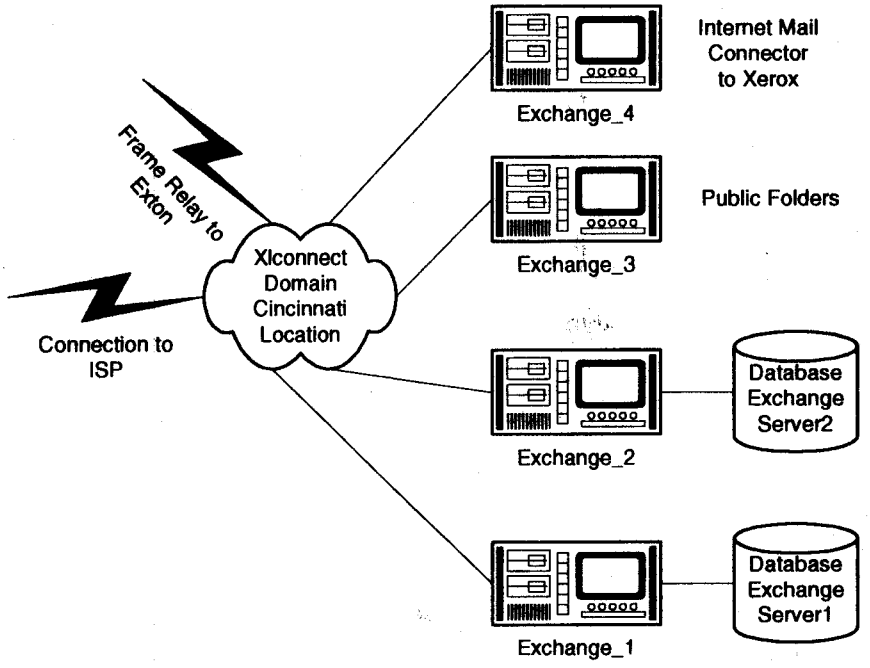


Figure 1: Current System Architecture

As the company has grown these servers have been slowly degrading in the Quality of Service that they provide to the clients. Disk space for the users mailboxes has become full and response time has slowed down.

2.0 Proposed Solution

Both Exton and Cincinnati IT team's collaborated to come up with a solution. They proposed buying or leasing new server hardware under the corporation's hardware agreement with Compaq and implement Microsoft Windows 2000 Advanced Server® or Data Center Server®[7] with Exchange Server 5.5 Enterprise Edition®[8]. Both of these software packages will also allow the IT team to implement a Cluster[9] environment at each location for reliability and scalability later in the project. Also, the current Compaq Proliant 2500 servers will be upgrade to Proliant 3000 servers with PII 450 Motherboard and processors along with an additional 256 MB RAM upgrade. In addition to the hardware upgrade they plan to split the current Exchange site in two. This will provide

better administration and management of the Exchange environment as well as reduce the use of bandwidth between the WAN link from Exton to Cincinnati (Pavy).

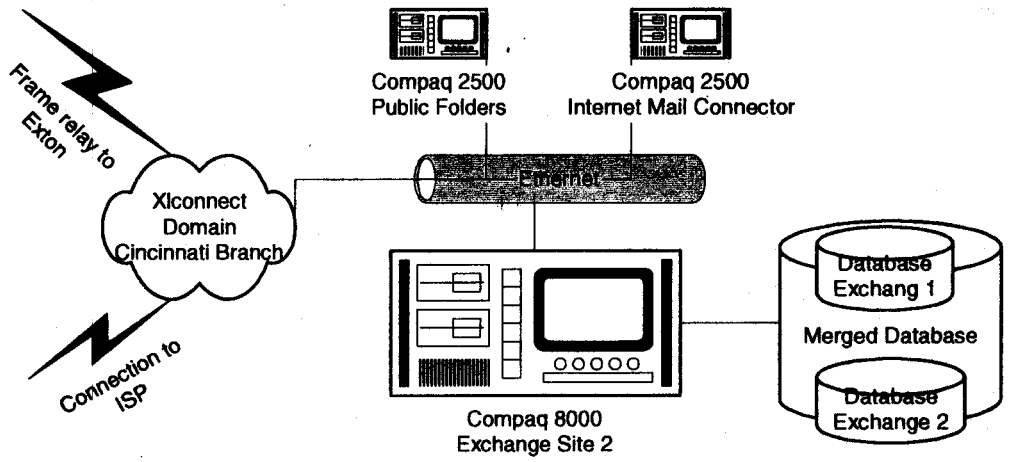


Figure 2: Proposed System Architecture

2.1 Summary of Hardware Upgrade:

- Purchase or Lease two new Compaq Proliant 8000 servers (one for Exton, one for Cincinnati)
    - Dual Pentium III 550 Mhz processors
    - 2 GB memory
    - 2 18.2 GB hard drives, mirrored for the system partition
    - 2 18.2 GB hard drives, mirrored for the log files
    - 5 18.2 GB hard drives, in a RAID 5 array for the data storage (72.8 GB usable storage)
- Upgrade four existing Compaq Proliant 3000 servers for use as IMC, Public Folders, and DL Expansion Servers
    - Dual Pentium II 450 Mhz processors
    - 768 MB memory

- Use existing 4.3 GB hard drives for mirrored system partition and RAID 5 data array

2.1.1 Benefits

- Consolidation of eleven servers to six
- Allows for upgrades to Windows 2000 and Exchange 2000
- Allows for increased employee base, and/or mailbox sizes
- Allows for use of Exchange Database Utilities
- Improves performance of Exchange Messaging System
- Allows for reduction in risk by splitting user mailboxes between two locations

2.2 Microsoft Windows 2000

Windows 2000 is the latest 32 bit NOS[10] from Microsoft. It currently comes in four different flavors, Professional, Server, Advanced Server, and Data Center Server. The differences are based on the type of backend power that you need for your network solution and the type of services you want to provide on your network. We will be using either Advanced Server or Data Center Server because these two products have support for server clustering and network load balancing. However, as a backup plan we will have to implement a Windows NT 4.0 Enterprise Server® environment in the event that Xerox Connect is not ready for the Windows 2000 environment proposed.

2.2.1 Windows 2000 Advanced Server (Minimum Requirements)

- 133 MHz or higher Pentium-compatible CPU.
- 256 MB of RAM recommended minimum (128 MB minimum supported; 8 GB maximum).

- 2 GB hard disk with a minimum of 1.0 GB free space. (Additional free hard disk space is required if you are installing over a network.)
- Windows 2000 Advanced Server supports up to eight CPUs on one machine.

The Windows 2000 Server family provides manageable, reliable solutions that scale from the workgroup to the datacenter.

2.3 Windows 2000 Clustering Technologies

Windows 2000 Advance and Datacenter server will allow us to deploy a clustered[11] server environment on a standard computer hardware platform without having to purchase expensive, dedicated hardware to do the same thing. This solution will provide high availability of the application and scalability of the hardware as the need arises. There are three main reasons to use a clustered environment.

- **High availability**. The cluster is designed to avoid a single point-of-failure. Applications can be distributed over more than one computer, achieving a degree of parallelism and failure recovery, and providing more availability.
- **Scalability**. You can increase the cluster's computing power by adding more processors or computers.
- **Manageability**. The cluster appears as a single-system image to end users, applications, and the network, while providing a single point-of-control to administrators. This single point-of-control can also be remote.

Microsoft currently has two different types of clustering technologies that it uses depending on your application of the service.

- **Cluster Service** This service is used for failover support of applications such as databases (SQL Server 7.0), messaging (Exchange Server 5.5) and file and print servers.
- **Network Load Balancing** This service takes the incoming network traffic and distributes it across the cluster so that no one machine is bogged down with requests while the others sit idle. This is bested suited for high demand Internet servers and databases. You can use one or a combination of both these technologies depending on your needs and site requirements. We will be using the cluster technology because it suits our needs for maintaining a high availability of our Microsoft Exchange Server.

2.4 Microsoft Exchange Server

Microsoft Exchange Server 5.5 SP3 is the latest messaging software form Microsoft. This client/server based software package enables a company to send e-mail internally as well as over the Internet. Exchange Server 5.5 allows a company to easily manage its messaging needs. According to Microsoft seventy percent of administrators prefer the powerful administration and unified graphical interface of Exchange Server and find it faster and easier to get their jobs done. Microsoft Exchange Server provides these features:

- **Industry-leading scalability.** Unlimited storage capacity and Symmetric Multiprocessing[12] support in Exchange Enterprise Edition enable hosting thousands of users per server on Windows NT class hardware. Single instance message store allows for maximum disk utilization.

- **High performance.** Internet standards provide the fastest MAPI, POP3, IMAP4, and NNTP server so your users can be working and not waiting for their server to respond.
- **High availability.** Clustering support in Exchange Enterprise Edition keeps the server up and running in the event of a system failure.
- **Reliability.** Exchange Server use transactions logs to commit messages. This ensures that there is one instance of a message and that the message was actually delivered. Exchange also uses a least-cost routing and load-balancing model that makes sure the messages get through.
- **Security.** Exchange Server 5.5 offers unified Exchange and Windows NT logon, password expiration, and support for the latest encryption standards (including SSL, E/SMTP, SASL, S/MIME, and digital signatures).

In addition to these features and benefits Exchange Server Enterprise Edition can be integrated into a Microsoft Cluster environment. This gives the added benefit of Reliability and maximum up time.

3.0 Design Freeze

The project will involve installing and configuring a Compaq Proliant 8000 server, as well as installing Microsoft Exchange Server 5.5 with service pack 3 on a Windows NT 4.0 Server with Service pack 6a on the new server and finally reconfiguring the older servers to play more of a services role with in the Exchange environment. This Design will replace the current Exchange server design.

3.1 User Profile

The users that this project covers will be the entire corporate user-base on the Company's internal network. The IT literacy for these users ranges from the not so IT literate to the highly skilled IT literate. However the scope of the project will be done in the background and will not involve much, if any, user intervention. The reason for this is because this project is a core infrastructure upgrade and not a client upgrade.

3.2 Design Protocols

This is a server upgrade and organization move and not a new install. We will be working with in the construct of the current Exchange environment. This leaves little room for design considerations if any since the Organization has already been layout and created. The only real design considerations left would be the physical location of the server, the new site name, and the method for moving the mailboxes into the new site.

The details include upgrading to a more powerful and large server, and breaking the current single organization unit into two for better management of resources. Selecting the best tool for moving the mailboxes out of the old site and into the new one. Finally, Re-assigning servers to handle outgoing smtp mail and public folders storage.

3.3 Timeline

Target Date 1: Submission of Proposal and Presentation Wednesday, May 6th, 2000.
Target Date 2: Take Exam 70-081 (Microsoft Exchange Server 5.5®) June 12th, 2000.
Target Date 3: Install Server Hardware and Windows 2000 Advanced Server® July 13th, 2000.
Target Date 4: Install Windows NT 4.0 Enterprise Server® July 21st, 2000.
Target Date 5: Complete mailbox move Research August 9th, 2000.
Target Date 6: Complete mailbox move Testing August 29th, 2000.
Target Date 7: Complete mailbox moves to new site on new server Saturday, November 3rd, 2000.
Target Date 8: Submission of Design Freeze Document and Presentation Wednesday, November 22nd, 2000.

Target Date 9: Submission of Final Project including all documentation Friday, March 2nd, 2001.

Target Date 10: Final presentations during the weeks of March 5-9, 2001 and March 12-16, 2001.

3.4 Budget

3.4.1 Software Needs

Microsoft Exchange Server 5.5 Enterprise Edition		$4859.00
Microsoft Exchange Server Service Pack 3		Free
Microsoft Exchange Server Post-Service Pack 3 Updates		Free
Microsoft Windows NT Server Enterprise Edition 4.0		$3199.00
Microsoft Windows NT Server Service Pack 6a		Free
Compaq Smart Start		Included
	Software Total	**$8058.00**

3.4.2 Hardware Needs

Compaq Proliant 8000 Server		$20,204.08
9 18.2GB SCSI Ultra Wide2 10,000rpm Hard Drives		$7705.08
3 256 MB ECC SDRAM DIMM 8000		$2516.34
Compaq Proliant 8000 Rack Mount Kit		Included
	Hardware Total	**$30425.50**

3.4.3 Incidentals

Microsoft Exchange Server 5.5 Study Guide		$52.95
Exam 70-081		$100.00
	Incidentals Total	**$152.95**
Total		$38636.45

3.4.4 Source of Funding

Funding for the Software and Hardware for this project will be covered thru corporate capital expenses. The funding for the Incidentals will, either be provided by the University of Cincinnati-College of Applied Science MPCT-IET program, or self funded with the exception of the Exam, which was paid for through the Companies training budget.

3.5 Deliverables

There are several deliverables that are involved in my project at different times. These involved both deliverables for class and for the project. I have had many discussions with my advisor about the deliverable that will be required for Senior design

III and we have come up with a Core set of deliverables that will be expected of me. The other set of deliverables are those that come due for each step of Senior design such as Progress reports, Proposals, Presentations, and Onsite visit to the project.

The first deliverable was in Senior Design I. Here I had to put together a detailed proposal about what I wanted to pursue as a senior project. I decided on a Networking project that entailed Microsoft NT Server, Microsoft Exchange Server 5.5 and a brand new Compaq Proliant 8000 server. I also had to provide a presentation on my project, which included a timeline and budget analysis. This deliverable was due at the end of Senior Design I.

The second deliverable is occurring during Senior Design II and involves an onsite visit to the location where my project was done and a deliverables paper to lock down what will be delivered from me at the end of Senior Design II. The onsite visit is due at the end of Senior Design II.

The other Second Deliverable is the completion of a Design Freeze Document and presentation of a Prototype. This is Due on November 22, 2000.

The core deliverables will involve creating a set of Manuals that follow the style of Best Practices Documents. This set of manuals will cover the steps used to install the Server Hardware, Installing the Operating System, Installing Exchange Server 5.5, Upgrading to Windows 2000 Server and Setting up Clustering in an Exchange environment. The content of these manuals will not only cover the steps involved but the reasoning behind making certain decisions during the install process. Also in the manuals there will be sections covering pitfalls and known issues that were encountered during the project. Another purpose of these manuals will be to create a guide that could

possible be used later for upgrading the server to a Windows 2000 Server environment and adding it to a Clustered Server environment. This is a change from the original proposal because of design changes that have taken place during the life of the project.

4.0 Proof of Design

4.1 Compaq Proliant 8000 Install

In this section I will describe the methods and reasons used to install the physical hardware for this project. Issues involve installing rack mountable unit into rack, Power supply installation, hard drive installation and configuration, and network connectivity. I will also discuss problems and issues that needed to be resolved to complete the installation of the server.

The server that we used for this project is a brand new Compaq Proliant 8000. This server is configured with two Pentium III Xenon 500mHz processors, 1GB of RAM, three-channel array controller, two redundant power supplies, and nine 18.2GB hard drives. This server comes in a 19U (one U = 1.75") rack mountable shell.

4.2 Rack Mount

The server does not come ready to install into the rack right out of the box. Initially it comes as a rolling unit for under the desk type locations. This is easily fixed with the rack mount kit. The rack mount kit is designed specific for the Proliant 8000 server and comes with instructions on how to modify the server to fit into the rack.

First part of installing the rack mount kit was gathering the need tools for the job. This included several different size Phillips screw drivers and a torx drivers. The next step to installing the rack mount kit was to install the rails both on the server and on the rack. The rails allow the server to slide in and out of the rack for ease of maintenance.

For the server this included removing the wheels on the bottom of the server and two decorative pieces from the sides of the server. To install the rails on the rack, the kit came with an easy to follow template for lining up the holes for the rails and the screws. This included both the front and the back of the rack. Once the rails were installed it was time to insert the server into the rack. This is a two-person job since you have to align the rails up together and the weight of the server. At this point all extra weight was kept off the server such as power supplies and hard drives to make it as light as possible. Once the server was securely in the rack we were able to move on to the next part of the install.

4.3 Power Supplies

The Proliant 8000 server comes with two power supplies. Both of these power supplies work in tandem together to provide fault tolerance. Should one of the power supplies fail the other will sense this and pick up the slack.

To insert the power supplies into the server we needed access to the rear of the rack. We had to make sure that the server is locked into position so that we could push on the back of the server without having it move. This ensured that we could securely fasten the power supplies into place. With the above precautions done the next step was to insert one power supply into each available slot. Next we took the provided plugs and inserted them into the back of the power supply. We then took the lose ends of the plugs and inserted them into the back of an uninterruptible power supply (UPS).

We used an UPS to provide uninterruptible power service to the server since it is a mission critical server. If the main power should go out there is a 10-20 second delay for the back up generator to kick in and switch over. The UPS provides uninterrupted

power to the server during this time. Since the change over from power station to generator is not the most elegant event the UPS also provides line conditioning to prevent powers surges and lags. We recommend putting all mission critical servers on a UPS even if a back up generator is not installed. This way you will at least have time to properly shutdown the server and reduce the risk of damaging the server and its data.

4.4 Hard Drive Installation and Configuration

After the server is installed in the rack and the power supplies have been connected to power the next step we performed was the hard drive installation and configuration. This process involved installing the physical hard drives into the proper slots of the server then addressing and configuring the arrays.

We used a total of nine drives in two arrays. In the first array channel we installed three drives in a Raid 5 configuration. These drives would house the system partition and the log files. The second array channel housed the Microsoft Exchange Information Store. This is the database that contains all the email address, mailboxes, configuration settings and mail messages. This array we installed the remaining six drives in a Raid 5 configuration.

The tool we used to configure the array was the Compaq SmartStart CD Release 4.50. This CD is a bootable CD and contains all the tools and utilities we needed to prepare the hard drives. The CD came with the server when we purchased it. Essentially once we inserted the CD into the server and booted it up the CD and its program took over the rest of the setup. All we had to do was answer questions about how we wanted the server to be installed. Appendix A contains the step-by-step instructions provide by Compaq that we used for this process.

4.5 Network Connectivity

The Compaq Proliant 8000 server came with a network card preinstalled from the factory. The Network card is an Intel 10/100 TX Ethernet card. It has two Ethernet connections. One connection is for the loop back connector and the other connection is for the network. You can use the loop back connector to test [illegible] not on the network. We connected one end of the network cable into the back of the network card and the other end into an available network port. Also, we had to make sure that the port was active and on the right segment. We had to turn the port up and move it to the proper network segment.

A note about the network card is that it will not work properly without the loop back connector installed in at least one of the available connections.

4.6 Server Problem and Solutions

One of the problems encountered during the server setup happened during the actually power up of the server. After everything had been connected we attempted to power on the server. However, we were not getting a green light on the power up button. Instead we had an orange light. This being a new server no one seemed to know what the orange light meant. Obviously there was a problem, because the server would not start up. A quick look over of the server proved that everything was installed right and secure but the server still did not start up. The next step we decided to take was to inspect the inside of the server to see if anything was loose inside possible from shipping or when we oh and ah at it. Initially everything looked OK but further investigation lead us to a set of lights on one of the main boards. However, the problem with this was that there was no key to decipher the meaning of the lights. It was determined that these lights were the

interrupt lights. Before the server can power up all systems must be ready. If one of the systems fails it trips its interrupt and the server will not power up. To decipher the interrupt lights we had to go to the online manual that came with the server. This revealed that the light pattern we were getting meant that one of the dual processors was not completely inserted into its socket. This had happened because one of the administrators had removed it to goggle at it and did not insert it properly back into its slot. Once this was corrected the interrupt lights went away and the server booted up.

Another issue we ran across was the network card. We had never seen a network card with two connections in the back of one card. Further more one of the connections had a cable in it already. Rummaging around the server documentation I found a notice concerning the second connection. It turned out that it was a loop back connector and need to be installed if the second connection was not going to be used. The network card it self turned out to be a dual NIC card meaning that it had two separate transceivers for high availability and redundancy. We decide not to use the second connection and left the loop back connector on.

4.7 Windows Operating System Install

In this section I will be discussing the process used to install the operating system onto the Compaq Proliant 8000 Server. Topics to be covered are, OS installation and configuration, issues concerning the OS install, reasoning behind choosing this version of the OS and finally conclusions. When this section is done hopefully I will have laid out a best practice method that can be followed for future OS installs.

4.8 OS Installation and Configuration

For this OS install it was finally decided that we would use Windows NT 4.0 Enterprise Server® with service pack 6a. Original plans to install Windows 2000 Advanced Server® were scratched when it was determined that more discovery needed to happen before a 2000 install could take place.

A lot of information has been written on the steps to follow for installing Windows NT 4.0 Enterprise Server® (NT) and it is not my intentions to write another "how to" manual. However, I do intend to cover the details that are specific to our installation and in doing so hope to create a best practice that can be followed in subsequent installations of the OS. However, for reference purposes I have included a "how to install Windows 2000 Server" guide from the TechRepublics website in appendix B.

Before beginning the installation some discovery needs to be done. Items that need to be discovered are:

- Is this server going to be on the network or is it going to be a stand only server?
- If this server is on the network what IP address will it be assigned?
- If working in a multiple domain environment which domain will the server reside in?
- What will be the host name of the server?
- Do I need an NTFS file system or will a FAT file system work?
- Do I have all the valid licenses I need for this server?

All this information should be gathered and kept with you during the install. This way you will be able to answer the install questions as they arise. I have inserted the

TechRepublics checklist in appendix A. This checklist has more detail but covers the same issues.

When we used the Compaq SmartStart CD for the hardware configuration we told the software what OS we where going to install. During the hardware setup there was be a point where the setup program asked us for the OS CD. At this point the hardware setup is complete and the OS setup program takes over from there.

With our gathered information we started the OS install and configured the OS with the proper settings on the network. From there we moved forward and installed the latest service packs and formatted the additional partitions. Because NT essentially installs itself after the initial questioning phase, we were done with the OS install and configuration portion of this project.

4.9 Issues Concerning OS Install

There were several issues that came up during our process of installing the OS. The first issue involved our original OS install. The second issue involved a change to our original OS configuration, which involved a complete re-install of the OS. Finally, the third issue involved having to install a completely different version of the OS.

The first time we installed an OS on the new server we installed Windows 2000 Advanced Server (Windows 2000) as a member server of our domain. This was the original plan of our project for an OS on this server. This install went smoothly and was ready for the exchange piece to be installed when we received a call from the corporate headquarters stating that we needed to change the configuration of the OS to a domain controller. This meant that we had to re-install the OS to configure it this way.

We re-installed Windows 2000 as a domain controller with severe reservation. The reasoning behind this new configuration had to do with the company's future plans to upgrade to an active directory environment. The main thinking behind this new configuration was that active directory lives on a domain controller and if it was going to use exchange's directory information then exchange needed to be on the domain controller. At this point I confirmed that active directory could use the exchange server's directory information but that it was not recommend that exchange be on a domain controller. This was recommended for several reasons. The first being that you do not want that much network traffic on the same server that is running your messaging software and active directory requests. Secondly, this creates a single point of failure for both your exchange server and domain controller. This situation should be avoided if at all possible. Because of this situation the project was put on hold for about a week until it was decide to go ahead with the NT 4.0 solution.

At this point we installed NT on the server and made it ready for the Exchange piece. This configuration was considered the best option at the time because it would allow the administrators enough time to shore up their Windows 2000 plans. Also, since NT was already part of the current exchange environment it was already known that there was little trouble, if any, with this configuration and would best suite our needs for a stable environment to continue the project.

4.10 Reasoning Behind Choosing This Version of the OS

As stated early the original plan for this server was to install Windows 2000 Advanced Server. This would have allowed the option to use windows clustering technology for disaster recovery. However, since Windows 2000 was still fairly new at

the time and there was not a lot of internal knowledge about the product at the time, as well as, the company's future plans to upgrade to Active Directory still being unclear, it was decided to stick with an OS that everyone was familiar with and more importantly could support.

The benefit of going with NT instead of Windows 2000 was twofold. First, everybody could use it and support it and since we were trying something new we felt it was best to at least keep some aspects of the project simple. Secondly, since the current Exchange environment was already running on the NT platform we eliminated any compatibility issues that may have existed had we upgraded to Windows 2000 and had to run two different environments. This last issue was not fully considered when the initial planning stages of the project started.

4.11 OS Conclusions

By not installing Windows 2000 in this project we leave room for a future project that would involve upgrading the server OS to Windows 2000 Advanced Server® and implementing a clustered environment. As I stated earlier I have included a "how to install Windows 2000 Server" document in the appendix C. I have also included documentation from Microsoft on their clustering technology. This documentation should give enough background information to get started on developing a clustered environment. This information is not only relevant for this Exchange project but can be used for any other server environment that will benefit from a clustered environment.

4.12 Microsoft Exchange Server 5.5 Install and Configuration

The third and final part of this project is the installation and configuration of Microsoft Exchange Server 5.5 Enterprise Edition® (Exchange). This portion of the

documentation will cover the details involved in installing exchange, configuration methods, utilities used to move mailboxes and servers into the new exchange environment, and finally problems and solutions encountered during the process.

4.13 Exchange Install

There is as much documentation on installing Exchange as there is on installing Windows NT. So it is not my intention re-write what already has been written. Instead I will talk about the special considerations for our particular installation of Exchange.

Once the server platform was finally decided on, and all of its service packs and updates were installed we were ready to begin installing Exchange. To do this we need to gather some information about our Exchange environment first. Here is a list of things we needed to know:

- Make sure that the NT server name is the one we wanted.
- Name and password of the Exchange administrator account.
- The Exchange Organization and Site Names
- Installation path.
- Components to be installed.

Gathering this information before we began our install allowed the install to go as smoothly as possible.

The reason we want to make sure that the NT server name is the way we wanted it was because this is the name that our Exchange clients will refer to the Exchange server. So we had to make sure that it was something fitting and easy to remember. We will also need to have created an Exchange administrator username and password. Fortunately one already existed for our environment. Exchange server uses this account to start its

services on the server. The next thing we will need is the Organization and Site name. Our Organization name already existed so we did not have to do anything for this part except have its name. We where creating a new site within our existing Exchange environment so we needed to come up with a new site name before we began our install. Another thing we had to consider was the location of the Exchange server program, database, and log files. Finally, we had to also know which components we were going to need this server to run.

Once all this information was gathered we were ready to install Exchange onto the server. With this information at hand all we had to do was answer the questions as the installation wizard ask them and click next to continue. Once all the general information is collected Exchange server installs itself. After the installation is complete it will reboot the server and automatically run the Exchange Performance Optimizer. This tool allows us to choose the location of the database files and log files on the Exchange server as well as how the server will act and the number of users it will support. This allows Exchange server to optimize itself for its environment. When this completed we were ready to move user mailboxes onto the new server. But first I would like to talk about our Exchange configuration.

4.14 Exchange Configuration

In this section I will talk about the details of our Exchange configuration, because they played an important role in this project. This will lead us to the next important part of the project, which was moving the user mailboxes from one Exchange site to another and the utilities we used to accomplish this.

As stated earlier in this document I gave a run down of the old Exchange server environment along with a diagram of how that environment looked. This section will describe how that environment ended up.

During the installation process we decided to put the Exchange server files on our system drive which was labeled C:\. We created a new Exchange site within our current Exchange organization. This configuration was chosen to better utilize exchange management and network bandwidth across the WAN. We brought the new server up in this new site without any mailboxes associated with it.

The configuration of the database and log file drives was done during the Exchange Performance Optimizer tool. We first chose the "1,000-4,999 users on this server" setting. Next we told the Exchange Performance Optimizer tool that it was only going to be a "Private Information Store" server. Once this was done it was time to tell the server which drives to use to store the database and log files. We put the Exchange server database file on the D:\ drive and the Exchange server log files on the E:\ drive. This configuration takes advantage of the Compaq Proliant 8000's multiple array controller for better performance.

Once the site was up and running and all the files put in place, we were ready to start moving mailboxes over to the new server and into the new site. The following figure shows the final Exchange sever configuration.

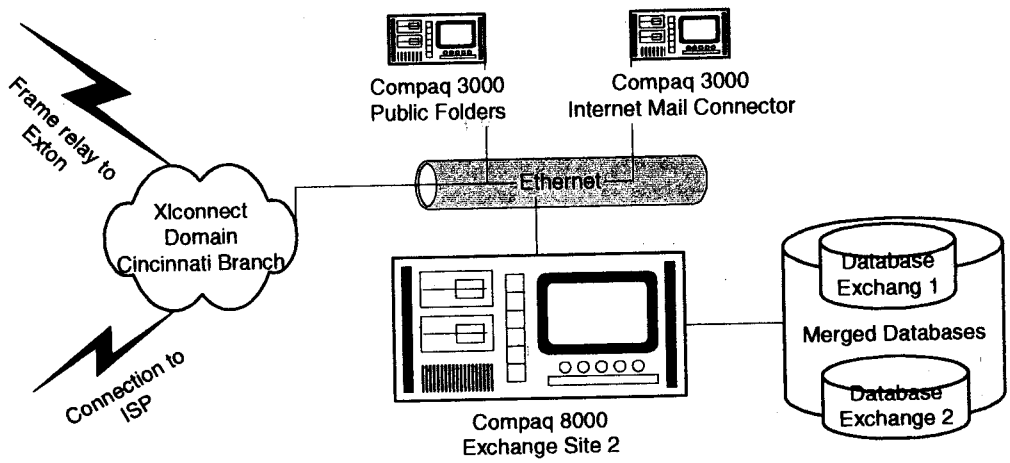


Figure 3. This shows the final Exchange environment.

4.15 Exchange Utilities

In this section I will discuss the two utilities that can be used to move an existing server and mailboxes into a new Exchange site. I will continue to discuss the reason behind the utility that we finally chose to use. I will not go into the step-by-step procedures for this since this process has already been documented. However, I have included instructions for both processes in the appendices of this document for that very reason.

First, I will discuss the problem that needs to be solved. Exchange comes with a built in utility that will allow you to move an existing mailbox to a different server within the same site. This tool is very easy to use and moving a mailbox to another server is very easy. All you basically have to do is select the mailbox or mailboxes that you want to move and then from the Exchange administrator toolbox choose "Move Mailbox". However, this will only work for a server that exists in the same site as the original server. Our problem is that we want to create a second site and move existing mailboxes into this new site. Unfortunately, Exchange does not come with a built in utility to allow you to do this easily. There is basically two ways to solve this issue.

The first way to solve this problem is to use a utility that can be found on the Back Office Resource Kit from Microsoft called Xmerge. This utility allows you to move a mailbox's contents to the new server in the new site. To do this it writes the mailbox out to a personal folder. The contents of the personal folder are then copied into a mailbox on the new server. The mailbox on the new server has to be created before the merge process begins. The merge process uses a user list to determine which mailboxes are to be moved. Once the mailbox has been moved the original mailbox will need to be deleted and the user will need to be informed of the new location of their mailbox.

The problem with this utility is that you have to setup several CSV files and you have to be very careful to setup this files correctly. Another issue with this utility is that while the merge process is running users will not have access to their mailbox. Also this tool is not setup very well to move a large amount of mailboxes.

The Move Server utility, found on the Exchange Server SP2 CD, is a better tool to use for this process. This utility will move the mailboxes into the new site without the headaches of having to configure CSV files and generating new mailboxes in the new site. It does this by moving the server and its contents to the new site by changing all the old site association entries in the database to refer to the new site.

The way we did this was by bring up the Compaq Proliant 8000 server in the new site. Then we created a Site Connector so that both of the sites in our Exchange organization were aware of each other. We then configured directory replication between the two sites so that they would have a common global address list. While replication was going on we brought up a transition server in the original site and moved a selected number of mailboxes over to this server in preparation to be moved into the new site.

This transition server was the server that we ran the Move Server utility on to move it into our new site. The reason we only selected a small number of mailboxes to be moved was based on the amount of hard drive space that we had on the transition server. Unfortunately, we did not have an additional server with enough hard drive space to move all of the desired mailboxes at the same time. The figure below shows our Exchange environment with our transition server in the original site.

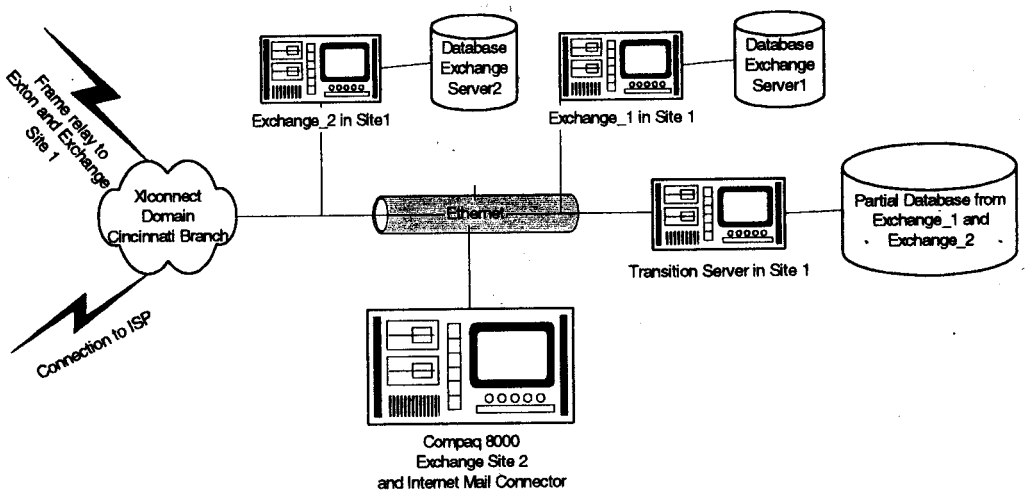


Figure 4. Showing Exchange environment with Transition server in Site 1.

Once the sites were aware of each other and sharing information and the transition server was ready to be moved we isolated the transition server from the rest of the Exchange environment be breaking replication between the two sites. Once this was done we were ready to run the Move Server utility. I will not go into the steps on how to run this utility because I have included a document on this process in the appendices. Once the Move Server utility was ran it took anywhere from 4 to 6 hours to run depending on the number of mailboxes and there size. When the Move Sever utility finished our transition server was in our new site. With the transition server in the new site all we had to do was use the move mailbox tool from the Exchange administrator tool

to move the mailboxes over to the new server. The Figure below shows this process completed.

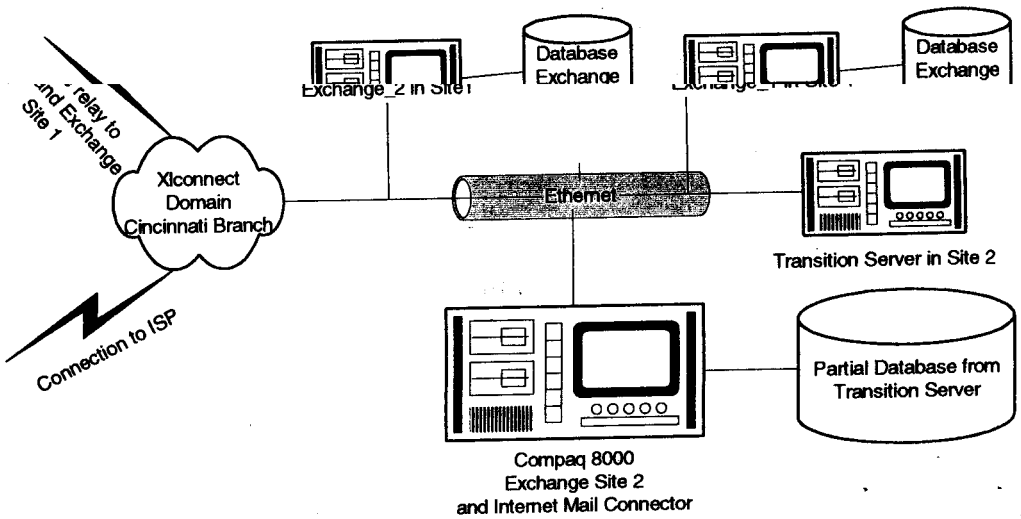


Figure 5. Exchange environment after the transition server move and the mailbox move.

After the mailboxes on the transition server were moved over to the new server in the new site we had to reinstall Exchange on the transition server back into the original site. This allowed us to repeat the process all over again.

We repeated this process for the rest of the mailboxes that needed to be moved. This process ended up taking us several weeks because we could only move about 300 mailboxes every two weeks. We would prepare the transition server on Monday and move the selected mailboxes to this server during the week. The users mail client was smart enough to point to the new location as long as it was located in the same site. Then over the weekend we would run the Move Server utility and if everything went well we spent the next week having the users point their mail clients to the new server in the new site. After moving a few mailboxes we eventually were able to use two transition servers to move a group of mailboxes every week.

4.16 Problems and Solutions

We had many problems during this process of the project. We dealt with each problem as it arrived. The first of are problems was trying to get the Xmerge utility to work. The main problem we ran into with this utility was formatting the CSV file properly. We spent about a week and a half working on this issue until an alternative utility was found. We abandoned the Xmerge utility in favor of the move server utility.

Another problem we ran into dealt with using the move server utility. To make the utility easier to mange we needed a transition server. We did not have a problem with acquiring another server. The problem we had was not having enough drive space to be able to move all the mailboxes at the same time. We had to break the moves down into chunks. The criteria for selecting the mailboxes to move, was based on the location of the users. We would move a branch at a time so that during the support phase of the transition we could better manage users issues.

One of the bigger problems we had involved an issue with the move server utility dying in the middle of a transition. This would leave the transition server in an inconsistent state with half the users in one site and the other half in the other site. We discovered that some of the reasons this would happen would be because user mailboxes would be corrupted. Or there was a problem with private information store database. We would run the offline defrag utility and the database consistency checker on the database to try and resolve this issue. Some times we would have to go into the database to remove old mailboxes that were no longer used and causing problems with the utility.

Whenever the utility would blow up we would have to re-install Exchange back into the original site and then restore the database from a backup. Once this was done

and any repair utilities were run we would attempt to run the move server utility again. This usually fixed the problem.

The final problem we ran into had to deal with our parent corporation. We were October our parent company requested that we merge our Exchange environment into their Exchange environment. This meant having to move our server into a new organization and a new site. Fortunately we had already been through the process of moving mailboxes this way and had a chance to clean up our Exchange environment along the way to make this a non-issue.

5.0 Conclusions and Recommendations

Working on this project I have learned several things, most of which involved the planning of projects. But more importantly, I have learned that the best made plans can be messed up as the requirements of the project suddenly change, and as the needs of the project change you need to plan accordingly.

Even though my project did not end up the way the initial proposal stated all was not lost. The project as a whole was a valuable learning tool that I will be able to use in future projects. Also, because all the initial proposal requirements where not meet, this leaves plenty of room for future projects.

One such project should involve the installation of Windows 2000 Advance Sever ® as an upgrade to the current OS. This project would require considerable planning and testing as it is not recommended to try this in a production environment. Even though this sounds like a simple OS install you should always error on the side of caution when it comes to the users data. You do not want to find yourself in a situation were you have

to explain to the user why all of his e-mail is gone. Testing will allow you to head off this and any complex issues that could arise from an upgrade as well as determine if an upgrade or a complete re-install is the correct path to go.

A second project that should evolve from this project involves installing an Outlook Web Access® server for access to email from outside of the corporate network. A separate server could be setup so that users could access their mailboxes from outside the network. This would entail the configuration of an IIS server using secured socket layer for secured communications. The recommendation for secure socket layer is very serious since users will be accessing their corporate mailbox from the not so secure environment of the Internet. Using secure socket layer communications will ensure that only the proper people can see what needs to be seen.

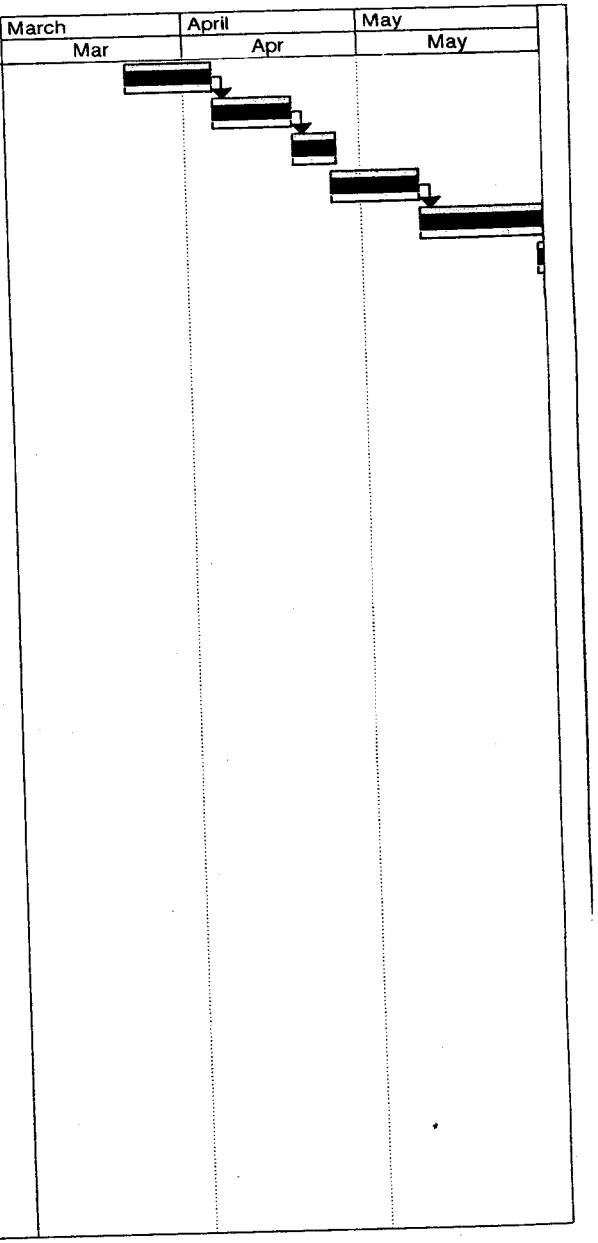
Finally, a third project that should be the implemented involves clustering of the Exchange server. This will provide for fault tolerance and load balancing of the Exchange environment. Doing this will increase performance of the Exchange server environment and provide a backup to the Exchange server in the event that it has a hardware failure. It is recommend that this project be done after the successful completion of the OS upgrade to Windows 2000 Advance Sever ®. This is a requirement to use the latest clustering technology from Microsoft®.

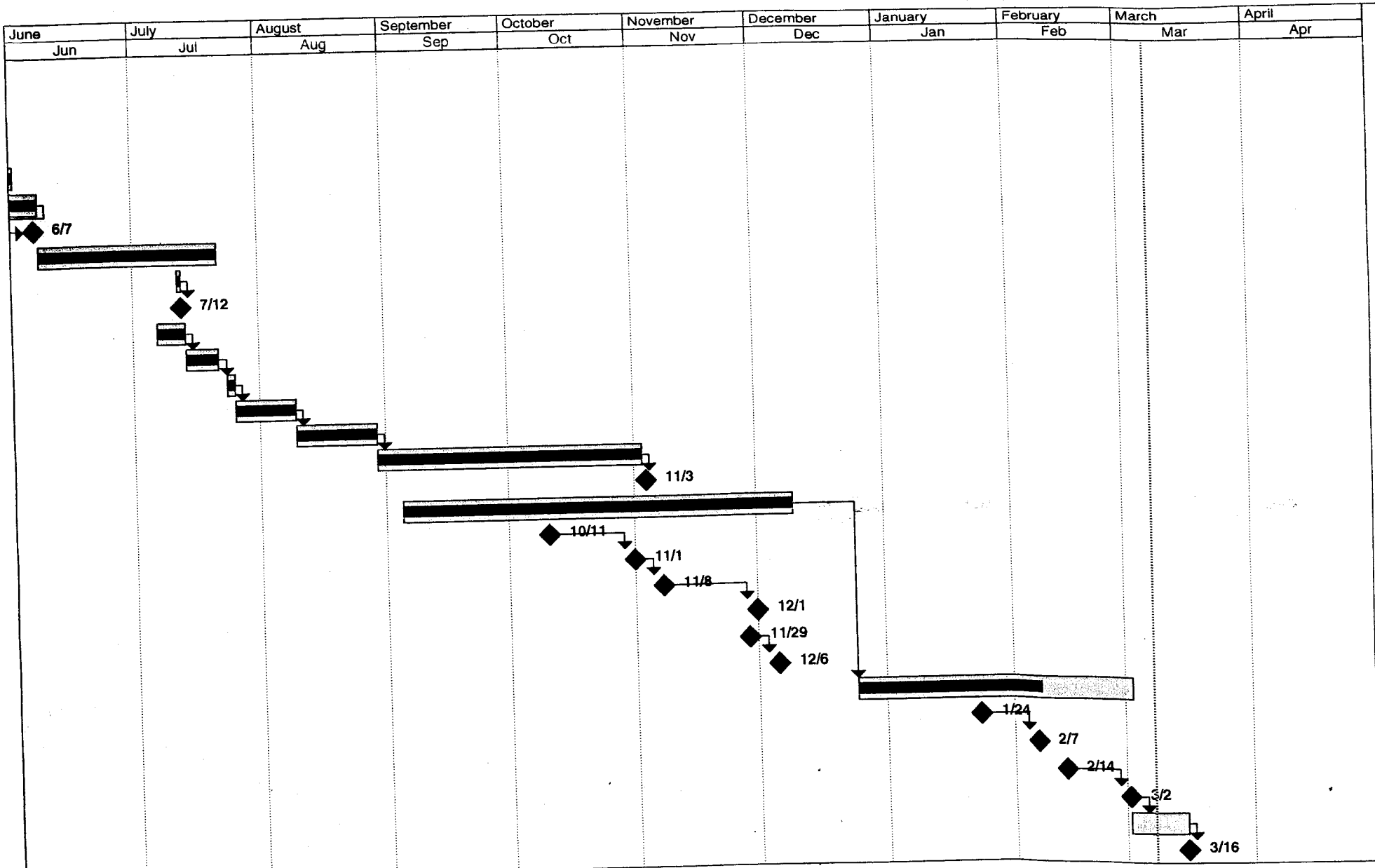
These recommendations should be considered along with thorough planning for each of these projects. Thorough planning will ensure that you are prepared to solve any issues that could arise during the actual implementation of the project. Also, documentation of each project should take place so that others will know what has already been researched or completed. This will show what was needed to get to this

point so and not have to reinvent the wheel, wasting time and energy repeating processes and mistakes that have already been made.

Appendix A
Gantt Chart

ID		Task Name	Duration	Start	Finish	Predecessors
1	✓	Identify Area of Inquiry	11 days	Wed 3/22/00	Wed 4/5/00	
2	✓	Reasearch and Write Area of Inquiry	9.5 days	Thu 4/6/00	Wed 4/19/00	1
3	✓	Meet with Advisor about Area of Inquiry and turn in Progress report	5.5 days	Wed 4/19/00	Wed 4/26/00	2
4	✓	Start full reasearch and rough draft of Propsal	11 days	Wed 4/26/00	Wed 5/10/00	
5	✓	Additional Reasearch and completeion of Propsal	16 days	Thu 5/11/00	Thu 6/1/00	4
6	✓	Presentation of Propsal	6 days	Wed 5/31/00	Wed 6/7/00	
7	✓	Presetation Milestone	0 days	Wed 6/7/00	Wed 6/7/00	6
8	✓	Read and Learn Exchange Software	33 days	Thu 6/8/00	Fri 7/21/00	
9	✓	Take Exan 70-081	1 day	Wed 7/12/00	Wed 7/12/00	
10	✓	Exam Milestone	0 days	Wed 7/12/00	Wed 7/12/00	9
11	✓	Install Windows 2000 Advanced Server	6 days	Fri 7/7/00	Thu 7/13/00	
12	✓	Install NT Server4.0	6 days	Fri 7/14/00	Fri 7/21/00	11
13	✓	Exchange Server 5.5	2 days	Mon 7/24/00	Tue 7/25/00	12
14	✓	Move Mailbox Reasearch	11 days	Wed 7/26/00	Wed 8/9/00	13
15	✓	Move Mailbox Testing	14 days	Thu 8/10/00	Tue 8/29/00	14
16	✓	Move Mailboxes	47 days	Wed 8/30/00	Thu 11/2/00	15
17	✓	Move Mail Milestone	0 days	Fri 11/3/00	Fri 11/3/00	16
18	✓	Senior Design II	70 days	Tue 9/5/00	Sat 12/9/00	
19	✓	Progress Check 1	0 days	Wed 10/11/00	Wed 10/11/00	
20	✓	Progress Check 2	0 days	Wed 11/1/00	Wed 11/1/00	19
21	✓	Draft of Design Freeze Due	0 days	Wed 11/8/00	Wed 11/8/00	20
22	✓	Design Freeze Document Due	0 days	Fri 12/1/00	Fri 12/1/00	21
23	✓	Design Freeze Presentation	0 days	Wed 11/29/00	Wed 11/29/00	
24	✓	Senior Design II Milestone	0 days	Wed 12/6/00	Wed 12/6/00	23
25		Senior Design III	50 days	Mon 12/25/00	Fri 3/2/01	18
26	✓	Progress Check I	0 days	Wed 1/24/01	Wed 1/24/01	
27	✓	Progress Check II	0 days	Wed 2/7/01	Wed 2/7/01	26
28	✓	All Documentation Completed	0 days	Wed 2/14/01	Wed 2/14/01	
29		All Documentation for Project Due	10 days	Fri 3/2/01	Fri 3/2/01	28
30		Senior Design III Presentations	0 days	Fri 3/2/01	Thu 3/15/01	29
31		Senior Design III Milestone		Fri 3/16/01	Fri 3/16/01	30




June
Jun
July
Jul
August
Aug
September
Sep
October
Oct
November
Nov
December
Dec
January
Jan
February
Feb
March
Mar
April
Apr
6/7
7/12
11/3
10/11
11/1
11/8
12/1
11/29
12/6
1/24
2/7
2/14
3/2
3/16

Appendix B
Smart Start CD Information

HOW TO USE SMARTSTART TO SETUP YOUR S

Before using SmartStart, it is assumed that you have:

- Connected your server hardware as shown on the hardware installation poster.
- Obtained your Operating System Software CD.

1 BOOT THE SERVER FROM THE SMARTSTART CD

ASSISTED OR MANUAL INSTALLATION

When you boot your system, SmartStart scans your server and detects whether or not your machine has been previously configured and installed with an operating system. If SmartStart detects that the system has been previously configured, you can choose among the following options if applicable to your server:

- Run System Configuration Utility
- Run Array Configuration Utility
- Update System Partition
- Run System Erase Utility
- Create Support Software Disks
- Run Fibre Channel Diagnostics
- Run Array Diagnostics Utility
- Run Systems ROMPaq
- Exit SmartStart

The System Erase Utility completely clears the systems of all configuration information, software, and data and prepares it for a new setup. If you do not want to clear the system partition but do want to upgrade it, select *Update System Partition*. If you want to change any hardware configuration, select *Run System Configuration Utility*.

REPLICATED INSTALLATION

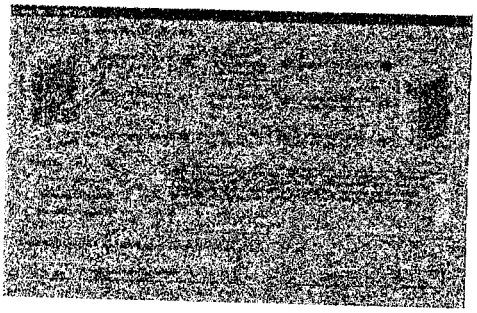
If you are planning a replicated install, you can start the process in one of two ways: You can boot from a replication diskette to automatically enter the process, or at step 3 you can select the SmartStart Replicated Installation path. For more information, review the *Replicated Installation* requirements outlined in step 3.

2 SELECT THE LANGUAGE, COUNTRY, KEYBOARD, AND DATE/TIME

You are asked to specify your language, country, keyboard, and date/time. After you enter this information, a summary screen displays your selections. Review your selections and select *Exit* if you would like to make any changes. Select *Continue* if the information is correct.

3 SELECT THE INSTALLATION PATH

Select one of the three SmartStart methods to install the OS on your server. Your options are Assisted Installation, Replicated Installation, or Manual Installation. Refer to the *OS Installation Table* for the installation methods available with your OS.

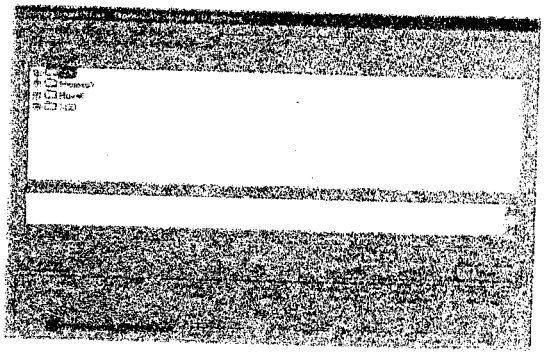


ASSISTED INSTALLATION

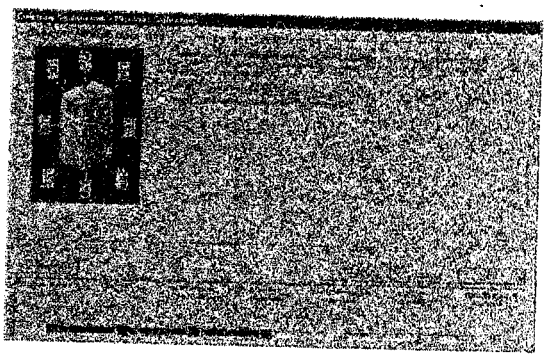
During an Assisted Installation, you need the following items:

- Compaq SmartStart and Support Software CD
- Operating System Software CDs
- Compaq Server Profile Diskette
- Compaq Management CD (optional)

1. Select *Assisted Installation Path*. You are prompted to insert the Compaq Server Profile Diskette. Do not remove the Server Profile Diskette until prompted.
2. A list of supported operating systems (OS) displays. Select the OS to be installed.



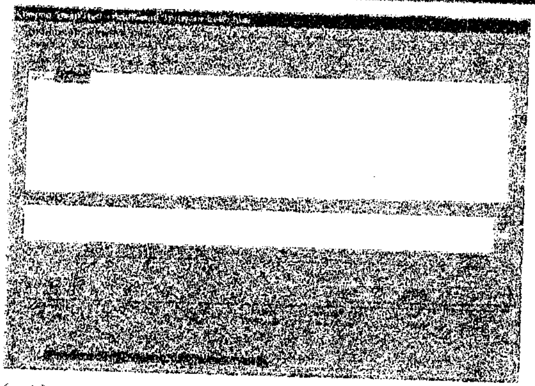
3. SmartStart saves this information and the System Configuration Utility launches and makes various checks on your server. If there is a Compaq Array Controller installed in your server, the Array Configuration Utility is launched at this time. This utility guides you through the configuration of this controller. The process of system checks includes several reboots and continues for approximately 3 to 5 minutes. Also, at this time a system partition is created and the system utilities are copied onto it.
4. With some operating systems you are asked to specify your software source. If you are not using an Integration Server, select *Install software from CD only* and continue to step 5. If you are connecting to an Integration Server, select *Install software from Integration Server and CD*. For more information on setting up and using an Integration Server, refer to the *Compaq Integration Server User Guide* on the SmartStart CD.



5. If you selected an Integration Server as your software source, the next screen requires that you enter the server name and password, network interface controller information, and, if required, the IP addresses for the target server and Integration Server. Refer to the *Compaq Integration Server User Guide* located on the SmartStart CD for instructions.

Note: Customers using SmartStart Integration Server functionality are bound by the terms and conditions of the software license agreements and contracts for the software to be stored or deployed on an Integration Server.

ERVER AND INSTALL YOUR OPERATING SYSTEM



6. After you complete the Integration Server information, a screen displays the additional system software available for installation. If you selected to use an Integration Server, this list is based on what is available on both the Integration Server and the available CDs. Make your selections from the list. You are informed of any compatibility issues with your software selections at this point.

7. A summary of the software you selected displays and indicates whether this software is to be installed from the SmartStart and Support Software CD or an Integration Server. Select *Next* to verify your selections, or *Back* to change the selected software products.

8. You are prompted to insert the appropriate CDs in order to retrieve any product specific information required during the initial installation interviews.

9. Once all of the products are selected, you are guided through a series of interviews to collect information specific to the software being installed. In addition to the software product interviews, an interview on the setup of your Insight Management Agents is available.

Note: Select the *Summary* button to view system information.

10. You are asked if you want to run Diskette Builder to create *setup support software diskettes* that allow you to update the drivers on other Compaq servers. Creating setup diskettes is optional.

11. Once you have completed the interview process you are prompted to insert the operating system CD and the server is prepared for the OS installation. (If you are using the Integration Server as your software source all files are copied automatically.) The system then copies the files and runs checks. This process takes approximately 15 to 120 minutes, depending on your selections.

You have now completed the configuration process for your server and the selected products are installed.

REPLICATED INSTALLATION

To replicate a configuration you must:

- Complete the SmartStart Assisted Installation path on one server.
- During this installation, you are prompted to create a replication profile diskette using a blank 1.44 MB diskette (not included with SmartStart). You may use an existing replication profile diskette when saving your configurations as long as it was created with the same version of SmartStart. Several configurations can be saved to one diskette.
- Save the configuration to the SmartStart replication profile diskette. Replicated installation only copies the configuration. It cannot be used to replicate data other than system files.

IMPORTANT: For replicated installations, the target server must be identical to the server where the original configuration was saved. All network interface controllers must be in the same slots, memory must be identical, and drive capacity must be the same. A text file that contains information on the configuration will be saved to the replication profile diskette.

1. Select *Replicated Installation Path* or insert the replication profile diskette and SmartStart CD into the target server and reboot the server. To create a replication profile diskette refer to the text above.

2. After the system boots you are prompted to enter the date and time. Click *Continue* when you are ready to proceed.

3. Read and acknowledge the SmartStart Program License Agreement. Click *Continue* when you are ready to proceed.

4. Select the Replication Profile from the Replication Profile Information screen and click *OK*. The system will reboot and automatically run the Compaq System Configuration Utility.

5. After the system is configured you are prompted to insert the Compaq Server Profile Diskette. Insert the diskette into the target server and click *Continue*.

6. If your original installation included software from the Compaq Management CD, insert it at this time. After the Management CD software is loaded you are prompted to re-insert the SmartStart CD.

7. After completing the interview process insert the operating system CD, and the server is prepared for the OS installation. The system then copies files and runs checks. This process takes approximately 15 to 120 minutes depending on the selections made during the original install.

You have now completed the replicated installation process for your server and the selected products are installed.

MANUAL INSTALLATION

During a Manual Installation, you need the following items:

- Compaq SmartStart and Support Software CD
- Operating System Software CDs
- Compaq Management CD (optional)

1. Select *Manual Installation*.

2. The System Configuration Utility runs and begins to configure the system. If there is a Compaq Array Controller installed on your server, the Array Configuration Utility launches at this time. This utility guides you through the configuration of this controller.

3. You are asked if you want to run Diskette Builder to create *setup support software diskettes* that allow you to update the drivers on other Compaq servers. Creating setup diskettes is optional.

4. If you are installing a Novell operating system a custom Manual Installation interview will run. This interview allows you to view specific installation instructions, enable a Novell license (using previously purchased Activation Keys), create a Novell DOS 7 or Caldera DOS 7.02 diskette, copy DOS CD-ROM drivers to a boot diskette, or create Novell Support Software Diskettes (NSSD).

5. Insert the operating system CD or setup diskette. The server then reboots to begin the operating system installation.

6. The installation process provided by the selected operating system vendor takes over at this point.

7. Install any additional software products by following the software vendor's installation instructions.

Once you have completed the software vendor's installation process, your server is configured.

REGISTER YOUR SERVER TODAY AT WWW.COMPAQ.COM/REGISTER

Now you can quickly and easily register your Compaq products online. Customer service is our top priority at Compaq, and we want to know who you are so that we can serve you better in the future.

To register your Compaq hardware online go to www.compaq.com/register and enter your name, server serial number, and OS information. You may also use your Compaq Server Profile Diskette to register after configuring your server with SmartStart. Simply follow the instructions on our web page and insert the Compaq Server Profile Diskette when prompted.

CREATE SUPPORT SOFTWARE DISKETTES THROUGH DISKETTE BUILDER

Diskette Builder is a delivery mechanism that provides you with support software for NetWare, Windows NT, OS/2, SCO OpenServer, SCO UnixWare, DOS, Compaq Insight Manager, Banyan, and Compaq System Utilities. You have the choice of creating OS-specific support diskettes or loading the disk images directly to your hard drive. This support software allows you to update the drivers on your Compaq servers.

1. Insert the SmartStart CD.

2. Select *File*, then *Run* using the Windows NT Program Manager or select *Start*, then *Run* if you are using Windows 95.

3. Enter [drive]:\DSKBLDR\DSKBLDR.EXE - where [drive] is the drive letter of your CD-ROM. You may install the Diskette Builder to your hard drive by entering [drive]:\DSKBLDR\SETUP.EXE

4. Once the program launches, follow the instructions on the screen. You have the choice of creating OS specific support diskettes or loading the disk images directly to your hard drive. This support software allows you to update the drivers on your Compaq servers.

INSTALLING COMPAQ INSIGHT MANAGER

Refer to the *Compaq Insight Manager* booklet and the Compaq Management CD for detailed information on installing Insight Manager and the Compaq Server Management Agents.

For more information on SmartStart, visit us at:
www.compaq.com/smartstart

SERVER SETUP AND MANAGEMENT PACK

SMARTSTART AND SUPPORT SOFTWARE CD

Compaq Utilities

- System Configuration Utility
- Array Configuration Utility
- Server Diagnostics
- Array Diagnostics Utility
- ROMPaq Files
- Diskette Builder Utility
- Remote Utilities
- System Erase Utility

Compaq Support Software for:

- Microsoft Windows NT (NT SSD)
- Novell Products (NSSD)
- IBM OS/2
- SCO OpenServer and UnixWare (EFS)
- MS-DOS/Microsoft Windows
- Fibre Fault Isolation Utility

MANAGEMENT CD

- Compaq Insight Manager
- Compaq Server Management Agents for NetWare, Microsoft Windows NT, SCO OpenServer, SCO UnixWare, and IBM OS/2

COMPAQ INSIGHT MANAGER BOOKLET

COMPAQ SERVER PROFILE DISKETTE

PROGRAM LICENSE AGREEMENT

MINIMUM HARDWARE REQUIREMENTS

Compaq server with a minimum of:

- 32 megabytes of RAM
- One of the controllers from the *Automatically Installed Boards* list
- A Compaq IDE CD-ROM drive or a SCSI CD-ROM drive connected to the Integrated Fast-SCSI-2 Controller or Fast-Wide SCSI-2 Controller in the Compaq ProLiant or Compaq Prosignia VS server
- A System ROM that supports booting the system from CD
- A mouse connected to the Auxiliary Input Pointing Device connector and a keyboard
- A VGA or greater monitor

MICROSOFT SMALL BUSINESS SERVER

To configure your Compaq server hardware and install the Microsoft Small Business Server software (OS media required), please refer to online instructions and help files on the SmartStart and Support Software CD.

Note: Please refer to the Compaq White Paper detailing additional installation and verification procedures for Microsoft BackOffice Small Business Server on specific Compaq Prosignia and ProLiant Servers. It is available for downloading at ftp://ftp.compaq.com/pub/products/servers/[illegible]SBS.pdf

NETWARE FOR SMALL BUSINESS

To configure your Compaq server hardware and install the NetWare for Small Business software (OS media required), please refer to online instructions and help files on the SmartStart and Support Software CD.

AUTOMATICALLY INSTALLED BOARDS

Operating system software and device drivers are automatically installed and configured for the boards in the following table. Other boards may be fully supported by SmartStart but require that you manually install or configure the system software after the initial operating system installation is complete. Please refer to the System Administration Information in SmartStart under the *Review SmartStart Settings* button for a detailed report of each board in the system.

AUTOMATICALLY INSTALLED BOARDS

Board Name	Windows NT	NetWare	SCO Open Server	SCO UnixWare	IBM OS/2
Compaq 32-Bit DualSpeed Token Ring Controller*	X	X	X	X	X
Compaq DualSpeed Token Ring Module	X	X	X	X	X
Compaq Integrated 10/100 TX UTP Controller (also referred to as Compaq 10/100 TX Embedded UTP/Ethernet Controller)	X	X	X	X	X
Compaq NetFlex ENET-TR Controller	X	X	X	X	X
Compaq NetFlex-2 DualPort ENET Controller	X	X	X	X	X
Compaq NetFlex-2 DualPort TR Controller	X	X	X	X	X
Compaq NetFlex-2 ENET-TR Controller	X	X	X	X	X
Compaq NetFlex-2 TR Controller	X	X	X	X	X
Compaq NetFlex-3/E Controller	X	X	X	X	X
Compaq NetFlex-3/P Controller	X	X	X	X	X
Compaq Remote Insight Board		X			
Compaq Server Manager/R			X	X	
Compaq Integrated SMART Array Controller	X	X	X	X	X
Compaq SMART Array Controller	X	X	X	X	X
Compaq SMART-2SL Array Controller	X	X	X	X	X
Compaq SMART-2/P Array Controller	X	X	X	X	X
Compaq SMART Array 4200 Controller	X	X	X	X	X
Compaq SMART Array 4250ES Controller	X	X	X	X	X
Compaq Smart Array 3100ES Controller	X	X	X	X	X
Compaq Smart Array 3200 Controller	X	X	X	X	X
Compaq Smart Array 221 Controller	X	X	X	X	X
Compaq Intelligent Drive Array Controller-2	X	X	X	X	X
Compaq Wide-Ultra SCSI-3 Adapter	X	X	X	X	X
Compaq 64-Bit Dual Channel Wide Ultra2 SCSI Adapter	X	X	X	X	X
Compaq 64-Bit/66 MHz Dual Channel Wide-Ultra3 SCSI Adapter	X	X		X	
Compaq Dual Channel Wide-Ultra SCSI-3 Adapter	X	X	X	X	X
Compaq Integrated Dual Channel Wide-Ultra SCSI-3 Adapter	X	X	X	X	X
Compaq Netelligent 4/16 TR PCI IBM STP/UTP	X	X	X		X
Compaq Netelligent 4/16 TR PCI UTP/STP	X	X	X		
Compaq Netelligent 10/100 TX PCI UTP Dual Port	X	X	X	X	X
Compaq Netelligent 100 FDDI PCI	X		X		
Compaq Netelligent PCI 10 Base-T/2	X	X	X		
Compaq Netelligent 10/100 TX PCI UTP	X	X	X	X	X
Compaq Netelligent 10 T PCI UTP	X	X	X	X	X
Compaq Netelligent 16/4 TR IBM PCI UTP	X	X	X	X	X
Compaq NC3120 Fast Ethernet NIC	X	X			
Compaq NC3122 Fast Ethernet NIC	X	X			
Compaq NC1120 Ethernet NIC	X	X			
Compaq NC3161 Fast Ethernet NIC	X	X			
Compaq NC3160 Fast Ethernet NIC	X	X			
Compaq NC3121 Fast Ethernet NIC	X	X			
Compaq NC3131 Fast Ethernet NIC	X	X			
Compaq NC3132 Fast Ethernet Module	X	X			
Compaq NC6132 Gigabit Module	X	X			
Compaq NC6133 Gigabit Module	X	X			
Compaq NC3133 Fast Ethernet Module	X	X			
Compaq NC4621 Token Ring NIC	X	X			
Compaq NC6134 Gigabit NIC	X	X			
Compaq NC3163 Fast Ethernet NIC	X	X			
Compaq NC3162 Fast Ethernet NIC	X	X			
Compaq NC3123 Fast Ethernet NIC	X	X			
IBM 16/4 Token Ring PCI Special	X	X			

*The desired network media interface (AUI, RJ45 or DB-9) must be manually configured at the Review/Modify Configuration selection of the System Configuration Utility in SmartStart for proper operation of these NICs.

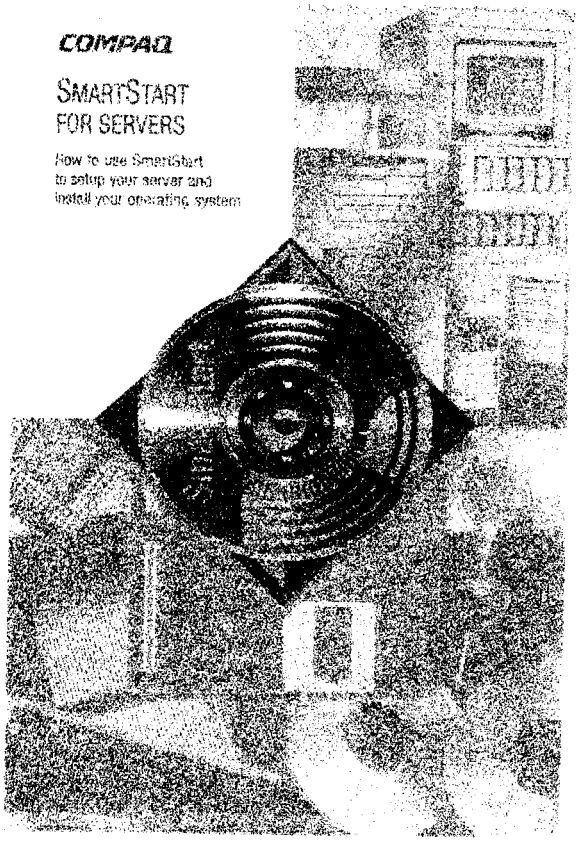
For more information on SmartStart, visit us at:
www.compaq.com/smartstart

See Reverse Side for SmartStart Installation Instructions

COMPAQ

SmartStart for Servers

How to use SmartStart to setup your server and install your operating system



Tenth Edition (December 1998)
Part Number 284128-401

START OFF RIGHT! USE SMARTSTART, THE QUICK AND EASY WAY TO SET UP YOUR SERVER.

Compaq SmartStart is the intelligent tool for setting up your Compaq server. It's also a great way to install your operating system to ensure optimized performance and integration with your hardware platform. SmartStart technology is the result of thousands of hours of testing by both Compaq engineers and our industry-leading software partners. So, using SmartStart is like having a team of system engineers assisting you in the integration of your hardware and software. The SmartStart integration process delivers optimized performance levels, a proven reliable installation, and a consistent, repeatable configuration that is simple to use and manage.

USING SMARTSTART, YOU CAN:

- Auto-detect and configure your server hardware and drive arrays.
- Complete the installation of all major server operating systems (OS) using off-the-shelf media.
- Install the latest Compaq-optimized drivers, ROMPaqs, and management agents.
- Deploy and maintain multiple servers using the Integrated Server Management and Replication tools.
- Test server hardware.
- Create support software diskettes that allow you to update your drivers.

INSTALLATION PATHS

SmartStart supports the installation of "off-the-shelf" OS software (as distributed by the software vendor).

In addition to installing software from CDs, SmartStart also has the capability of installing software from a central server on the network. For information on how to enable this capability, refer to the online *Integration Server Guide* located on the SmartStart CD. This guide also contains information on Integration Maintenance Utilities for updating your server.

There are three methods for using SmartStart to install the OS on your server.

■ ASSISTED INSTALLATION

For the full benefit of SmartStart tested hardware configuration and OS installation, select this path. The Assisted Installation interview collects information on your server configuration preferences and then provides recommendations to help you optimize hardware performance. Assisted Installation ensures the correct device drivers are integrated for your Compaq hardware.

■ REPLICATED INSTALLATION

As an Assisted Installation option, the Replicated Installation feature allows you to replicate a saved SmartStart configuration across multiple servers. Whether your servers require identical configurations for internal consistency or remote maintenance, the Replicated Installation feature dramatically reduces the complexity of configuring and maintaining multiple servers throughout the enterprise.

■ MANUAL INSTALLATION

Manual Installation allows you to run the System Configuration Utility in manual mode and install system software using the installation process which is native to the software.

The following chart shows the SmartStart installation methods that can be used with each operating system.

OS INSTALLATION TABLE

Operating System	Installation Path Availability		
Microsoft Windows NT Server 4.0	✔	✔	✔
Windows NT Server, Enterprise Edition 4.0	✔	✔	✔
Windows NT Server 4.0 Terminal Server Edition		✔	
Microsoft BackOffice Small Business Server		✔	
NetWare 5	✔	✔	
Novell Small Business Suite 5	✔	✔	
NetWare 4.2	✔	✔	
NetWare 4.11		✔	
NetWare for Small Business 4.2	✔	✔	
NetWare 3.2		✔	
SCO OpenServer 5	✔	✔	✔
SCO UnixWare 7.1.7.6.1	✔	✔	✔
SCO UnixWare 2.1.3		✔	
IBM Warp Server 4 and Warp Server Advanced 4	✔	✔	
Banyan Vines		✔	
Citrix Winframe 1.7		✔	

Appendix C
Windows NT Install Information

Seven steps to a successful Windows 2000 installation

- ❑ **Ensure that the systems that will be running Windows 2000 meet Microsoft's minimum hardware requirements.** Microsoft recommends the following:

  If you're preparing to install Windows 2000 Professional, you'll need:

  Processor: A Pentium 133 or better

  Memory: 64 MB

  Hard disk: A 2 GB disk with 650 MB of free space

  If you're preparing for Windows 2000 Server or Advanced Server, you'll need:

  Processor: A Pentium 133 or better

  Memory: 128 MB

  Hard disk: A 2 GB disk with 1 GB of free space

- ❑ Verify that your hardware, including network adapters, monitors, CD-ROM drives, and other important peripherals, are supported by the Windows 2000 platform. Compatibility errors related to upgrading should be minimal, as Windows 2000 and the Windows Driver Model include support for more peripherals and devices than the Windows NT 4 platform. You can check compatibility using Microsoft's Readiness Analyzer, or you can Search For Compatible Hardware Devices.

- ❑ **Choose an install method.** In addition to the installation methods administrators will be familiar with from the NT 4.0 platform, IT pros will find new options. The installation methods supported by Windows 2000 include:
  - Traditional CD-ROM-based installation
  - Network-based installation
  - Disk Duplication-based installation
  - Automated installation using the Windows 2000 Setup Manager Wizard
  - Remote Installation Services

- ❑ **Know which file system you're going to use.** Many important Windows 2000 features, including Active Directory Services, rely upon NTFS. However, you'll also find Windows 2000 supports FAT and FAT32.

- ❑ **Select a licensing method.** Per seat licensing requires that each client have a Client Access License (CAL). Per server licensing dictates the number of client connections a server can support. As a result, per server mode requires that each server connection a client establishes possess a CAL. Organizations operating multiple Windows 2000 servers will probably find per seat the most efficient licensing model.

- ❑ **Have your namespace planned properly.** The time to design your domain structure isn't when Windows 2000 prompts you for a domain or workgroup name—it's before. Remember, too, that domain names in Windows 2000 take the fully qualified domain name structure, server1.techrepublic.com.

- ❑ **Create a computer account.** If you're adding systems to a Windows 2000 domain, computer accounts must exist. Without a pre-configured computer account, the installer will require Administrator-level permissions. Appropriate passwords will also be required.

How to install:
Windows 2000 Server
A systematic guide to installing Windows 2000 Server

This Installation Guide

Table of Contents

About

About this Installation Guide

This guide covers installing Windows 2000 Server or Advanced Server on a computer without an operating system and no hard disk partition. It is assumed that the installer possesses basic knowledge of the following:

- Hard disk partitions
- Windows NT domains
- Network protocol usage

The Windows 2000 installation occurs in two parts. The first portion involves basic software and hardware setup in a DOS-like environment. The installer prompts the user with a few questions, including preferred partition and file system information. Setup then partitions and formats the hard disk, if needed.

The second part of installation occurs within the Windows environment. This part of the installation installs hardware and software that will be used within Windows 2000. In addition, the installer will be able to select protocols for networking and set up services for the server to use once the Windows Setup program is complete.

Are you ready? Let's install Windows 2000 Server.

The Basic Installation: Step One

To begin the basic installation of Windows 2000, it's recommended that the target system be clean. Windows 2000 supports dual-boot configurations, but issues can arise when hosting multiple operating systems on the same server. Take care not to delete the wrong partition or copy over another system's files when installing Windows 2000 if you are, indeed, dual booting.

Make sure that the target system has the ability to boot from a CD-ROM. Insert the Windows 2000 Server or Advanced Server CD into the CD-ROM drive and power up the computer. You will soon see the following screen, as shown in Figure 1.

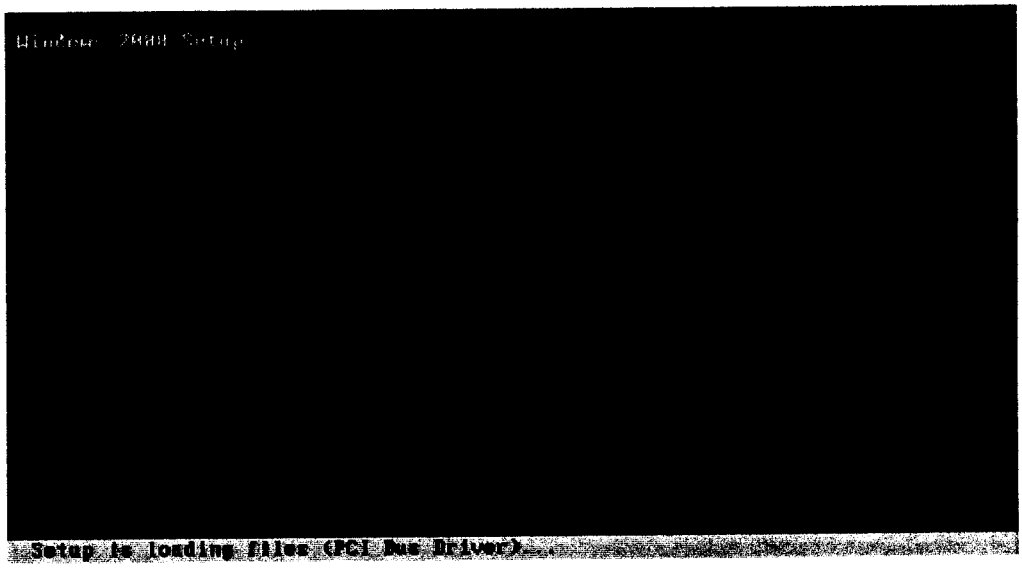


Figure 1: The basic setup screen

You will notice at the bottom of the screen that Windows 2000 is copying the files needed to begin the Setup program. Once all of the necessary files have been copied, the installation can proceed.

The Basic Installation: Step Two

You are now ready to begin the basic Windows 2000 server setup. You are given two choices, as seen below in Figure 2. The first option is to continue with Windows 2000 Setup. Select [Enter], and the Setup program will continue installing the OS. You choose this option to fix any problems that may have occurred during the installation. The second option, quit Setup, allows you to leave the Setup program without damaging any existing partition or software on option will appear. Repair A Windows 2000 Installation can be selected if you want to try to recover from a corrupted Win2K installation.)

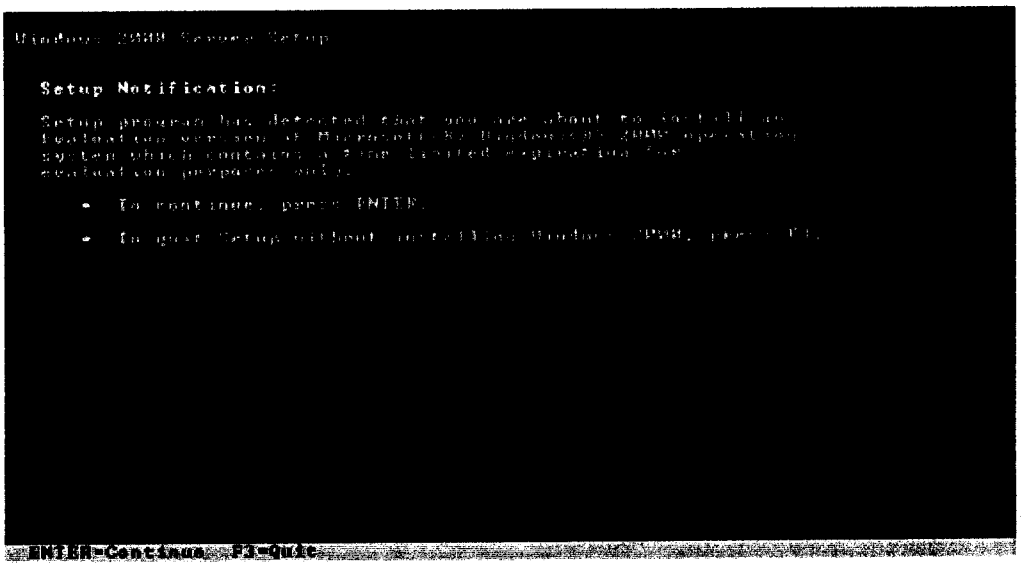


Figure 2: Setup Notification screen

To continue with the installation, hit [Enter].

The Basic Installation: Step Three

Next, the Setup program presents options for selecting a partition, as seen in Figure 3. The partition screen allows you to select the partition where Windows 2000 should be installed.

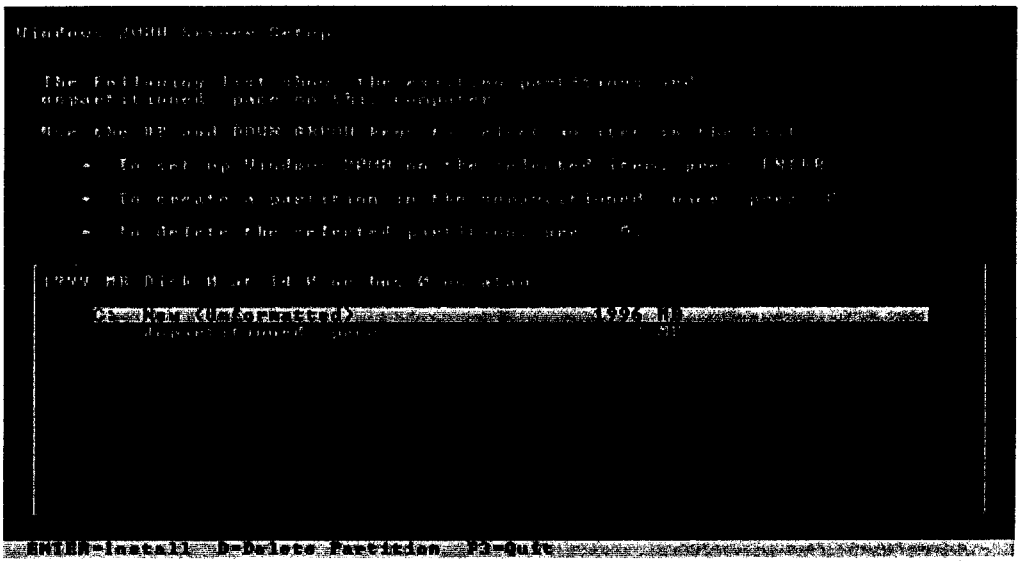


Figure 3: You must select the partition where Windows 2000 should be installed.

Once a partition has been selected, you must specify the file system with which the partition should be formatted, as shown in Figure 4. Two choices are presented: NT file system (NTFS) and file allocation table (FAT).

NTFS is required if you intend to make use of file-level permissions and Active Directory Services. It is highly recommended you use the NTFS file system rather than FAT. NTFS is much more stable than FAT. You should only consider using the FAT file system if there's a need to access the Windows 2000 files from another FAT-based operating system.

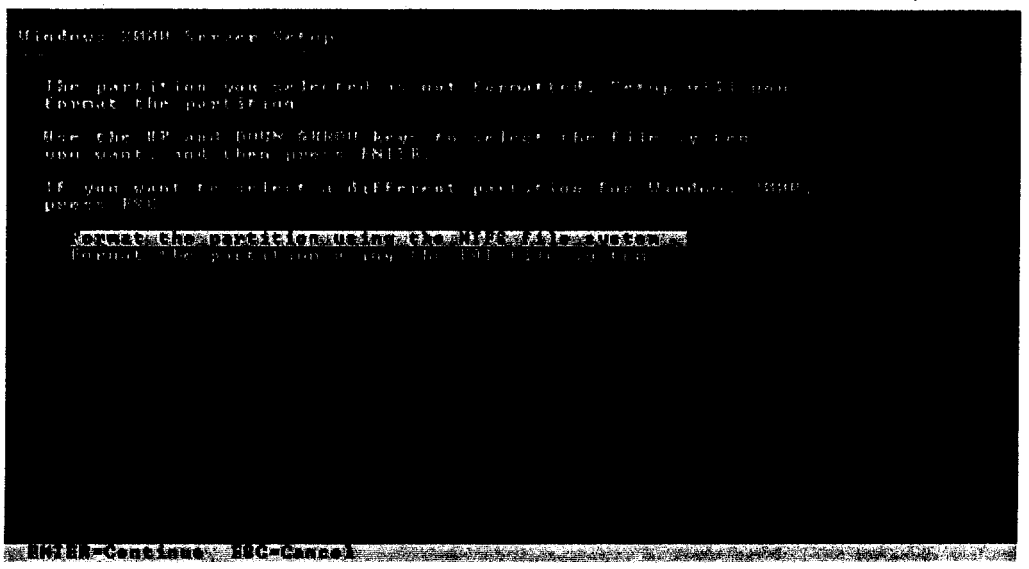


Figure 4: You must select a file system when installing Windows 2000.

The Basic Installation: Step Four

Once the NTFS partition has been created and formatted, Setup begins copying the files needed to install Windows 2000 into the installation folders, as seen in Figure 5. This particular step can take quite a bit of time, depending on the speed of your computer and its CD-ROM drive. As in the Windows NT install procedure, the bottom right corner of the screen displays which files are being copied to the hard disk.

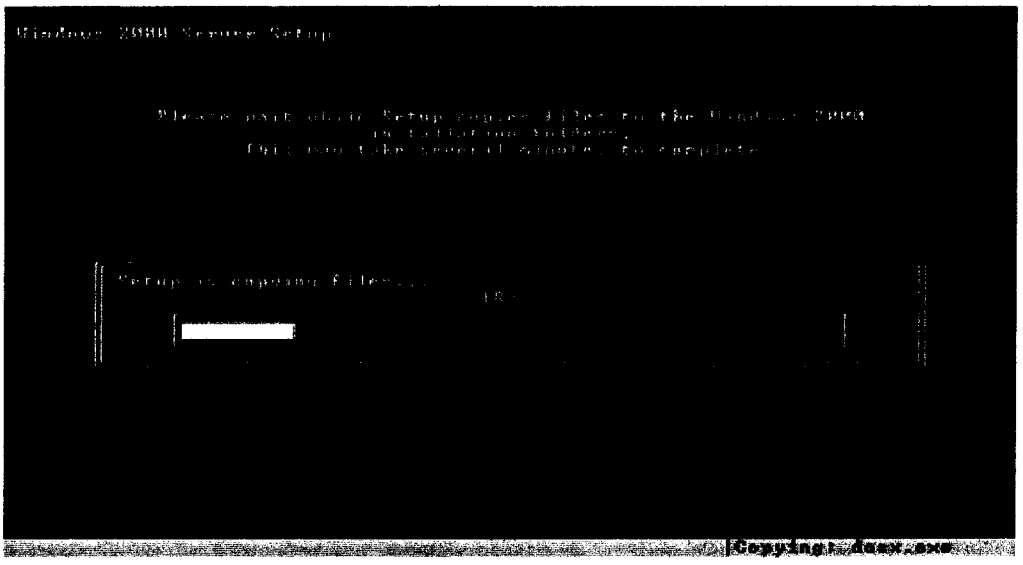


Figure 5: The Setup program copies files to the hard drive.

The Basic Installation: Step Five

Once all of the files have been copied to the installation folders, the setup program prompts you to restart the computer so that the Setup program can continue within a Windows interface. If you don't respond to restart the machine, the Setup program automatically restarts the computer so that the installation may continue.

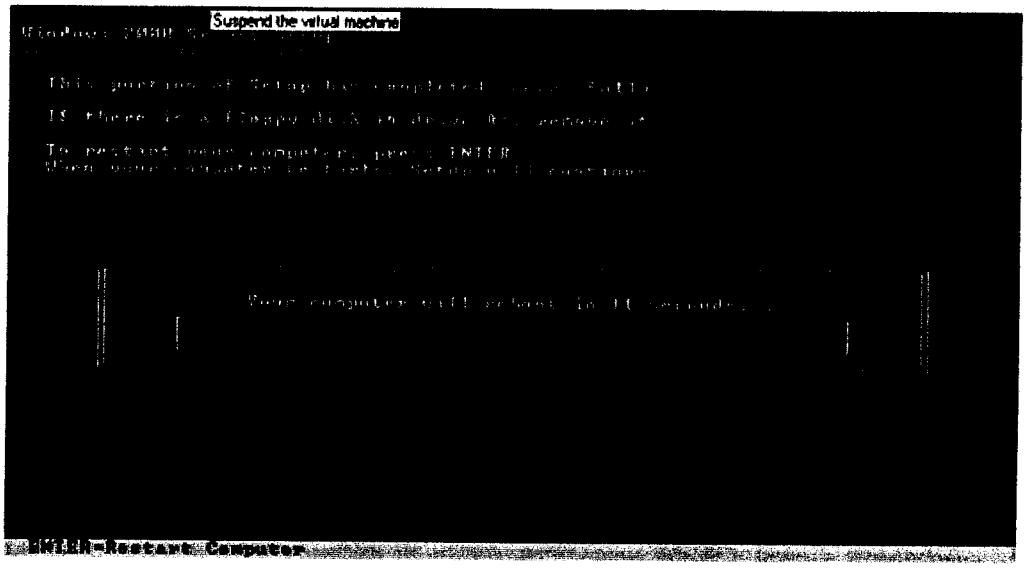


Figure 6: The system must reboot for installation to continue.

The Windows Installation: Step Six

Once the computer restarts, the Windows-based portion of the installation begins, as shown in Figure 7. The blue bar at the bottom tracks the startup progress. After Windows has loaded all the files needed to continue, the blue bar fills, and the Setup program continues.

Figure 7: The Windows 2000 splash screen

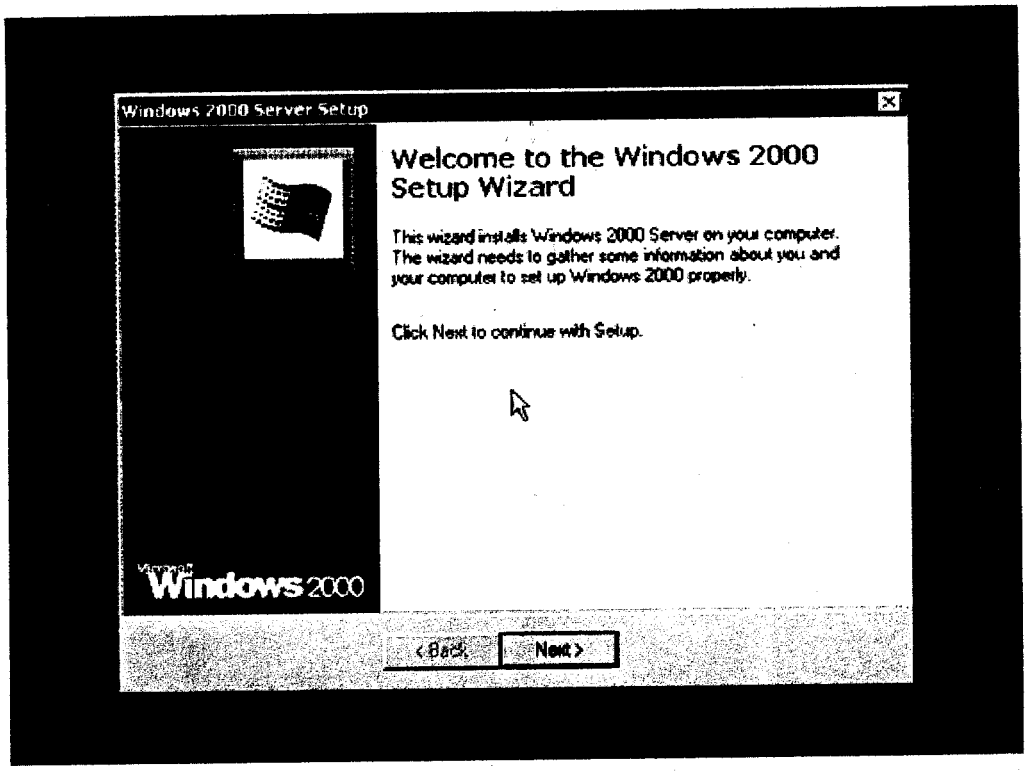


Figure 8: Welcome to the Windows 2000 Setup Wizard

Once all of the files needed to continue have been loaded, Windows displays a wizard welcoming the installer to Windows 2000, as seen in Figure 8. To begin the installation wizard, click Next.

The Windows Installation: Step Seven

Once you begin the installation wizard, Windows begins installing the hardware contained on the machine, as seen in Figure 9. During this time, the installation wizard searches the computer for Plug-and-Play (PnP) hardware, and non-PnP or "legacy" hardware. This particular part of the installation could be lengthy, especially if there are many different pieces of hardware in the system.

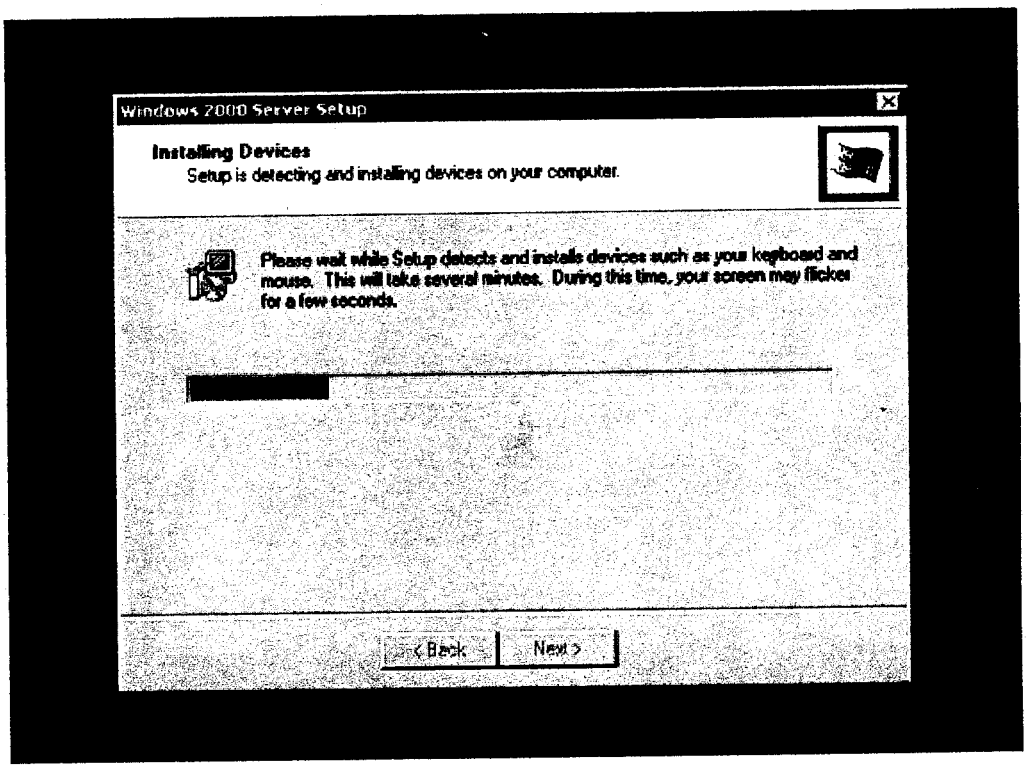


Figure 9: The Windows 2000 Installation Wizard searches for installed devices.

The Windows Installation: Step Eight

Once the installation wizard has detected all the hardware on the machine, the Regional Settings window appears, as shown in Figure 10. Here is where you make changes to system locale settings and keyboard controls for the system defaults.

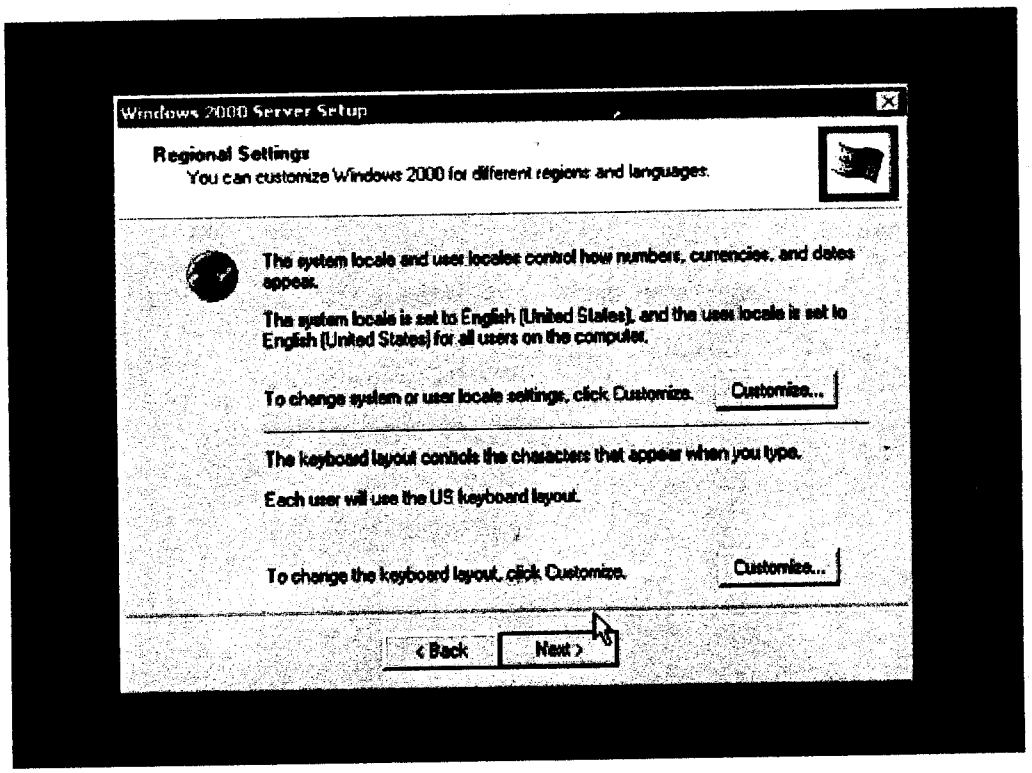


Figure 10: Regional Settings are changed during Setup.

The Windows Installation: Step Nine

After you've configured the regional settings, the installation wizard presents the Personalize Your Software dialog box. Here you should specify your name and organization. You also have the option of leaving the organization field blank. However, it's advised that each space be completed, as Windows uses the data in these fields during Setup to complete information in other areas of the wizard.

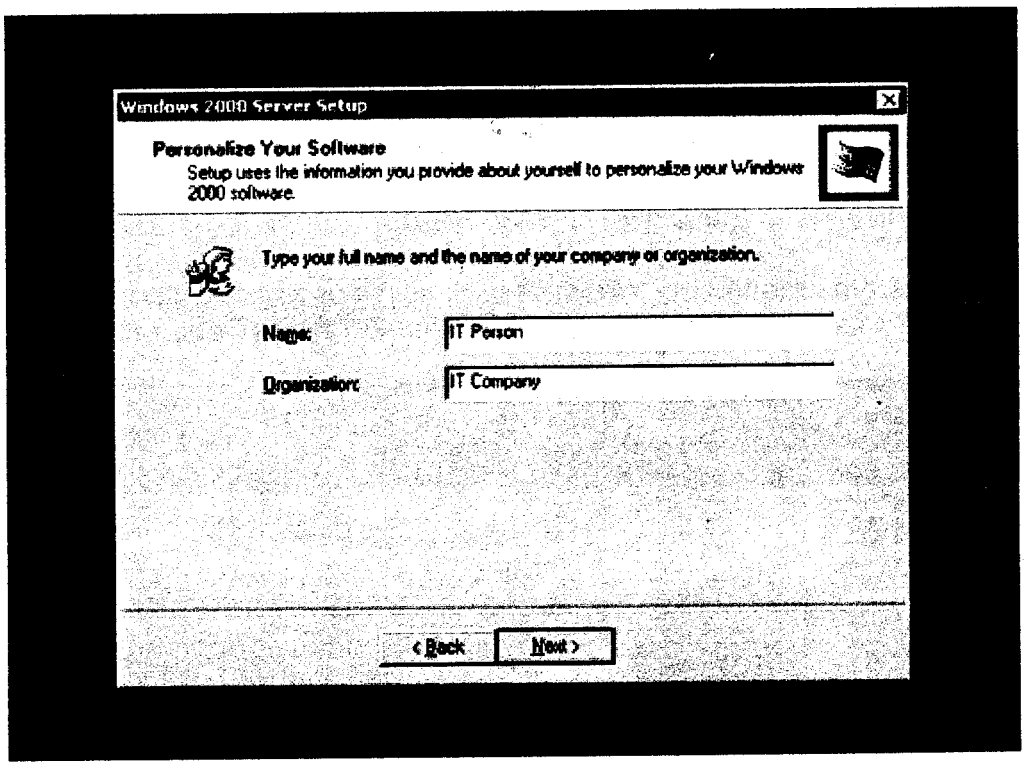


Figure 11: The Personalize Your Software dialog box prompts you for your name and your organization.

The Windows Installation: Step Ten

Depending on the version of Windows 2000 server that you are installing, you may receive a notice to enter the product key. If the version you're installing requires the product key, you'll be prompted for it at this time. However, if you're using a version that doesn't require a product key, you'll be taken directly to the Licensing Mode dialog box, as shown in Figure 12.

Here you'll find two options from which to select. You can specify Per Server or Per Seat. The difference between the two is as follows:

- **Per Server**: Each connection to the server must have its own client access license.
- **Per Seat**: Each computer must have its own client access license.

If there's any confusion as to which license mode you should select, such as if you plan to also use Terminal Services, contact Microsoft for more information.

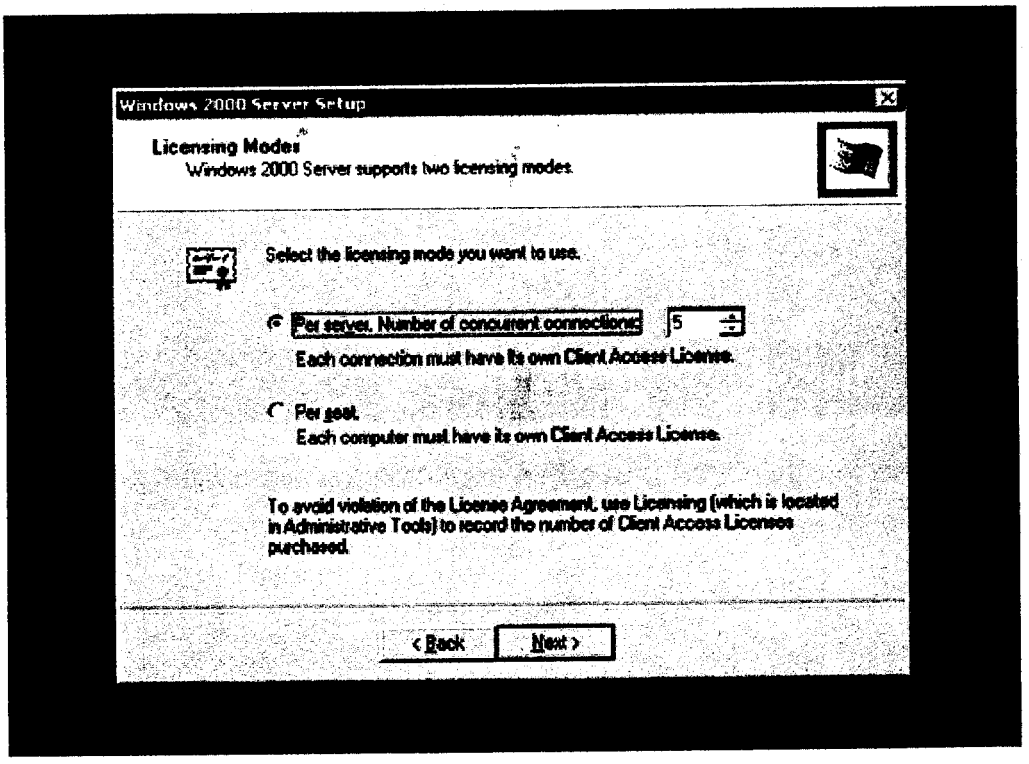


Figure 12: Be sure to choose the correct license mode for your organization.

The Windows Installation: Step Eleven

Next, the Windows 2000 Server Setup Wizard asks for your computer name, which will represent the machine on the network. The installation wizard, as shown in Figure 13, will provide a suggestion by default, but it's best to provide a more recognizable name. The Computer Name And Administrator Password dialog box also requests the Administrator password. This password allows full access to the machine once Windows 2000 is completely set up.

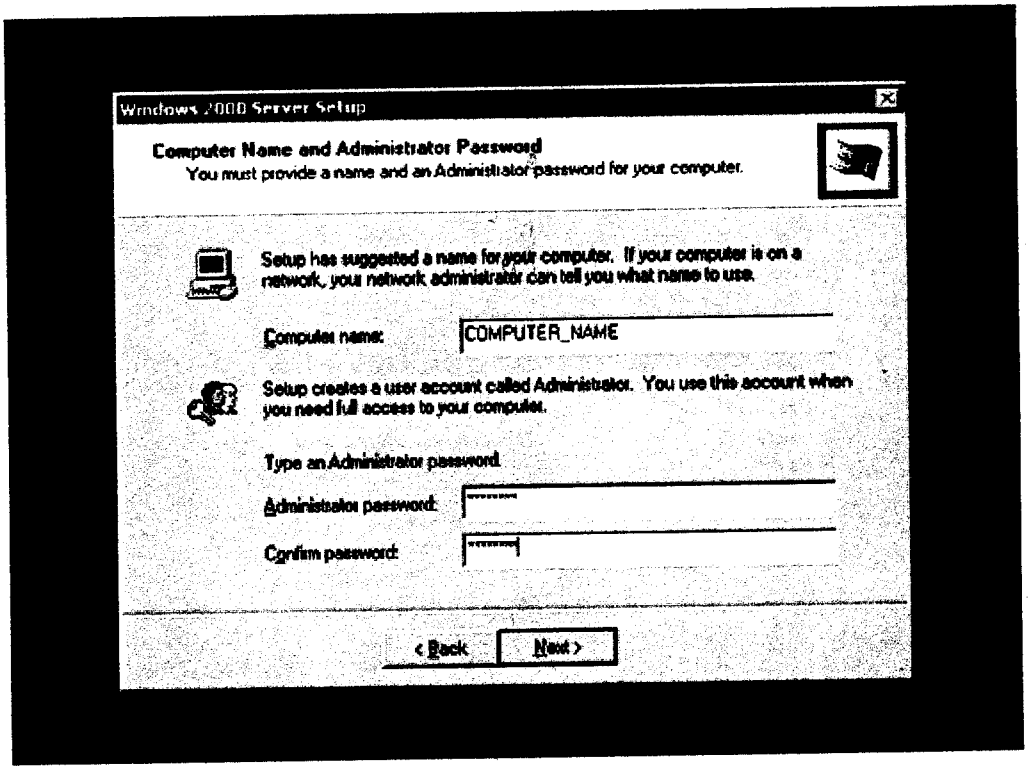


Figure 13: You must provide a computer name and Administrator password when installing Win2K.

The Windows Installation: Step Twelve

Once you've provided the Administrator password and clicked Next, you'll be taken to the Windows 2000 Components screen, as shown in Figure 14. Here you select the services, applications, utilities, and tools you'd like to install. You can either select the default installation, or customize your own. Remember: You can always install these components later from the Add/Remove Programs applet within Control Panel.

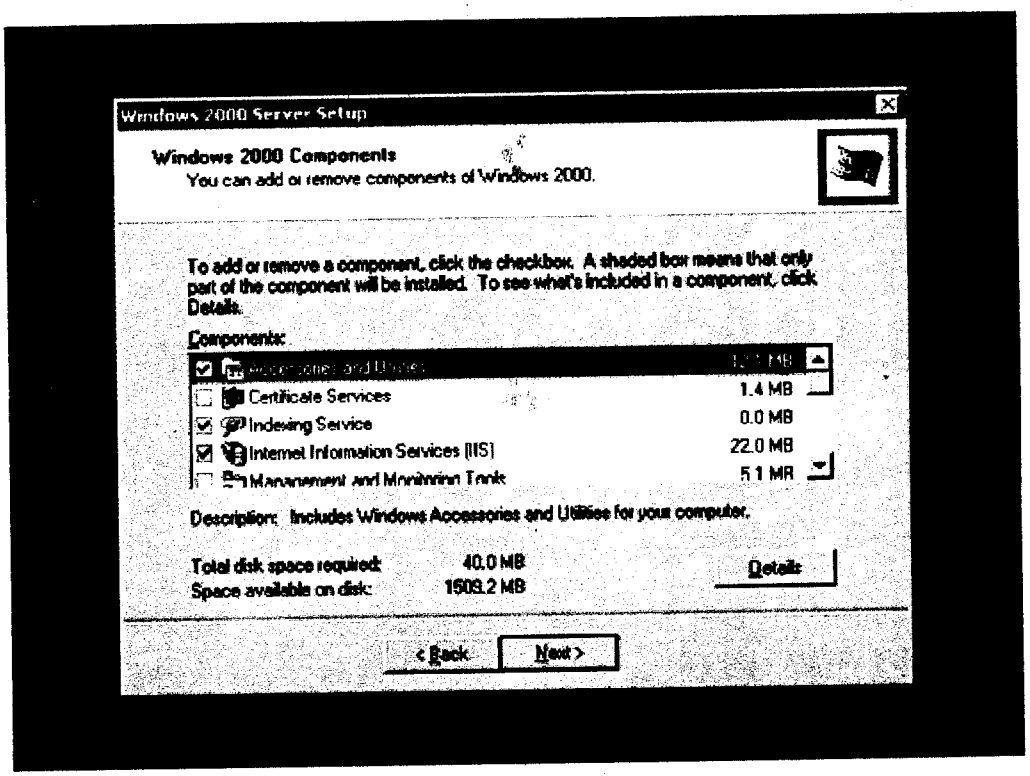


Figure 14: The Windows 2000 Components screen provides the opportunity to add components during installation.

The Windows Installation: Step Thirteen

Next, adjust the date, time, and time zone from the Date And Time Settings window. By using a drop-down menu, you simply select the date, time, and time zone. You can also select whether the system should automatically adjust for daylight savings changes.

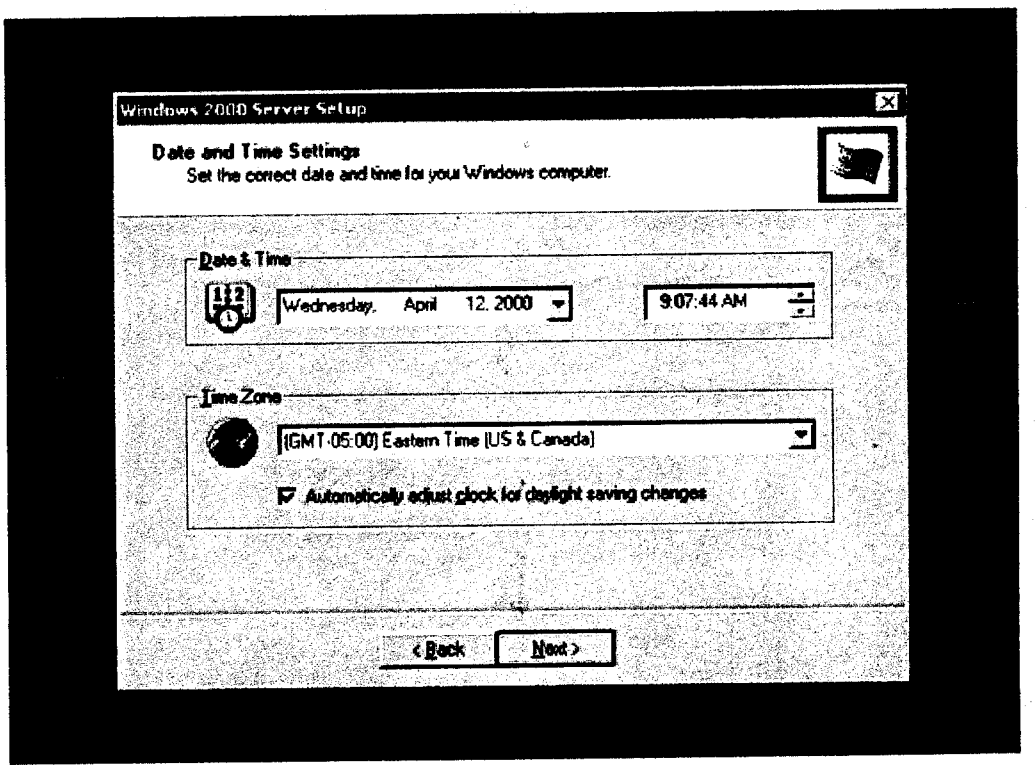


Figure 15: Date and time settings are adjusted during installation.

The Windows Installation: Step Fourteen

As the wizard continues, you'll reach the Network Settings window. This portion of the installation includes an attempt by Windows to detect and install all network components, such as NIC cards and protocols. Once Windows has detected all hardware and setup protocols, you'll be asked whether you want a typical network installation or whether you wish to perform a network installation manually, as shown in Figure 16. Select the option that works best for your network.

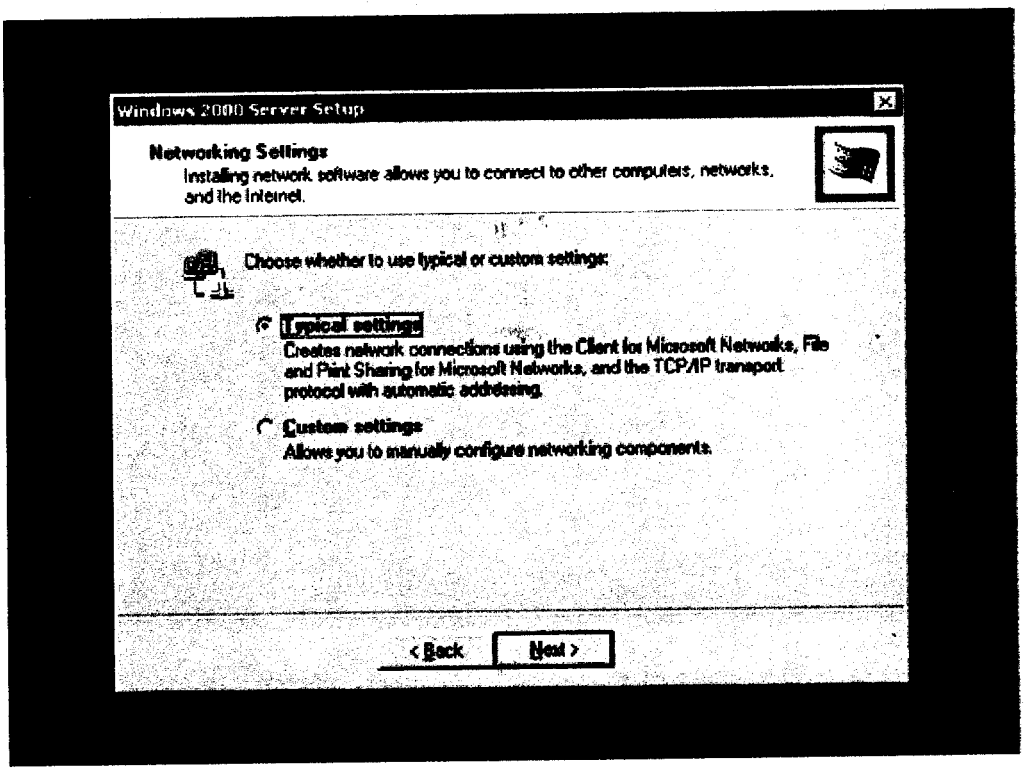


Figure 16: Network Settings window

Once Windows has configured network settings, you'll be asked whether the computer is to be part of a workgroup or a domain, as shown in Figure 17. Select the first option if you want to install the server on a network without a domain or if it is not on a network. Choose the second option if the computer is to be a member of an existing domain. You must also provide the workgroup or domain name before proceeding to the next step.

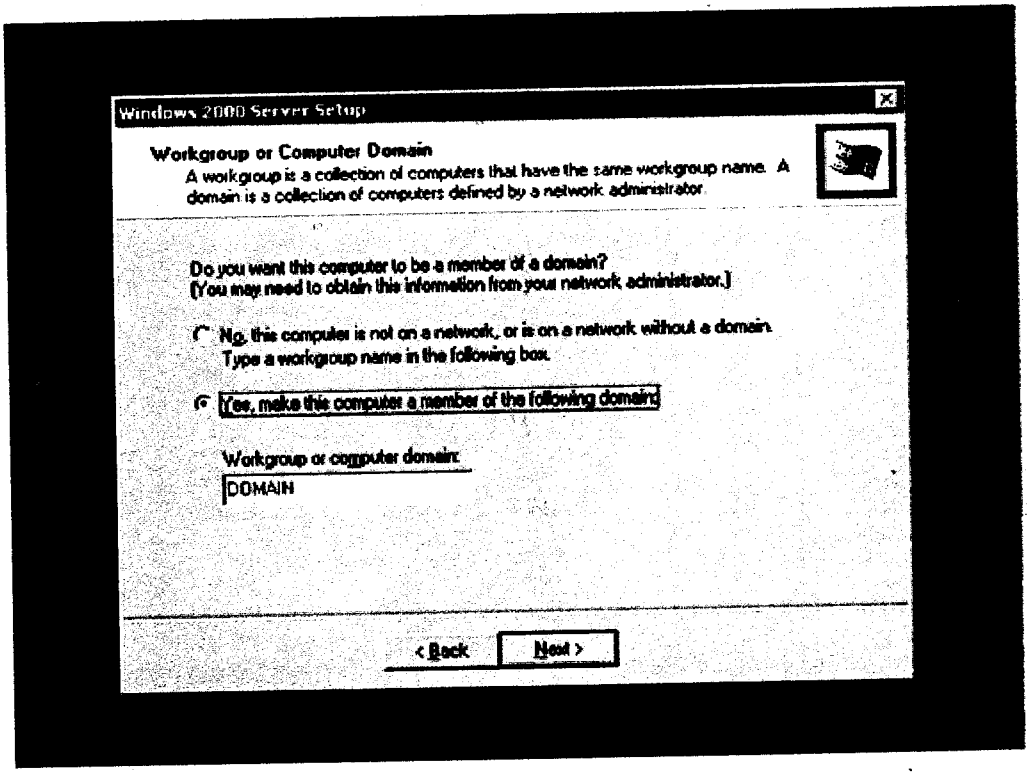


Figure 17: You must specify whether a system is to be a member of a workgroup or domain.

The Windows Installation: Step Fifteen

After specifying workgroup and domain information, the Windows 2000 Setup program begins installing the components chosen earlier, as shown in Figure 18. This process could take awhile, depending on which components you chose to install.

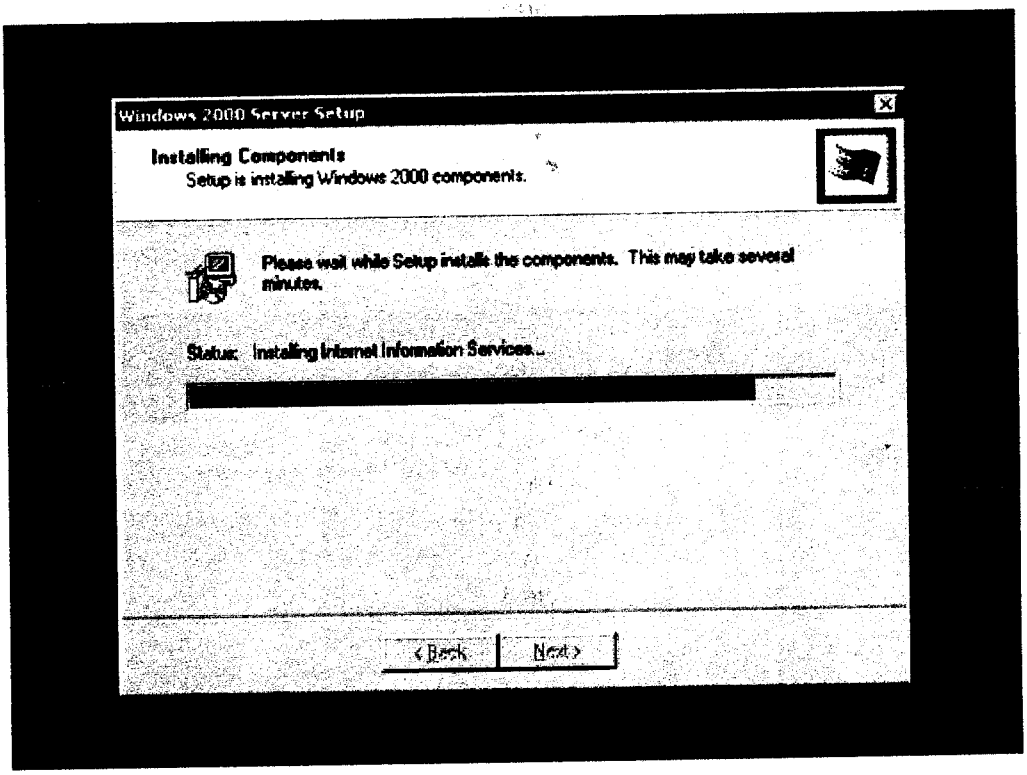


Figure 18: Windows 2000 tracks the installation's progress.

The Windows Installation: Finishing Up

To complete its installation, the wizard sets up the Start menu items and registers the components that were just installed, as shown in Figure 19. Once it has accomplished these tasks, it saves the settings it just created and removes all the temporary files that were used during the installation process. Note that this particular part of the Setup program takes time and could very well be the longest part of the installation.

After the wizard has successfully performed its final tasks, the wizard's finish menu pops up. Once the installer selects Next, the computer will shut down and restart. Windows then loads normally from this point on. Eventually, you will reach the logon screen. Press [Ctrl] [Alt] [Delete] to bring up the login screen, and enter the Administrator password specified in Step Eleven.

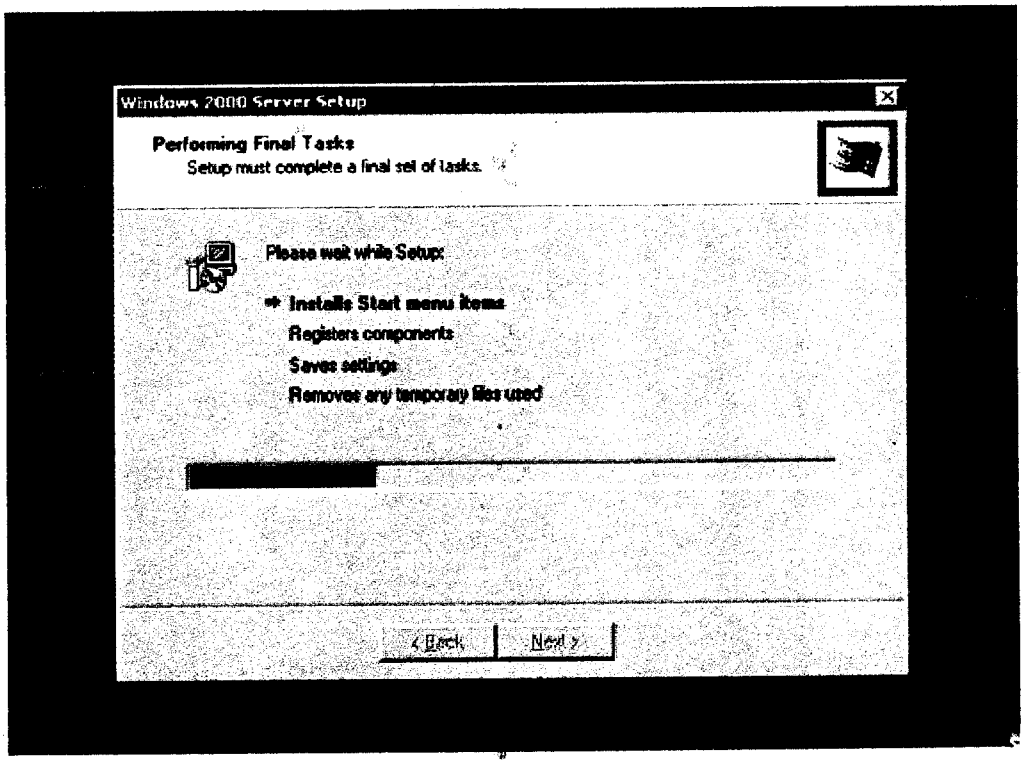


Figure 19: Windows finalizes its installation.

Appendix D
NT Clustering Information

Introducing Windows 2000 Clustering Technologies

Posted: Thursday, February 17, 2000

Microsoft® Windows® 2000 Advanced Server and Datacenter Server operating systems enable organizations to deploy business-critical e-commerce and line-of-business applications on industry-standard computer hardware. Clustering technologies are key tools in making this possible.

Clustering refers to linking individual servers physically and programmatically and coordinating communication between them so they can perform common tasks. Should any one server stop functioning, a process called failover automatically shifts its workload to another server to provide continuous service. In addition to failover, some forms of clustering also employ load balancing, which enables the computational workload to be distributed across a network of linked computers.

Combined with advanced symmetric multiprocessing (SMP) and large memory support in both Windows 2000 Advanced Server and Datacenter Server operating systems, Windows clustering technologies enable organizations to ensure the availability of critical applications while being able to scale those applications both up and out to meet increased demand.

Defining a Cluster in Windows 2000

A cluster is a group of independent computers that work together to run a common set of applications and provide the image of a single system to the client and application. The computers are physically connected by cables and programmatically connected by cluster software. These connections allow computers to use failover and load balancing, which is not possible with a stand-alone computer.

Windows 2000 clustering technology provides high availability, scalability, and manageability:

- **High availability**. The cluster is designed to avoid a single point-of-failure. Applications can be distributed over more than one computer, achieving a degree of parallelism and failure recovery, and providing more availability.
- **Scalability**. You can increase the cluster's computing power by adding more processors or computers.
- **Manageability**. The cluster appears as a single-system image to end users, applications, and the network, while providing a single point-of-control to administrators. This single point-of-control can be remote.

Two Types of Clusters in Windows 2000

In the Windows 2000 Advanced Server and Datacenter Server operating systems, Microsoft introduces two clustering technologies that can be used independently or in combination, providing organizations with a complete set of clustered solutions that can be selected based on the requirements of a given application or service. Windows clustering technologies are illustrated in figure 1 and include:

- **Cluster service**. This service is intended primarily to provide failover support for applications such as databases, messaging systems, and file and print services. Cluster service supports 2-node failover clusters in Windows 2000 Advanced Server and 4-node clusters in Datacenter Server. Cluster service is ideal for ensuring the

availability of critical line-of-business and other back-end systems, such as Microsoft Exchange Server or a Microsoft SQL Server™ 7.0 database acting as a data store for an e-commerce Web site.

- **Network Load Balancing (NLB)**. This service load balances incoming Internet Protocol (IP) traffic across clusters of up to 32 nodes. Network Load Balancing enhances both the availability and scalability of Internet server-based programs such as Web servers, streaming media servers, and Terminal Services. By acting as the load balancing infrastructure and providing control information to management applications built on top of Windows Management Instrumentation (WMI), Network Load Balancing can seamlessly integrate into existing Web server farm infrastructures. Network Load Balancing will also serve as an ideal load balancing architecture for use with the Microsoft release of the upcoming AppCenter Server in distributed Web farm environments.

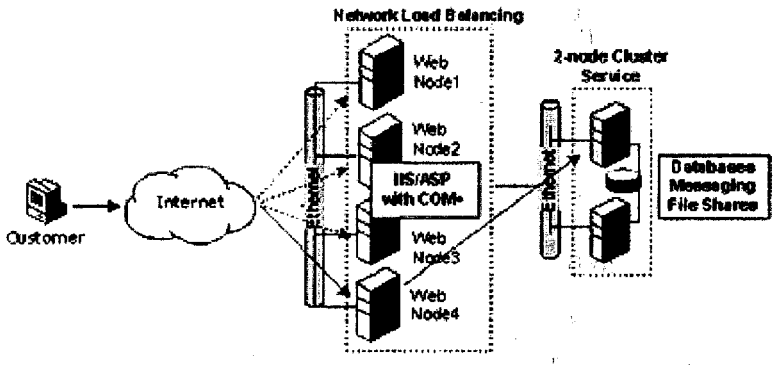


Figure 1. Both Windows clustering technologies deployed in a typical e-commerce environment.

The Value of Cluster Service

Line-of-business applications are applications that are central to a company's operations, and include systems such as databases, messaging servers, enterprise resource planning (ERP) applications, and core file and print services. Cluster service in the Windows 2000 operating system ensures that these critical applications are online when needed by removing the physical server as a single point-of-failure.

In the event that a hardware or software failure occurs in either node, the applications currently running on that node (and you may run more than one), are then migrated by Cluster service to the surviving node and re-started. Because Cluster service uses a shared-disk configuration with common bus architectures such as SCSI and Fibre Channel, no data is lost during a fail-over.

The benefits of deploying the Windows 2000 operating system with Cluster service are:

- **Reduce unplanned downtime**: Downtime caused by hardware or software failures can result in lost revenue, wasted IT staff work, and unhappy customers. Using Cluster service with a shared-disk solution on critical line-of-business applications can significantly reduce the amount of application downtime caused by unexpected failures.

- **Smoothly deploy upgrades with rolling upgrade support**: Cluster service is ideally suited for ensuring transparent upgrades of applications without interrupting your clients. By migrating your applications to one node, upgrading the first node, and then migrating them back, you can roll out hardware, software, and even operating systems upgrades without taking the application offline. Cluster service in Windows

2000 supports rolling operating system upgrades from Windows NT® Server 4.0, Enterprise Edition clusters deployed with Service Pack 4 or higher.

- **Deploy the applications you rely on**: Cluster service is supported by dozens of cluster-aware applications spanning a wide range of functions and vendors. Cluster-aware applications include databases such as Microsoft SQL Server 7.0 and IBM DB2, messaging servers such as Microsoft Exchange Server 5.5 and Lotus Domino, management tools like NetIQ's AppManager, disaster recovery tools like NSI Software's DoubleTake 3.0, and ERP applications including SAP, Baan, PeopleSoft, and JD Edwards. And you can now cluster such services as DHCP, WINS, SMTP, and NNTP.

- **Deploy the applications on which you rely on industry-standard hardware**: Keep costs down by deploying Cluster service clusters on standard computer server and storage hardware, avoiding costly and often proprietary alternative high-availability solutions. Cluster service solutions are currently offered by most systems vendors including Dell, Compaq, IBM, Hewlett-Packard, Unisys, and Data General.

Finally, Cluster service in Windows 2000 is now easier to set up and use than ever before. With a substantially improved Setup wizard, Cluster service setup requires less entries and less time to install and configure than with Windows NT Server 4.0, Enterprise Edition. Combined with the improved Cluster Administrator (now a Microsoft Management Console snap-in), the Cluster service in the Windows 2000 operating system is redefining how simple building clusters on standard Intel PC-based hardware can be.

The Value of Network Load Balancing

With the explosive growth of the Internet and associated services (intranets, extranets, and hosted applications), the need for dynamic scalability of Web servers has never been greater. With Network Load Balancing (NLB), Windows 2000 provides an integrated infrastructure for building your critical, in-demand Web sites in a distributed, load-balanced manner. Combined with the distributed application features of Component Services and the enhanced scalability of Internet Information Services (IIS) 5.0, NLB helps ensure that your Web services can scale to handle the heaviest of traffic loads, while also guarding against both planned and unplanned server downtime.

The benefits of deploying Network Load Balancing are:

- **Scale Web applications by quickly and incrementally adding additional servers**: Plan for the future by deploying an NLB cluster one server at a time, while avoiding substantial up-front costs for expensive proprietary hardware-based load balancing systems. Designed for use with a diverse array of applications and services, Network Load Balancing uses a statistical load-balancing model to distribute incoming IP requests across a cluster of up to 32 servers. Because it is integrated into the Windows 2000 networking infrastructure, NLB is a simple, effective means of adding capacity to Windows 2000-based, Web-based applications.

- **Ensure that your Web sites are always online for your customers**: With sub-10 second failover time for Web servers clustered with NLB, your customers' buying or browsing experience will never be interrupted by either planned upgrades or maintenance, or unplanned server downtimes. Combined with application health monitoring tools such as the Microsoft ClusterSentinel, which is included in the Windows 2000 Resource Kit, NLB is the quick, no-hassle means of making sure your site is online when your customers need it.

- **Build for Microsoft AppCenter Server tomorrow**: Deploying your site today using the NLB service in the Windows 2000 operating system ensures that your site is

ready for deploying Microsoft AppCenter Server tomorrow. AppCenter Server includes management, monitoring, and replication features that are ideal complements for Web server clusters built with NLB. AppCenter Server will also include advanced setup and management features specifically tailored to enhance NLB clusters.

Network Load Balancing in Windows 2000 Advanced Server and Datacenter Server, and its predecessor in Windows NT Server 4.0, Enterprise Edition, are in use on some of the world's most popular Web destinations, including Microsoft Web properties (Microsoft.com, MSN™, MSNBC, Expedia®), Dell.com, and TV Guide Online.

Using the Two Together

Both Windows Clustering technologies can be used in conjunction to create highly scalable and available n-tier e-commerce sites. By deploying Network Load Balancing across a front-end Web server farm, and clustering back-end line-of-business applications such as databases with Cluster service, you can gain all the benefits of near-linear scalability with no server or application-based single points-of-failure. Combined with industry-standard best practices for designing high-availability networking infrastructures, you can ensure your Windows 2000-based Internet-enabled business will be online all the time and can quickly scale to meet demand.

Which Clustering Technology Should be Used for Your Application?			
Technology / Scenario	Cluster Service	Network Load Balancing	Benefits
[illegible]		✓	✓Quickly expand your capacity ✓Minimize site downtime
[illegible]		✓	✓Quickly expand your capacity ✓Minimize effects of server failures
[illegible]	✓		✓Minimize service downtime ✓Ensure data consistency after failover
[illegible]	✓		✓Minimize application downtime ✓Ensure data consistency after failover
[illegible]	✓	✓	✓Quickly expand your capacity ✓Minimize effects of server/app. downtime

For More Information

Sources of additional information on the Windows clustering technologies can be found on the Microsoft Web sites:

General Information About Microsoft Clustering Technologies
Microsoft Windows 2000 Advanced Server

Last Updated: Wednesday, February 16, 2000

Step-by-Step Guide to Installing Cluster Service

Posted: Friday, January 28, 2000

This step-by-step guide provides instructions for installing Cluster service on servers running the Windows® 2000 Advanced Server and Windows 2000 Datacenter Server operating systems. The guide describes the process of installing the Cluster service on cluster nodes. It is not intended to explain how to install cluster applications. Rather, it guides you through the process of installing a typical, two-node cluster itself.

Contents

Introduction

Back to Top

A server cluster is a group of independent servers running Cluster service and working collectively as a single system. Server clusters provide high-availability, scalability, and manageability for resources and applications by grouping multiple servers running Windows® 2000 Advanced Server or Windows 2000 Datacenter Server.

The purpose of server clusters is to preserve client access to applications and resources during failures and planned outages. If one of the servers in the cluster is unavailable due to failure or maintenance, resources and applications move to another available cluster node.

For clustered systems, the term *high availability* is used rather than *fault-tolerant*, as fault tolerant technology offers a higher level of resilience and recovery. Fault-tolerant servers typically use a high degree of hardware redundancy plus specialized software to provide near-instantaneous recovery from any single hardware or software fault. These solutions cost significantly more than a clustering solution because organizations must pay for redundant hardware that waits idly for a fault. Fault-tolerant servers are used for applications that support high-value, high-rate transactions such as check clearinghouses, Automated Teller Machines (ATMs), or stock exchanges.

While Cluster service does not guarantee non-stop operation, it provides availability sufficient for most mission-critical applications. Cluster service can monitor applications and resources, automatically recognizing and recovering from many failure conditions. This provides greater flexibility in managing the workload within a cluster, and improves overall availability of the system.

Cluster service benefits include:

- **High Availability**. With Cluster service, ownership of resources such as disk drives and IP addresses is automatically transferred from a failed server to a surviving server. When a system or application in the cluster fails, the cluster software restarts

the failed application on a surviving server, or disperses the work from the failed node to the remaining nodes. As a result, users experience only a momentary pause in service.

- **Failback**. Cluster service automatically re-balances the workload in a cluster when a failed server comes back online.
- **Manageability**. You can use the Cluster Administrator to manage a cluster as a single system and to manage applications as if they were running on a single server. You can move applications to different servers within the cluster by dragging and dropping cluster objects. You can move data to different servers in the same way. This can be used to manually balance server workloads and to unload servers for planned maintenance. You can also monitor the status of the cluster, all nodes and resources from anywhere on the network.
- **Scalability**. Cluster services can grow to meet rising demands. When the overall load for a cluster-aware application exceeds the capabilities of the cluster, additional nodes can be added.

This paper provides instructions for installing Cluster service on servers running Windows 2000 Advanced Server and Windows 2000 Datacenter Server. It describes the process of installing the Cluster service on cluster nodes. It is not intended to explain how to install cluster applications, but rather to guide you through the process of installing a typical, two-node cluster itself.

Checklists for Cluster Server Installation

Back to Top

This checklist assists you in preparing for installation. Step-by-step instructions begin after the checklist.

Software Requirements

- Microsoft Windows 2000 Advanced Server or Windows 2000 Datacenter Server installed on all computers in the cluster.
- A name resolution method such as Domain Naming System (DNS), Windows Internet Naming System (WINS), HOSTS, etc.
- Terminal Server to allow remote cluster administration is recommended.

Hardware Requirements

- The hardware for a Cluster service node must meet the hardware requirements for Windows 2000 Advanced Server or Windows 2000 Datacenter Server. These requirements can be found at the Product Compatibility Search page.
- Cluster hardware must be on the Cluster Service Hardware Compatibility List (HCL). The latest version of the Cluster Service HCL can be found by going to the Windows Hardware Compatibility List and then searching on *Cluster*.
- Two HCL-approved computers, each with the following:
  - A boot disk with Windows 2000 Advanced Server or Windows 2000 Datacenter Server installed. The boot disk cannot be on the shared storage bus described below.

- A separate PCI storage host adapter (SCSI or Fibre Channel) for the shared disks. This is in addition to the boot disk adapter.
- Two PCI network adapters on each machine in the cluster.
- An HCL-approved external disk storage unit that connects to all computers. This will be used as the clustered disk. A redundant array of independent disks (RAID) is recommended.
- Storage cables to attach the shared storage device to all computers. Refer to the manufacturers' instructions for configuring storage devices. If an SCSI bus is used, see Appendix for additional information.
- All hardware should be identical, slot for slot, card for card, for all nodes. This will make configuration easier and eliminate potential compatibility problems.

Network Requirements

- A unique NetBIOS cluster name.
- Five unique, static IP addresses: two for the network adapters on the private network, two for the network adapters on the public network, and one for the cluster itself.
- A domain user account for Cluster service (all nodes must be members of the same domain).
- Each node should have two network adapters—one for connection to the public network and the other for the node-to-node private cluster network. If you use only one network adapter for both connections, your configuration is unsupported. A separate private network adapter is required for HCL certification.

Shared Disk Requirements:

- All shared disks, including the quorum disk, must be physically attached to a shared bus.
- Verify that disks attached to the shared bus can be seen from all nodes. This can be checked at the host adapter setup level. Please refer to the manufacturer's documentation for adapter-specific instructions.
- SCSI devices must be assigned unique SCSI identification numbers and properly terminated, as per manufacturer's instructions. See Appendix for information about installing and terminating SCSI devices.
- All shared disks must be configured as basic (not dynamic).
- All partitions on the disks must be formatted as NTFS.

While not required, the use of fault-tolerant RAID configurations is strongly recommended for all disks. The key concept here is fault-tolerant raid configurations—not stripe sets without parity.

Cluster Installation

Back to Top

Installation Overview

During the installation process, some nodes will be shut down and some nodes will be rebooted. These steps are necessary to guarantee that the data on disks that are attached to the shared storage bus is not lost or corrupted. This can happen when multiple nodes try to simultaneously write to the same disk that is not yet protected by the cluster software.

Use Table 1 below to determine which nodes and storage devices should be powered on during each step.

The steps in this guide are for a two-node cluster. However, if you are installing a cluster with more than two nodes, you can use the **Node 2** column to determine the required state of other nodes.

Table 1. Power Sequencing for Cluster Installation

Step	Node 1	Node 2	Storage	Comments
Setting Up Networks	On	On	Off	Verify that all storage devices on the shared bus are powered off. Power on all nodes.
Setting up Shared Disks	On	Off	On	Shutdown all nodes. Power on the shared storage, then power on the first node.
Verifying Disk Configuration	Off	On	On	Shut down first node, power on second node. Repeat for nodes 3 and 4 if necessary.
Configuring the First Node	On	Off	On	Shutdown all nodes; power on the first node.
Configuring the Second Node	On	On	On	Power on the second node after the first node was successfully configured. Repeat for nodes 3 and 4 if necessary.
Post-installation	On	On	On	At this point all nodes should be on.

Several steps must be taken before installing the Cluster service software. These steps are:

- Installing Windows 2000 Advanced Server or Windows 2000 Datacenter Server on each node.
- Setting up networks.
- Setting up disks.

Perform these steps on every cluster node before proceeding with the installation of Cluster service on the first node.

To configure the Cluster service on a Windows 2000-based server, your account must have administrative permissions on each node. All nodes must be member servers, or all nodes must be domain controllers within the same domain. It is not acceptable to have a mix of domain controllers and member servers in a cluster.

Installing the Windows 2000 Operating System

Please refer to the documentation you received with the Windows 2000 operating system packages to install the system on each node in the cluster.

This step-by-step guide uses the naming structure from the "Step-by-Step Guide to a Common Infrastructure for Windows 2000 Server Deployment". However, you can use any names.

You must be logged on as an administrator prior to installation of Cluster service.

Setting up Networks

Note: *For this section, power down all shared storage devices and then power up all nodes. Do not let both nodes access the shared storage devices at the same time until the Cluster service is installed on at least one node and that node is online.*

Each cluster node requires at least two network adapters—one to connect to a public network, and one to connect to a private network consisting of cluster nodes only.

The private network adapter establishes node-to-node communication, cluster status signals, and cluster management. Each node's public network adapter connects the cluster to the public network where clients reside.

Verify that all network connections are correct, with private network adapters connected to other private network adapters only, and public network adapters connected to the public network. The connections are illustrated in Figure 1 below. Run these steps on each cluster node before proceeding with shared disk setup.

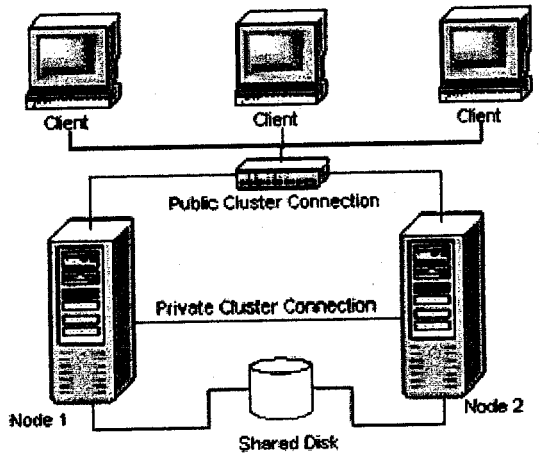


Figure 1. Example of two-node cluster

Configuring the Private Network Adapter

Perform these steps on the first node in your cluster.

1. Right-click **My Network Places** and then click **Properties**.

2. Right-click the **Local Area Connection 2** icon.

Note: *Which network adapter is private and which is public depends upon your wiring. For the purposes of this document, the first network adapter (Local Area Connection) is connected to the public network, and the second network adapter (Local Area Connection 2) is connected to the private cluster network. This may not be the case in your network.*

3. Click **Status.** The **Local Area Connection 2 Status** window shows the connection status, as well as the speed of connection. If the window shows that the network is disconnected, examine cables and connections to resolve the problem before proceeding. Click **Close**.

4. Right-click **Local Area Connection 2** again, click **Properties**, and click **Configure**.

5. Click **Advanced**. The window shown in Figure 2 should appear.

6. Network adapters on the private network should be set to the actual speed of the network, rather than the default automated speed selection. Select your network speed from the drop-down list. Do not use an Auto-select setting for speed. Some adapters may drop packets while determining the speed. To set the network adapter speed, click the appropriate option such as **Media Type** or **Speed**.

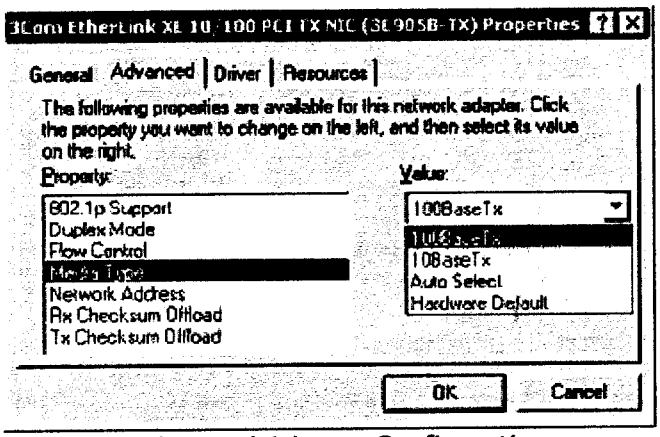


Figure 2. Advanced Adapter Configuration

All network adapters in the cluster that are attached to the same network must be identically configured to use the same **Duplex Mode**, **Flow Control**, **Media Type**, and so on. These settings should remain the same even if the hardware is different.

Note: *We highly recommend that you use identical network adapters throughout the cluster network.*

7. Click **Transmission Control Protocol/Internet Protocol (TCP/IP)**.

8. Click **Properties**.

9. Click the radio-button for **Use the following IP address** and type in the following address: **10.1.1.1**. (Use **10.1.1.2** for the second node.)

10. Type in a subnet mask of **255.0.0.0**.

11. Click the **Advanced** radio button and select the **WINS** tab. Select **Disable NetBIOS over TCP/IP**. Click **OK** to return to the previous menu. *Do this step for the private network adapter only.*

The window should now look like Figure 3 below.

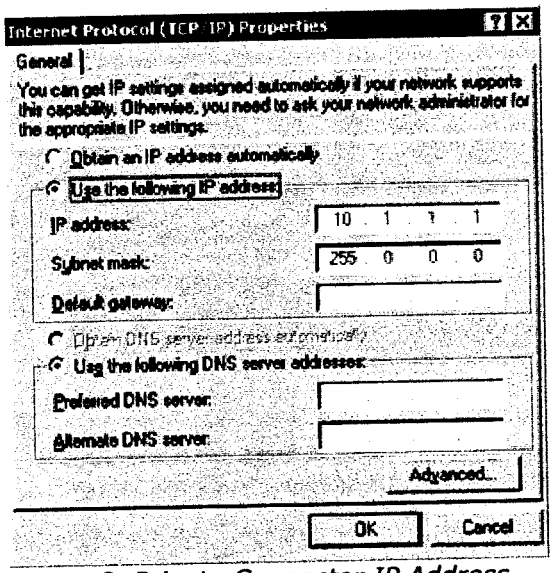


Figure 3. Private Connector IP Address

Configuring the Public Network Adapter

Note: *While the public network adapter's IP address can be automatically obtained if a DHCP server is available, this is not recommended for cluster nodes. We strongly recommend setting static IP addresses for all network adapters in the cluster, both private and public. If IP addresses are obtained via DHCP, access to cluster nodes could become unavailable if the DHCP server goes down. If you must use DHCP for your public network adapter, use long lease periods to assure that the dynamically assigned lease address remains valid even if the DHCP service is temporarily lost. In all cases, set static IP addresses for the private network connector. Keep in mind that Cluster service will recognize only one network interface per subnet. If you need assistance with TCP/IP addressing in Windows 2000, please see Windows 2000 Online Help.*

Rename the Local Area Network Icons

We recommend changing the names of the network connections for clarity. For example, you might want to change the name of *Local Area Connection (2)* to something like *Private Cluster Connection*. The naming will help you identify a network and correctly assign its role.

1. Right-click the **Local Area Connection 2** icon.
2. Click **Rename**.
3. Type **Private Cluster Connection** into the textbox and press **Enter**.
4. Repeat steps 1-3 and rename the public network adapter as **Public Cluster Connection**.

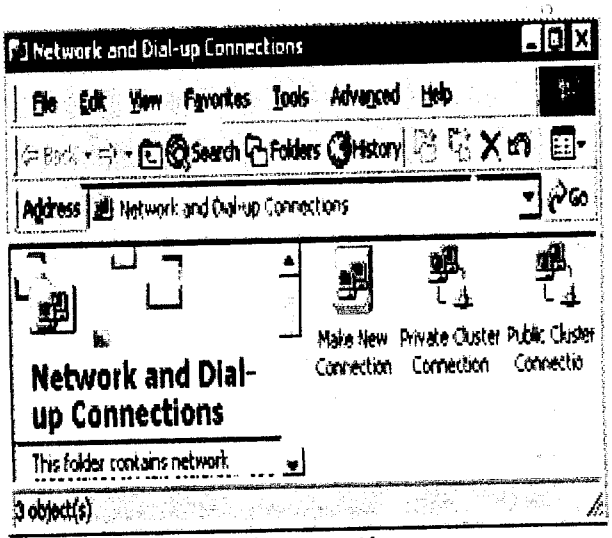


Figure 4. Renamed connections

5. The renamed icons should look like those in Figure 4 above. Close the **Networking and Dial-up Connections** window. The new connection names automatically replicate to other cluster servers as they are brought online.

Verifying Connectivity and Name Resolution

To verify that the private and public networks are communicating properly, perform the following steps for each network adapter in each node. You need to know the IP address for each network adapter in the cluster. If you do not already have this information, you can retrieve it using the ipconfig command on each node:

1. Click **Start,** click **Run** and type **cmd** in the text box. Click **OK**.

2. Type **ipconfig /all** and press **Enter**. IP information should display for all network adapters in the machine.

3. If you do not already have the command prompt on your screen, click **Start**, click **Run** and typing **cmd** in the text box. Click **OK**.

4. Type **ping ipaddress** where *ipaddress* is the IP address for the corresponding network adapter in the other node. For example, assume that the IP addresses are set as follows:

Node	Network Name	Network Adapter IP Address
1	Public Cluster Connection	172.16.12.12
1	Private Cluster Connection	10.1.1.1
2	Public Cluster Connection	172.16.12.14
2	Private Cluster Connection	10.1.1.2

In this example, you would type **ping 172.16.12.14** and **ping 10.1.1.2** from Node 1, and you would type **ping 172.16.12.12** and **10.1.1.1** from Node 2.

To verify name resolution, ping each node from a client using the node's machine name instead of its IP number. For example, to verify name resolution for the first cluster node, type **ping hq-res-dc01** from any client.

Verifying Domain Membership

All nodes in the cluster must be members of the same domain and able to access a domain controller and a DNS Server. They can be configured as member servers or domain controllers. If you decide to configure one node as a domain controller, you should configure all other nodes as domain controllers in the same domain as well. In this document, all nodes are configured as domain controllers.

Note: *See Related Links at the end of this document for links to additional Windows 2000 documentation that will help you understand and configure domain controllers, DNS, and DHCP.*

1. Right-click **My Computer**, and click **Properties**.
2. Click **Network Identification**. The System Properties dialog box displays the full computer name and domain. In our example, the domain name is **reskit.com**.
3. If you are using member servers and need to join a domain, you can do so at this time. Click **Properties** and follow the on-screen instructions for joining a domain.
4. Close the **System Properties** and **My Computer** windows.

Setting Up a Cluster User Account

The Cluster service requires a domain user account under which the Cluster service can run. This user account must be created before installing Cluster service, because setup requires a user name and password. This user account should not belong to a user on the domain.

1. Click **Start**, point to **Programs**, point to **Administrative Tools**, and click **Active Directory Users and Computers**.
2. Click the **+** to expand **Reskit.com** (if it is not already expanded).
3. Click **Users**.
4. Right-click **Users**, point to **New**, and click **User**.
5. Type in the cluster name as shown in Figure 5 below and click **Next**.

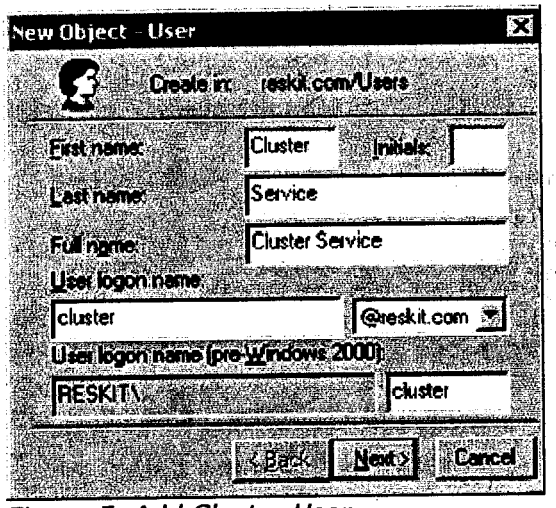


Figure 5. Add Cluster User

6. Set the password settings to **User Cannot Change Password** and **Password Never Expires**. Click **Next** and then click **Finish** to create this user.

   Note: *If your administrative security policy does not allow the use of passwords that never expire, you must renew the password and update the cluster service configuration on each node before password expiration.*

7. Right-click **Cluster** in the left pane of the Active Directory Users and Computers snap-in. Select **Properties** from the context menu.

8. Click **Add Members to a Group**.

9. Click **Administrators** and click **OK**. This gives the new user account administrative privileges on this computer.

10. Close the **Active Directory Users and Computers** snap-in.

Setting Up Shared Disks

Warning: *Make sure that Windows 2000 Advanced Server or Windows 2000 Datacenter Server and the Cluster service are installed and running on one node before starting an operating system on another node. If the operating system is started on other nodes before the Cluster service is installed, configured and running on at least one node, the cluster disks will probably be corrupted.*

To proceed, power off all nodes. Power up the shared storage devices and then power up node one.

About the Quorum Disk

The quorum disk is used to store cluster configuration database checkpoints and log files that help manage the cluster. We make the following quorum disk recommendations:

- Create a small partition [A minimum of 50 megabytes (MB) to be used as a quorum disk. We generally recommend a quorum disk to be 500 MB.]
- Dedicate a separate disk for a quorum resource. As the failure of the quorum disk would cause the entire cluster to fail, we strongly recommend you use a volume on a RAID disk array.

During the Cluster service installation, you must provide the drive letter for the quorum disk. In our example, we use the letter **Q**.

Configuring Shared Disks

1. Right click **My Computer**, click **Manage**, and click **Storage**.
2. Double-click **Disk Management**.
3. Verify that all shared disks are formatted as **NTFS** and are designated as **Basic**. If you connect a new drive, the **Write Signature and Upgrade Disk** Wizard starts automatically. If this happens, click **Next** to go through the wizard. The wizard sets the disk to dynamic. To reset the disk to Basic, right-click **Disk #** (where # specifies the disk you are working with) and click **Revert to Basic Disk**.
4. Right-click **unallocated disk space**.
5. Click **Create Partition...**
6. The **Create Partition** Wizard begins. Click **Next** twice.
7. Enter the desired partition size in MB and click **Next**.
8. Accept the default drive letter assignment by clicking **Next**.
9. Click **Next** to format and create partition.

Assigning Drive Letters

After the bus, disks, and partitions have been configured, drive letters must be assigned to each partition on each clustered disk.

Note: *Mountpoints is a feature of the file system that allows you to mount a file system using an existing directory without assigning a drive letter. Mountpoints is not supported on clusters. Any external disk used as a cluster resource must be partitioned using NTFS partitions and must have a drive letter assigned to it.*

1. Right-click the desired partition and select **Change Drive Letter and Path**.
2. Select a new drive letter.
3. Repeat steps 1 and 2 for each shared disk.

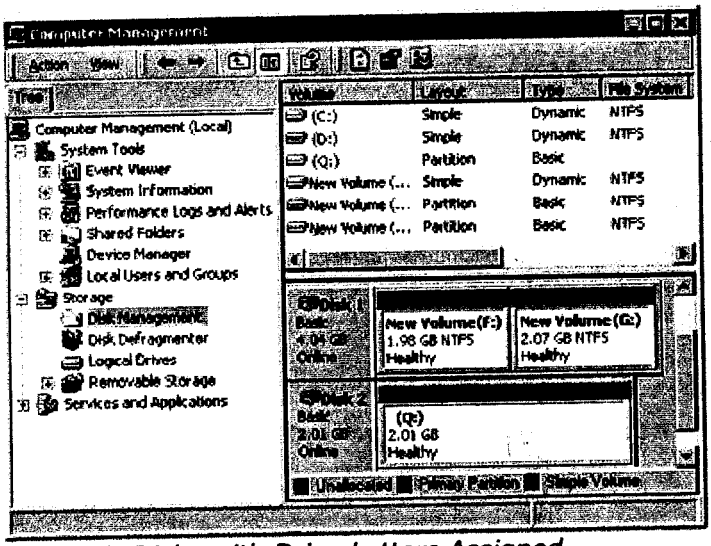


Figure 6. Disks with Drive Letters Assigned

4. When finished, the **Computer Management** window should look like Figure 6 above. Now close the Computer Management window.

Verifying Disk Access and Functionality

1. Click **Start**, click **Programs**, click **Accessories**, and click **Notepad**.
2. Type some words into Notepad and use the **File/Save As** command to save it as a test file called **test.txt**. Close Notepad.
3. Double-click the **My Documents** icon.
4. Right-click **test.txt** and click **Copy**.
5. Close the window.
6. Double-click **My Computer**.
7. Double-click a shared drive partition.
8. Click **Edit** and click **Paste**.
9. A copy of the file should now reside on the shared disk.
10. Double-click **test.txt** to open it on the shared disk. Close the file.
11. Highlight the file and press the **Del** key to delete it from the clustered disk.

Repeat the process for all clustered disks to verify they can be accessed from the first node.

At this time, shut down the first node, power on the second node and repeat the *Verifying Disk Access and Functionality* steps above. Repeat again for any additional nodes. When you have verified that all nodes can read and write from the disks, turn off all nodes except the first, and continue with this guide.

Install Cluster Service software

Back to Top

Configuring the First Node

Note: *During installation of Cluster service on the first node, all other nodes must either be turned off, or stopped prior to Windows 2000 booting. All shared storage devices should be powered up.*

In the first phase of installation, all initial cluster configuration information must be supplied so that the cluster can be created. This is accomplished using the **Cluster Service Configuration** Wizard.

1. Click **Start**, click **Settings**, and click **Control Panel**.
2. Double-click **Add/Remove Programs.**
3. Double-click **Add/Remove Windows Components**.
4. Select **Cluster Service**. Click **Next**.
5. Cluster service files are located on the Windows 2000 Advanced Server or Windows 2000 Datacenter Server CD-ROM. Enter **x:\i386** (where *x* is the drive letter of your CD-ROM). If Windows 2000 was installed from a network, enter the appropriate network path instead. (If the Windows 2000 Setup flashscreen displays, close it.) Click **OK**.
6. Click **Next**.
7. The window shown in Figure 7 below appears. Click **I Understand** to accept the condition that Cluster service is supported on hardware from the Hardware Compatibility List only.

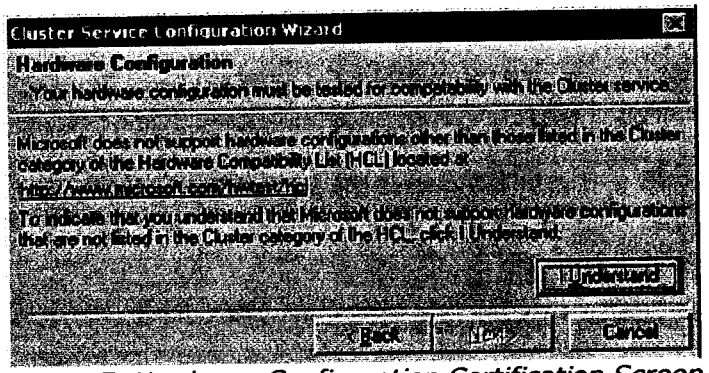


Figure 7. Hardware Configuration Certification Screen

8. Because this is the first node in the cluster, you must create the cluster itself. Select **The first node in the cluster**, as shown in Figure 8 below and then click **Next**.

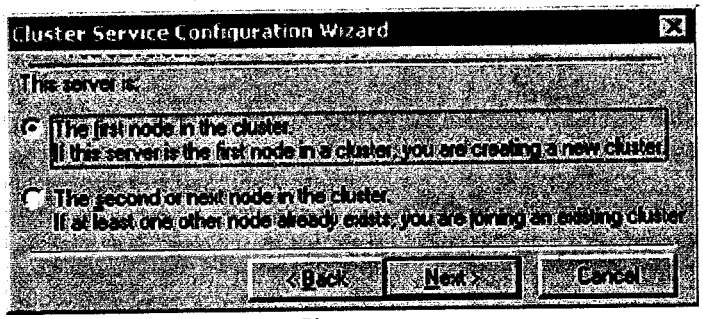


Figure 8. Create New Cluster

9. Enter a name for the cluster (up to 15 characters), and click **Next**. (In our example, we name the cluster **MyCluster**.)

10. Type the **user name** of the cluster service account that was created during the pre-installation. (In our example, this user name is **cluster**.) Leave the password blank. Type the **domain name**, and click **Next**.

Note: *You would normally provide a secure password for this user account.*

At this point the **Cluster Service Configuration** Wizard validates the user account and password.

11. Click **Next**.

Configuring Cluster Disks

Note: *By default, all SCSI disks not residing on the same bus as the system disk will appear in the Managed Disks list. Therefore, if the node has multiple SCSI buses, some disks may be listed that are not to be used as shared storage (for example, an internal SCSI drive.) Such disks should be removed from the Managed Disks list.*

12. The **Add or Remove Managed Disks** dialog box shown in Figure 9 specifies which disks on the shared SCSI bus will be used by Cluster service. Add or remove disks as necessary and then click **Next**.

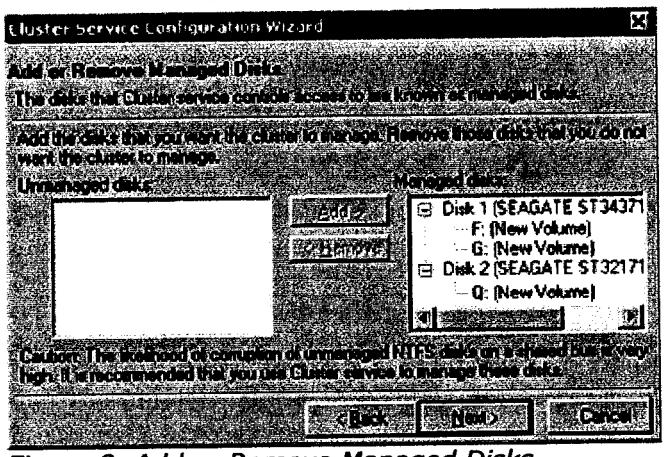


Figure 9. Add or Remove Managed Disks

Note that because logical drives F: and G: exist on a single hard disk, they are seen by Cluster service as a single resource. The first partition of the first disk is selected as the

quorum resource by default. Change this to denote the small partition that was created as the quorum disk (in our example, drive **Q**). Click **Next**.

In production clustering scenarios you must use more than one private network for cluster communication to avoid having a single point of failure. Cluster service can use private networks for cluster status signals and cluster management. This provides more security than using a public network for these roles. You can also use a public network for cluster management, or you can use a mixed network for both private and public communications. In any case, make sure at least two networks are used for cluster communication, as using a single network for node-to-node communication represents a potential single point of failure. We recommend that multiple networks be used, with at least one network configured as a private link between nodes and other connections through a public network. If you have more than one private network, make sure that each uses a different subnet, as Cluster service recognizes only one network interface per subnet.

This document is built on the assumption that only two networks are in use. It shows you how to configure these networks as one mixed and one private network.

The order in which the **Cluster Service Configuration** Wizard presents these networks may vary. In this example, the public network is presented first.

13. Click **Next** in the **Configuring Cluster Networks** dialog box.

14. Make sure that the network name and IP address correspond to the network interface for the *public* network.

15. Check the box **Enable this network for cluster use.**

16. Select the option **All communications (mixed network)** as shown in Figure 10 below.

17. Click **Next.**

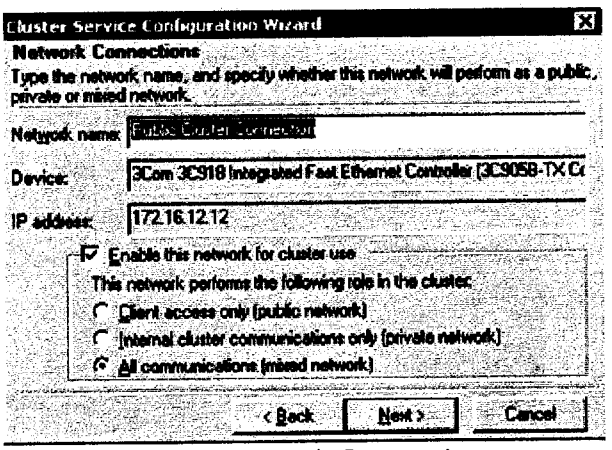


Figure 10.Public Network Connection

18. The next dialog box shown in Figure 11 configures the private network. Make sure that the network name and IP address correspond to the network interface used for the *private* network.

19. Check the box **Enable this network for cluster use.**

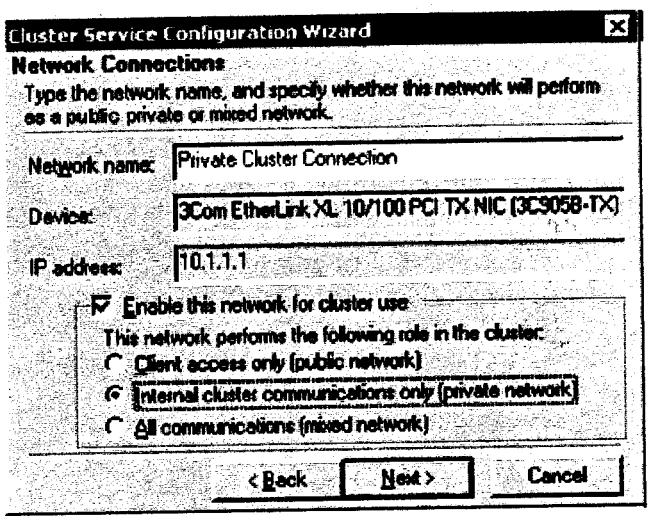


Figure 11. Private Network Connection

21. Click **Next**.

22. In this example, both networks are configured in such a way that both can be used for internal cluster communication. The next dialog window offers an option to modify the order in which the networks are used. Because **Private Cluster Connection** represents a direct connection between nodes, it is left at the top of the list. In normal operation this connection will be used for cluster communication. In case of the **Private Cluster Connection** failure, cluster service will automatically switch to the next network on the list—in this case **Public Cluster Connection**. Make sure the first connection in the list is the Private Cluster Connection and click **Next**.

Important: *Always set the order of the connections so that the Private Cluster Connection is first in the list.*

23. Enter the unique cluster **IP address (172.16.12.20)** and **Subnet mask (255.255.252.0)**, and click **Next**.

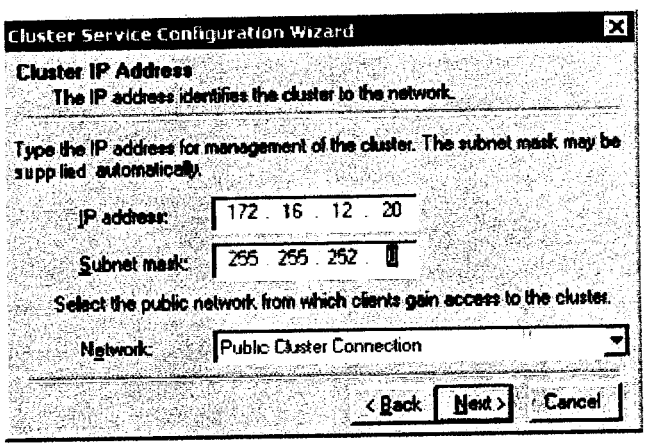


Figure 12. Cluster IP Address

The **Cluster Service Configuration** Wizard shown in Figure 12 automatically associates the cluster IP address with one of the public or mixed networks. It uses the subnet mask to select the correct network.

24. Click **Finish** to complete the cluster configuration on the first node.

The **Cluster Service Setup** Wizard completes the setup process for the first node by copying the files needed to complete the installation of Cluster service. After the files are copied, the Cluster service registry entries are created, the log files on the quorum resource are created, and the Cluster service is started on the first node.

A dialog box appears telling you that Cluster service has started successfully.

25. Click **OK**.

26. Close the **Add/Remove Programs** window.

Validating the Cluster Installation

Use the Cluster Administrator snap-in to validate the Cluster service installation on the first node.

1. Click **Start,** click **Programs**, click **Administrative Tools**, and click **Cluster Administrator**.

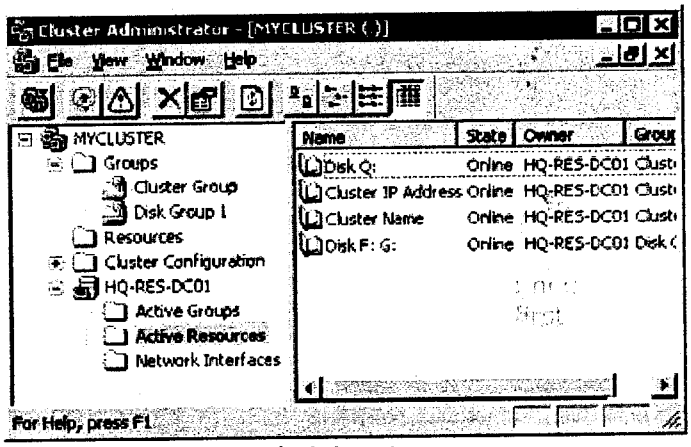


Figure 13. Cluster Administrator

If your snap-in window is similar to that shown above in Figure 13, your Cluster service was successfully installed on the first node. You are now ready to install Cluster service on the second node.

Configuring the Second Node

Note: *For this section, leave node one and all shared disks powered on. Power up the second node.*

Installing Cluster service on the second node requires less time than on the first node. Setup configures the Cluster service network settings on the second node based on the configuration of the first node.

Installation of Cluster service on the second node begins exactly as for the first node. During installation of the second node, the first node must be running.

Follow the same procedures used for installing Cluster service on the first node, with the following differences:

1. In the **Create or Join a Cluster** dialog box, select **The second or next node in the cluster**, and click **Next**.
2. Enter the cluster name that was previously created (in this example, **MyCluster)**, and click **Next**.
3. Leave **Connect to cluster as** unchecked. The **Cluster Service Configuration** Wizard will automatically supply the name of the user account selected during the installation of the first node. Always use the same account used when setting up the first cluster node.
4. Enter the password for the account (if there is one) and click **Next**.
5. At the next dialog box, click **Finish** to complete configuration.
6. The Cluster service will start. Click **OK**.
7. Close **Add/Remove Programs**.

If you are installing additional nodes, repeat these steps to install Cluster service on all other nodes.

Verify Installation

Back to Top

There are several ways to verify a successful installation of Cluster service. Here is a simple one:

1. Click **Start**, click **Programs**, click **Administrative Tools**, and click **Cluster Administrator**.

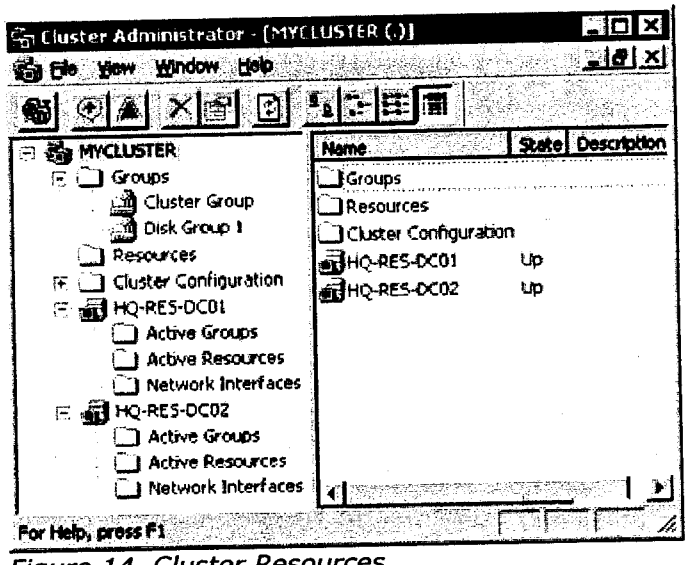


Figure 14. Cluster Resources

The presence of two nodes (HQ-RES-DC01 and HQ-RES-DC02 in Figure 14 above) shows that a cluster exists and is in operation.

2. Right-Click the group **Disk Group 1** and select the option **Move**. The group and all its resources will be moved to another node. After a short period of time the **Disk F: G:** will be brought online on the second node. If you watch the screen, you will see this shift. Close the **Cluster Administrator** snap-in.

Congratulations. You have completed the installation of Cluster service on all nodes. The server cluster is fully operational. You are now ready to install cluster resources like file shares, printer spoolers, cluster aware services like IIS, Message Queuing, Distributed Transaction Coordinator, DHCP, WINS, or cluster aware applications like Exchange or SQL Server.

Appendix: SCSI Drive Installations

Back to Top

This appendix is provided as a generic instruction set for SCSI drive installations. If the SCSI hard disk vendor's instructions conflict with the instructions here, always use the instructions supplied by the vendor.

The SCSI bus listed in the hardware requirements must be configured prior to installation of Cluster services. This includes:

- Configuring the SCSI devices.
- Configuring the SCSI controllers and hard disks to work properly on a shared SCSI bus.
- Properly terminating the bus. The shared SCSI bus must have a terminator at each end of the bus. It is possible to have multiple shared SCSI buses between the nodes of a cluster.

In addition to the information on the following pages, refer to the documentation from the manufacturer of the SCSI device or the SCSI specifications, which can be ordered from the American National Standards Institute (ANSI). The ANSI web site contains a catalog that can be searched for the SCSI specifications.

Configuring the SCSI Devices

Each device on the shared SCSI bus must have a unique SCSI ID. Since most SCSI controllers default to SCSI ID 7, part of configuring the shared SCSI bus will be to change the SCSI ID on one controller to a different SCSI ID, such as SCSI ID 6. If there is more than one disk that will be on the shared SCSI bus, each disk must also have a unique SCSI ID.

Some SCSI controllers reset the SCSI bus when they initialize at boot time. If this occurs, the bus reset can interrupt any data transfers between the other node and disks on the shared SCSI bus. Therefore, SCSI bus resets should be disabled if possible.

Terminating the Shared SCSI Bus

Y cables can be connected to devices if the device is at the end of the SCSI bus. A terminator can then be attached to one branch of the ***Y*** cable to terminate the SCSI bus. This method of termination requires either disabling or removing any internal terminators the device may have.

Trilink connectors can be connected to certain devices. If the device is at the end of the bus, a trilink connector can be used to terminate the bus. This method of termination requires either disabling or removing any internal terminators the device may have.

Y cables and trilink connectors are the recommended termination methods, because they provide termination even when one node is not online.

Note: *Any devices that are not at the end of the shared bus must have their internal termination disabled.*

Related Links

Back to Top

Part 2: Installing a Windows 2000 Professional Workstation and Connecting it to a Domain

- Windows 2000 Server Online Help
- Windows 2000 Planning and Deployment Guide
- Exploring Cluster Services & Load Balancing
- Windows 2000/NT Forum
- Windows 2000 Resource Kit

Last Updated: Monday, March 13, 2000

Appendix E
Exchange Server Planning and Upgrading

Microsoft
Exchange Server

Planning Your Implementation of Microsoft Exchange Server

White Paper

Abstract
This paper is a guide to help customers prepare for their implementation of Microsoft® Exchange Server. It defines a twelve-step process that customers should consider prior to implementation. From assessing users' needs to rolling out the plan, this paper is designed to assist customers in the planning, optimizing and piloting of their design. Readers should note that the intent of the guide is to highlight key considerations but should not be considered a substitution for the Microsoft Exchange Server documentation.

Microsoft Corporation • One Microsoft Way • Redmond, WA 98052-6399 • USA

0199

Table of Contents

Planning Your Implementation of Microsoft Exchange Server

White Paper

Published: September 1998

For the latest information, please see http://www.microsoft.com/exchange/

Introduction

Customers have been clear—they want a powerful yet manageable corporate messaging system to improve all forms of communications. Implementing such a system requires planning. This paper presents you with the essential factors in the planning process to help you successfully implement Microsoft® Exchange Server.

Planning and design optimization is an iterative process. There is no one perfect design for every company. Your implementation of Microsoft Exchange Server will require continual fine-tuning as your organization grows and your utilization of Microsoft Exchange Server expands.
For the purposes of this document we have defined the planning and design optimization process to consist of twelve steps. Every company may not be required to go through all twelve steps; for smaller businesses that have just a few servers, the planning process may be very simple, while for larger, global companies, the planning processes could be very involved. A number of planning issues, however, are common for both the large and small business, and hence, we trust that everyone will find value in reading and applying the information that is contained in this document.

The twelve steps we have defined are as follows:

Step 1: Assessing user needs What types of applications and services will your users require?
Step 2: Identifying your company's geographical profile Is your company in one city, one country, or is it worldwide?
Step 3: Choosing names What naming scheme will you use for your organization, sites, servers, mailboxes, distribution lists, public folders, and custom recipients?

Step 4: Assessing the underlying network What is the available network type and bandwidth? What protocols, transports and operating systems are being used?
Step 5: Choosing a Windows NT domain topology What is the appropriate Microsoft Windows NT® operating system domain topology for your organization?
Step 6: Determining the number of sites and site boundaries Based on factors such as network bandwidth, network traffic, cost, performance and the Windows NT domain model, what is the appropriate number of sites and appropriate size for each site in your organization?
Step 7: Linking sites What type of link will you use to connect sites? How will you connect your sites?
Step 8: Planning sites How many servers will each site have?
Step 9: Planning servers What are the hardware requirements for each server?
Step 10: Planning connections to other systems What type of connectivity to other systems do users need?
Step 11: Validating and optimizing the design How do you validate and optimize your design?
Step 12: Rolling out the plan What steps are required to implement the plan?

Part I: Designing Your Microsoft Exchange Server Topology

Part 1 of this white paper details the 12-step process. Part 2 explores steps 8 and 9 in greater detail.

Terms and Definitions

Microsoft Exchange Server: Includes the Microsoft Exchange Server directory service, information store, and message transfer agent. Microsoft Exchange Server is hosted on a computer that runs Windows NT Server version 3.51 or later.

Microsoft Exchange Server site: A group of one or more Microsoft Exchange Servers. All servers within a site must be able to establish synchronous remote procedure call (RPC) connections. The Microsoft Exchange Server site can be mapped to the Windows NT domain topology that you have already established. It can also span multiple trusted Windows NT domains that may already exist.

Microsoft Exchange Server organization: The aggregate of the Microsoft Exchange Server sites.

In the context of Microsoft Exchange Server, a Microsoft Exchange Server organization consists of Microsoft Exchange Server computers that are grouped together into sites. Designing a Microsoft Exchange Server topology is the process of conceiving and drawing plans for the number of sites, site boundaries, number of servers per site, and the links between them.
Designing a Microsoft Exchange Server organization—one with a logical number of sites, each of an appropriate size and connected by adequate links—requires a detailed analysis and basic understanding of various factors. These include the available network bandwidth, type of physical links, amount of internetwork traffic, types of network transports and protocols, operating systems in use, and costs.

Part 1 of this white paper provides a model for the planning and design optimization process. Use it as a guide in designing your own Microsoft Exchange Server topology.

Step 1: Assessing User Needs

The first step of implementing Microsoft Exchange Server is to identify the types of applications and services your users require, such as e-mail, calendaring, public folders, and connections to the Internet. After identifying user needs, you can associate them with the features available in Microsoft Exchange Server. You can then use this data to determine how to categorize users; the software, hardware, and training they need; the amount of server disk space they need; the type of public folders to be implemented; the amount of traffic they'll generate (based on message volume); and so on.

For instance, if you expect your users to be heavy public folder users, you may want to dedicate specific Microsoft Exchange Servers to act as public folder/bulletin board servers. That makes it easier to manage and back up public folder resources while providing better performance to those users just accessing the email facilities of Microsoft Exchange Server.

Step 2: Identifying your Company's Geographic Profile

The geographic profile includes all locations where your company has a facility. It can be clustered in a small region or dispersed over a large geographic area. Use a map or diagram to identify the geographic profile for your company. This is useful as a visual aid for identifying physical locations, types of users at each location, and available network connections.

Step 3: Defining the Naming Conventions

Each object in the directory is uniquely identified by a name (the Distinguished Name) and you must provide the site and organization names when you install and configure Microsoft Exchange Server. A good naming strategy is one that makes it easy for you to add and identify sites, servers, gateways, connectors, users, and all of the other objects. You can base your naming conventions on geography, company structure, building numbers, and so on.

The Microsoft Exchange Server directory-naming scheme has three levels. The first two (organization [O] and organizational unit [OU]) correspond to the organization and site names and have special meaning to the X.500 naming hierarchy. They also map to the PRMD and organization (O) X.400 address elements. All other directory objects are considered X.500 common names (the third level).

X.500	X.400	Microsoft Exchange Server
Country	Country	Country
Organization	PRMD	Organization
Organizational Unit	Organization	Site name
Common Name		Microsoft Exchange Server Recipient Container
Common Name	Surname, Given Name	Microsoft Exchange Server Recipient

Planning the naming conventions for your organization before you install and configure the system is important. Meaningful and logical names make it easy to both use and administer the system. It also minimizes rework due to unplanned name changes.

More About Distinguished Names

All directory objects are uniquely identified by a distinguished name that has a series of components identifying the full name, organizational unit, organization, and country. The directory objects are arranged in a hierarchical structure known as the directory information tree (DIT). The distinguished names and the DIT are based upon conventions used in the X.500 specification.

Example

The Distinguished Name for David Madison's mailbox (Davidmad) is:

o=FAB/ou=NAmerica-W/cn=recipients/cn=davidmad

where:

o (organization) = organization name (FAB)

ou (organizational unit) = site name (NAmerica-W)

cn (common name) = recipients container (recipients)

cn (common name) = mailbox name (Davidmad)

The distinguished name can be abbreviated by removing the labels from the naming components:

FAB/NAmerica-W/recipients/Davidmad

More About X.400 Addresses

Microsoft Exchange Server supports X.400 addressing, allowing other X.400 messaging systems to communicate directly with it. The X.400 address identifies a Microsoft Exchange Server recipient in the global X.400 address space. When a user sends a message to a Microsoft Exchange Server recipient, the users will typically select the recipient's name from the Address Book, implicitly supplying the directory distinguished name. Alternatively, the originator can supply the X.400 address of the recipient by typing it directly.

A valid X.400 address can contain any of the following hierarchically ordered attributes (the first three are required):

Country (c)
Administrative management domain or ADMD (a)
Private management domain or PRMD (p)
Organization (o)
Organizational units (ou1, ou2, ou3, and ou4)
Common name (cn)
Generation qualifier (q)
Initials (i)
Surname (s)
Given Name (g)

Example of a valid X.400 address:

X.400:g=Aaron;s=Con;o=NAmerica-W;p=FAB;a=mci;c=us

Organization Name

(See also section on Foreign E-Mail Addresses)

Choose an organization name that encompasses your entire enterprise. It must be unique and cannot be changed. When choosing an organization name, be aware that it is used to generate foreign e-mail addresses and the distinguished names of all directory objects such as mailboxes, public folders, and distribution lists. Organization names can contain up to 64 characters but for practical reasons, you may want to use names that are less than ten characters. This is especially true if you are connecting to legacy systems.

Site Names

Sites can be named by geographical location (countries, regions, and cities), by physical location (buildings), or by function. The latter is a useful model for accounting purposes in internal divisions. Like the organization name, site names must be unique, cannot be changed, and are used to generate foreign email addresses and directory names. Site names can contain up to 64 characters but like the organization name, you may want to choose site names that are less than ten characters especially if you are connecting to legacy systems.

Server Names

The Setup program uses the Windows NT Server computer name for the Microsoft Exchange Server server name. It is important to plan the names you want to use for your Microsoft Exchange Server computers before you install Microsoft Windows NT Server. Server names must be unique and cannot be changed without reinstalling Microsoft Exchange Server. They can contain up to 15 characters and cannot include any of the following characters:

Restricted Character	Name
.	Bullet
¤	Currency sign
¦	Broken vertical bar
§	Section sign
¶	Paragraph sign

If you are going to run logon scripts, do not use spaces in the computer names of the domain controllers.

Mailboxes Names

Choose mailbox names that are easy to identify based on your company standards for phone and address books. You might also want to consider coordinating mailbox name conventions with the naming scheme used for Windows NT user accounts or for previous e-mail systems.

When you configure a mailbox, you must specify names for different fields:

Field	Guideline	Restrictions
First Name	The user's first name.	Up to 16 characters. Can be changed.
Last Name	The user's last name.	Up to 40 characters. Can be changed.
Alias Name	A short name to identify the user. This name can be automatically generated when the first and last names are entered. The administrator can customize how the directory name is created through the Tools Option menu.	Up to 64 characters. Can be changed.
Display Name	The mailbox name as you want it displayed in the Administrator window and in the Address Book. For example, you can use First Name Last Name (Daniel Shelly), Last Name, First Name Initial. (Shelly, Daniel B. or Initial Last Name (DShelly). Whatever you use, be consistent so that all mailboxes are display in the same fashion. The display name is a mandatory field and can be automatically created when the first and last name fields are entered.	Up to 256 characters. Can be changed.
Directory Name	The name Microsoft Exchange Server uses to permanently identify an object in the directory service and to route messages. This name is for internal purposes only and it has no impact on how it's displayed to users (Address Book) or the administrator (Administrator window). It will automatically be created from the alias name if the directory name is not entered.	Up to 64 characters. Must be unique. Cannot be changed.

Mailboxes can be used to display resources such as conference rooms in the Address Book. If you intend to use them this way, use consistent names to display these resources. For example, if you use them for conference room, you can display them as conference room, building (size of room) as in Tahoe conference room, 2A (20). Whatever you decide, use the same conventions for all resources.

Foreign E-mail Addresses

To communicate with foreign mail systems, Microsoft Exchange users (recipients) must have an address in a format that the foreign system can understand. Similarly, users in a foreign system must be represented in Microsoft Exchange. A custom recipient is a user whose address is on a foreign mail system.

A *foreign e-mail address* is the address by which Microsoft Exchange recipients (mailboxes, distribution lists, public folders, and custom recipients) are known to foreign mail systems. Based on the site address, Microsoft Exchange automatically generates an MS Mail (PC), X.400, and Internet address for each

recipient. You can use the E-Mail Addresses property sheet on each recipient object to create, modify, or remove foreign e-mail addresses.

Gateways will use the Alias Name field to generate foreign email addresses. Different gateways will have different limits for the generated addresses.

X.400 Addresses

Here are the allowed characters in an X.400 address (X.400 O/R names). These characters are called a Printable String type according to the X.208 Recommendation.

Character	Designation
A, B, ¼, Z	Capital letters
a, b, ¼, z	Small letters
0, 1, ¼, 9	Digits
(space)	Space
'	Apostrophe
(	Left parenthesis
)	Right parenthesis
+	Plus sign
,	Comma
-	Hyphen
.	Full stop
/	Solidus
:	Colon
=	Equals sign
?	Question mark

SMTP

If your enterprise will be connected to the Internet or other SMTP systems, consider any character restrictions that SMTP imposes on its addressing scheme. For example, you can use lower and upper-case letters (a-z and A-Z) (no distinction is made between lowercase and uppercase characters), numbers (0-9), and the hyphen (-).

Step 4: Assessing the Underlying Network

The underlying network is one of the most important factors affecting your Microsoft Exchange Server topology and its configuration. As a result, it is extremely important to understand all aspects of it. Site boundaries, site links, message routing, directory replication, and system administration are some of the areas affected by network topology. The key elements are:

- Network size
- Network bandwidth
- Network type and links

- Network traffic patterns
- Network transports and protocols

Network Size

A Microsoft Exchange Server organization can span networks of different sizes: a single local area network (LAN) that connects a few computers for sharing files and printers; a mixed internetwork of LANs that connects computers company-wide; a metropolitan area network (MAN) that connect LAN segments within a campus, industrial park, or city; or a wide area network (WAN) that links all the computers of a global company.

Designing and configuring networks of different sizes requires different considerations. For example, for a large network you may need to set up multiple sites; you should consider how to move data—such as replicating directories and public folders between sites—over WAN links; and you need to configure the organization to provide the information and messaging services (such as local access to public folders) at the LAN level, where users create and receive information. On the other hand, a small company with a small network may have just one or very few sites, so it may not require considerations such as how data will be replicated over a WAN link.

Network Bandwidth

Network bandwidth is the data transmission capacity of a network link. Within a site, servers generally require higher bandwidth, synchronous remote procedure call (RPC) connections. Between sites, Microsoft Exchange Servers communicate via store-and-forward mail connections that can require less bandwidth. When configuring links between sites, an awareness of the available bandwidth will enable you to choose the most appropriate site link (site or X.400 connector), set directory and public folder replication schedules, and establish costs.

More about Remote Procedure Calls (RPCs)

Within a site, all Microsoft Exchange Server services communicate through Remote Procedure Calls (RPCs). RPCs can use named pipes, NetBIOS or Windows® Sockets to communicate with remote systems. This allows servers to communicate with each other efficiently and independently of the type of network. RPC supports the following network protocols transparently:

- IPX/SPX through Microsoft NWLink
- NetBEUI
- TCP/IP

Net Available Bandwidth

Net available bandwidth is the effective bandwidth that is available after bandwidth consumption by other applications is considered. The net available bandwidth on a network link between two servers—not the total available bandwidth—is the decisive factor for determining whether servers can be placed at the same site. Both the bandwidth and available bandwidth are important

considerations as you plan your company's deployment of Microsoft Exchange Server.

For example, if you have applications that must coexist with Microsoft Exchange Server on the same network, you should be aware of bandwidth consumption by each application. With Microsoft Exchange Server, you should also take into account the bandwidth that could be consumed if users attach large voice, video, and image files to their messages (messages themselves consume little bandwidth compared to these attachments). Network protocols that require back-forth acknowledgments or broadcasts can also contribute to bandwidth consumption.

Microsoft Exchange Server's client/server architecture provides an excellent way to make better use of network bandwidth because data is processed on the Microsoft Exchange Server and only the results are transmitted. This compares to file-based systems that transfer data files back-and-forth over a link.

Costs

In addition to ensuring that network links between servers have enough bandwidth to handle the common load due to message traffic, bursts in traffic, and public folder and directory replication traffic, you should also consider the costs of providing that bandwidth.
To provide some guidelines and examples of bandwidth costs, this table lists the approximate costs for connecting to the Internet over some common network links in the United States. The cost is based on bandwidth and availability. For example, both the PPP (point to point protocol) dial-up lines and dedicated PPP lines have the same bandwidth (up to the speed of the modem used.) However, dedicated PPP lines are more expensive because they are available 24 hours a day.

The values on the following table are valid in the United States but may not be valid in other countries. They are provided for illustration purposes only.

Network link	Bandwidth	Approximate cost
PPP dial-up line	modem speed (2.4, 19.2, to 38.4 Kb/s)	$20-30 per month
SLIP dial-up line	modem speed	$20-30 per month
Dedicated PPP/SLIP	modem speed	$200-300 per month
56K line	56 Kb/s	$150-300 per month
PPP ISDN	128 Kb/s	$70-100 per month plus equipment
T1	1.544 Mb/s	$1,500-2,000 per month
T3	44.184 Mb/s	$65,000-80,000 per month

Network Type and Links

There are different types of networks and methods to link them. This section will help you determine your site boundaries.

Characteristics of Common Network Links

The following tables list the most common network links and group them in three categories: low-to-medium bandwidth, medium-to-high bandwidth, and very high bandwidth. Generally, sites should be designed so their servers can connect through links in the medium-to-high and very high bandwidth range. Be aware that some of these links are available in ranges of bandwidth rather than just at a discrete bandwidth. For example, frame relay links come in a range from 64 to 512 Kb/s. if you have a frame relay connection between two servers at 64 Kb/s, consider placing them in different sites. On the other hand, if they are connected at 512 Kb/s, consider placing them in the same site.

Low-to-medium bandwidth connections

Network link	Bandwidth	Common use	Description
Dial-up phone line	2.4 , 19.2, to 38.4 Kb/s	Single user, remote connections to LANs and WANs	Copper, voice-grade wire. Bandwidths of up to 38.4 Kb/s are possible with high-speed modems configured with the same encoding and compression technology on both ends.
X.25 (leased lines)	19.2, 56, and 64 Kb/s	WANs	Provides permanent connections between LAN segments. X.25 is an international standard for sending packets over public data networks. Access to an X.25 network is through leased or dial-up lines.
Frame relay (leased lines)	64 to 512 Kb/s	WANs	Provides permanent connections between LAN segments. Frame relay is a method for sending packets over private and public data networks. It provides better performance than X.25 because it reduces some of the overhead used in X.25. Sprint, CompuServe, Tymenet, Williams Telecommunications, and other carriers offer frame relay services.
Fractional T-1	64 Kb/s	WANs and redundant links	A fraction of a T-1 line. Fractional T-1 allows people to buy T1 service in 64 Kb/s at an affordable price. Channels can be added to expand bandwidth up to a full T-1 line.

Medium-to-high bandwidth connections

Network link	Bandwidth	Common use	Description
Integrated Services Digital Network (ISDN)	128 to 150 Kb/s	LANs and WANs	High-speed, digital dial-up lines based on the Integrated Services Digital Network standard. Personal computers users benefit the most from these lines. They provide connections to data services, databases, and international networks at reasonably fast rates.
T-1	1.544 Mb/s	High-use WAN links	A high-quality digital line that runs over two twisted copper wires. T1 is commonly used to build private voice and data networks. Its bandwidth of 1.544 Mb/s can be divided into 24 64 Kb/s channels each carrying one voice or data transmission.
ArcNet	2.5 Mb/s	LANs	ArcNet links have a star or bus topology and use a token-passing access method with coaxial cable.
Token Ring	4 or 16 Mb/s	LANs	Token Ring links have star and ring topologies and use a token-passing access method with shielded or unshielded twisted-pair cable.

Network link	Bandwidth	Common use	Description
Thin Ethernet	10 Mb/s	Single LANs	Thin Ethernet links have a linear bus topology and use a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method with thin or twisted-pair cable.
Thick Ethernet	10 Mb/s	Multiple LANs	Same as thin Ethernet but with thick cable.
Fiber optic	10 to 100 Mb/s	High-use MAN links	Fiber optic cable that usually follows the Fiber Distributed Data Interface (FDDI) standard. It is used as backbone connections in MANs. Large networks with many LAN segments and heavy traffic benefit from FDDI fiber optic cable.

Very high bandwidth connections

Network link	Bandwidth	Common use	Description
Satellite connections	128 Kb/s to 1.544 Mb/s	Wireless WANs (many use them as backup connections)	Wireless connections that provide global data links. AT&T Tridom, Comsat General Corporation, and GTE Spacenet Corporation offer satellite links.
Microwave connections	1.544 Mb/s	Wireless LANs	Wireless connections that use waves at the microwave frequency.
T-3	44.184 Mb/s	High-use WAN links	Similar to T1 but it has higher bandwidth and can be divided into 28 T1 channels.
Synchronous Optical Network (SONET)	51.8 Mb/s to 2.5 GB/s	WANs	High-speed, fiber-optic connections defined by the SONET set of standards. SONET is an underlying transport network (similar to Ethernet) with a maximum bandwidth that is equivalent to 48 T3 lines.
Asynchronous Transfer Mode (ATM)	100, 200, and 400 Mb/s up to 9.6 GB/s	WANs LAN-to-WAN connections	Data transfer technology that provides a way to simultaneously send packets of information from many sources across a high-speed line, where it is reassembled and transferred to each destination point. ATM supports voice and video. ATM can be used on existing fractional T-1, T-1, T-3, and SONET as its physical medium.

Network Traffic Patterns

Network traffic is the amount of data that travels through a link. Network traffic patterns are predictable trends of data flow through a link over a period of time. Knowing or predicting network traffic patterns through a link allows you to determine whether the total available bandwidth will be enough to sustain bursts of traffic during heavy use of the network.

If network traffic exceeds the available network bandwidth, client/server response becomes unpredictable. To prevent this, monitor network traffic by measuring the network bandwidth utilization (how close a network link is to full capacity) and total packets per second (how close bridges and routers are to reaching full capacity.)

Monitoring network traffic requires specialized tools such as dedicated network monitoring software (such as Microsoft System Management Server) or a packet sniffer. On small networks, the Windows NT Performance Monitor can be used to monitor certain counters to get an idea of the traffic generated by certain processes. Here are examples of some useful counters.

This counter	Measures	Use it to estimate
Bytes Total/sec	The number of bytes per second that each server sends and receives	The overall network traffic to that server and compare it to the maximum available bandwidth for that link. If the sum is close to the maximum available bandwidth, you will know that link is reaching is maximum capacity and you should add a new segment to the network.
Messages/sec (MSExchangeMTA)	The number of P1 messages processed by the MTA per second.	The amount of traffic generated by message flow (number of messages.)
Message Bytes/sec (MSExchangeMTA)	The content size of P1 messages in bytes processed by the MTA per second.	The amount of traffic based on message size.
Reads/sec (MSExchangeDS)		The amount of traffic generated by directory replication.

Network Transports and Protocols

For your topology design, you should know what type of network transports you have so you can configure the site links (site, RAS or X.400 connector) appropriately.

For example, configuring site connectors in the Administrator program does not require knowledge or configuration of network transports because all communications happen over remote procedure calls (RPCs). The X.400 connector, on the other hand, requires knowledge of the network transport as it only works over TP0/X.25, TP4/CLNP or TCP/IP.

Another consideration is support for remote clients, for which RAS can be used. RAS supports the PPP (point to point) protocol that enables any client to use TCP/IP, IPX, or NetBEUI. RAS clients can dial in using standard telephone lines, a modem, or a modem pool.

Step 5: Choosing a Windows NT Domain Topology

Microsoft Exchange Server relies on Windows NT security to authenticate users and Microsoft Exchange Server services. It is important to choose a Windows NT domain model (or study the existing model) carefully because:

- It is very difficult to change a domain structure once it is implemented.
- Site boundaries depend on the domain structure in place. If sites span more than one domain, these domains must trust each other so users and Microsoft Exchange Server services can be authenticated across the site.
- You should be aware of how user accounts and global groups from one domain can be used in another domain, if at all.

More About Domains and Trust Relationships

A *domain* is a group of servers that share common security policy and user account databases. Therefore, it is only necessary to create one account per domain. The domain can contain single or multiple Windows NT Server computers. It can also contain other types of servers (such as Microsoft LAN Manager version 2.*x* servers) and clients (such as Windows NT Workstation, Windows for Workgroups, and MS-DOS®-based clients.)

You can simplify account management by establishing a *trust relationships* between domains. A trust relationship is the link between two domains that enables a user with an account in one domain to access resources on another domain. Users from the trusted domain can be given rights and permissions to objects in the trusting domain just as if they were members of the trusting domain. When domain A trusts domain B, it allows domain B to return to domain A a list of global groups and information about users who are authenticated in domain B.

Choosing a Windows NT Domain Model

There are four Windows NT domain models: single domain model, master domain model, multiple master domain model, and complete trust model. The appropriate model depends on your administrative resources and the size of your network. If a domain model is already in place, determine which one, how it is structured, how trust relationships are set up, why that model was chosen, and where the domain controllers are located.

Within each domain, there is a class of Windows NT Server computers that authenticate logon requests: the domain controllers.

More About Domain Controllers

Primary Domain Controller (PDC)

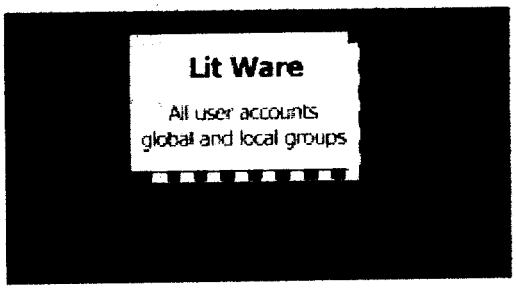
The PDC stores and maintains the security database for the domain. All changes to the security database must be done on the copy stored on the PDC. There can only be one PDC per domain.

Backup Domain Controller (BDC)

The backup domain controller also stores copies of the domain's security database and serves as a substitute when a PDC goes down. If this occurs, one of the backup domain controllers can be promoted to PDC. Because the PDC replicates all changes to the backup domain controllers automatically, the backup domain controller will have an up-to-date database, and the domain will continue to function.

Single Domain Model

The Windows NT single domain model is the simplest Windows NT security domain model. As its name implies, the network in this model has only one domain in which all Windows NT users are created. No trust relationships are necessary. This model is best for organizations with fewer than 10,000 users in which trust among the organizational groups (departments, divisions, and so on) is not an issue. However, if you anticipate growth in your organization, you might want to consider the multiple master model.

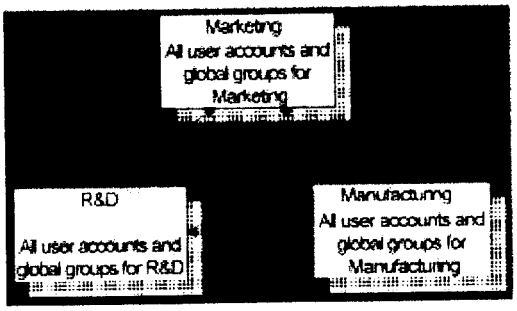


Advantages	Disadvantages
Best model for companies with few users and resources.	Poor performance if the domain has too many users and groups.
Centralized management of Windows NT user accounts.	No grouping of users into departments.
No trust relationships to administer.	No grouping of resources.
Windows NT local groups should be defined only once.	Browsing is slow if the domain has a large number of servers.

Complete Trust Domain Model

The Windows NT complete trust domain is a good model for companies that want to distribute management of users and domains among different departments. In this model, every domain on the network trusts every other domain.

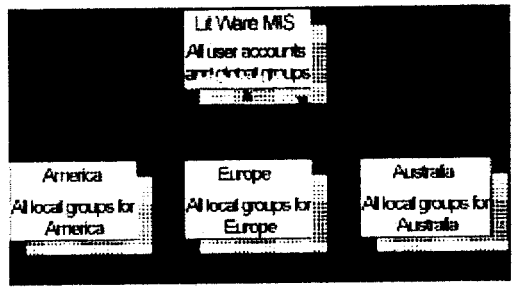
This model can support up to 10,000 users for each domain. So, for example, if you have three domains, it can support up to 30,000 users. Because each domain has full control over its own user accounts, this model works well for organizations without centralized management. It is, however, harder to assure the integrity of global groups the other domains might use.



Advantages	Disadvantages
Best for companies with no central MIS department.	Because there is no central management of users, this model is not practical for companies with central MIS departments.
scalable to networks with any number of users.	Very large number of trust relationships to manage.
Each domain has full control over its user accounts and resources.	Each domain must depend on other domains to not put inappropriate users into global groups.
Both resources and user accounts are grouped into departments.	

Single Master Domain Model

The master domain model is for companies where the network needs to be split into domains for organizational purposes. Each organizational group can manage its own resources, but user accounts and global groups need to be defined in the master domain. It can support up to 10,000 users centralized in the master domain.
Only the servers in the master domain have copies of the network user accounts. It is recommended that there is at least one extra server running Windows NT Server as a Backup Domain Controller in the master domain. Then, if the domain controller fails, the other can take over, and the network can keep running.



Advantages	Disadvantages
Best choice for companies that don't have too many users and must have shared resources split into groups.	Poor performance if the master domain has too many users and global groups.
User accounts can be centrally managed.	Local groups must be defined in each domain where they are to be used.
Resources are grouped logically.	
Department domains can have their own administrators to manage the resources in the department. Global groups are defined only once (in the master domain).	

Multiple Master Domain Model

This domain model is for companies that are organized by groups, departments, or locations and want centralized administration. Because it is the most scalable model, it is good for organizations that anticipate substantial growth. It can support up to 10,000 users per master domain.

This model is organized in two tiers. The first tier contains the master domains that trust each other. The second-tier domains trust the master domains, but the master domains do not trust them. Because all of the master domains trust each other, only one copy of each user account is needed, but accounts are split among the master domains.

The administrative requirements for this model can be considerably greater than the other models. Local and global groups may have to be defined several times, and there are several trust relationships to mange.

Advantages	Disadvantages
Best choice for companies with many users and a centralized MIS department.	Both local and global groups may have to be defined multiple times.
scalable to networks with any number of users.	More trust relationships to manage.
Resources are grouped logically.	Not all user accounts located in one domain.
Department domains can have their own administrators to manage the resources in the department.	

Choosing the Domain Controllers

Consider these factors when choosing your domain controllers:

Number of Domain Controllers

Configure at least one server per domain as a backup domain controller. For a more robust backup mechanism, it's a good idea to have several backup domain controllers in a domain.

Microsoft Exchange Server Computer as a Domain Controller

There is no requirement for a Microsoft Exchange Server computer to be a domain controller. You may decide to host Microsoft Exchange Server on your domain controller based on the type and number of servers you have available, and based on cost considerations. For performance reasons, however, we recommend that you do not install Microsoft Exchange Server on the primary domain controller

Physical Location

Make sure your domain controllers have reliable network connections to the servers in the domain. If a domain has servers at different physical locations connected by a WAN link, each location should have at least one backup domain controller.

Mapping Domains and Sites

Sites can map to domains in different ways. They can map one-to-one, or a site can span several domains, provided these domains trust each other.

There are no special rules to map sites to domains in the four domain models, and it is not necessary to map all existing domains to your sites. For example, if you have a complete trust model, you could place all servers in one of the domains or spread them among all domains. In the master and multiple master domain models, you could place all your servers in a single second-tier domain, in a single first-tier domain, or spread them across several first-tier domains. Your choice will depend on how you want to structure administration of the domains and the Microsoft Exchange Server computers that reside in them.

Step 6: Determining the number of Sites and Site Boundaries

Determining the number of sites and site boundaries are interrelated processes.

Defining Site Boundaries

There are several factors that determine where to draw site boundaries. Some factors are necessary conditions that all Microsoft Exchange Server computers must satisfy in order to be placed in the same site. Although not mandatory, other factors should also be considered when planning your site boundaries. These factors include administration, cost, security, and performance. There are also less tangible organizational issues that you should consider, such as grouping users that should work together in a single site.

It is important to plan the number of sites and their boundaries very carefully. Once you have created your sites, it is difficult to split or join other sites.

Necessary Conditions

Here is an overview of what is required at each Microsoft Exchange Server site.

Synchronous RPC Connectivity

All Microsoft Exchange Server computers within a site must be able to communicate through synchronous RPCs, the mechanism by which the servers exchange messages and directory information within a site.

A site's physical boundaries can be as large as you like, but they cannot span a connection that does not support synchronous RPC connections between all Microsoft Exchange Server computers. For example, if you have a large network spanning North America but the network connection between North America and South America does not support synchronous RPC connections, you must define separate sites for North America and South America and have email connectivity between them.

Security

Windows NT security must be set up in a way that allows the Microsoft Exchange Servers within a site to authenticate each other. This is necessary because all server services within a site must run under the same security context.

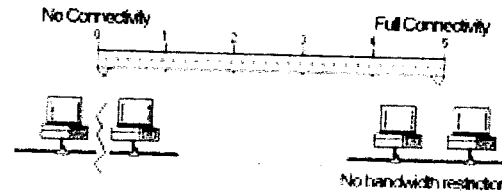
Permanent Connections

Your network must support permanent LAN connections between Microsoft Exchange Server computers in a site. These permanent connections include LANs, leased lines, and some types of WAN links. Periodic connections include any connection that is not available all the time, such as a dial-up connection through a modem. Often, such connections involve a distant geographical location that you connect to only a few times a day.

High Network Bandwidth

All servers within a site should be connected through a network link with relatively high bandwidth. The threshold for determining what high network bandwidth is somewhat arbitrary. The bandwidth must be enough to handle the volume of data being transferred such as message volume, directory replication and public folder replication. For some installations, links below 128 Kb/s may be sufficient but the threshold for your installation may be higher if you have large volumes of data.

The bandwidth available to connect two or more Microsoft Exchange Server computers generally falls under one of the ranges in this illustration:



These bandwidth ranges are summarized below:

Network Bandwidth Range	Explanation
0 to 1	No permanent connectivity. The connection is not available full-time and must be established periodically, usually through a modem dial-up line. Servers in this category must be placed in separate sites.
1 to 2	A permanent connection, such as a leased line, with a slow line speed of 128 Kb/s or less. Servers in this category generally should be placed in separate sites. This is not a requirement, however. To make your decision, use the performance and cost factors described later in this chapter.
2 to 3	A permanent connection, such as a leased line, with a medium line speed of 512 Kb/s. At this line speed, servers may or may not be placed in separate sites. To make your decision, use the performance and cost factors described later in this chapter.
3 to 4	A permanent connection, such as a leased line, with a fast line speed of 1 Mb/s. At this line speed, performance is less of a concern. Whether you place the server in a separate site depends on other factors, which are described later in this chapter.
4 to 5	Full connectivity: a logical LAN with no bandwidth restrictions. This server should generally be placed in the same site as the other servers to which it can connect.

Other Factors

Site Administration

Many Microsoft Exchange Server administrative services are configured automatically within a site, making it easier for you to administer servers that are grouped within a single site. As a result, you should configure your sites to cover as many servers as possible.

Windows NT Security

Microsoft Exchange Server uses the Windows NT security services to:

- Authenticate servers with one another.
- Authenticate a user's request to log on.
- Control who can access which objects (such as mailboxes and distribution lists).

- Determine which actions an individual can take on an object.
- Determine which events are audited.

As described in Step 4, Windows NT Server computers are grouped into Windows NT domains to administer a set of servers together and control and establish security for the network. You can control the level of security for your *Windows NT domains* by *establishing trust relationships* between them.

Cost

In addition to hardware costs, you should consider connection costs. Any Microsoft Exchange Server computer that is connected to another Microsoft Exchange Server computer over a line with charges based on the amount of data that is sent should be placed in a separate site. This allows you to minimize costs by minimizing the amount of information that is shared with that server.

Performance

Performance is another important factor to consider when drawing your site boundaries. Many performance issues are discussed in Part 2 of this white paper.

Directory Replication

Within a site, replication is multimaster and event driven. All Microsoft Exchange Server computers exchange all of their directory information with each other automatically. When drawing site boundaries, consider how directory replication affects cost and performance.

The cost of replicating directory information between two servers is determined by the cost of maintaining the link between those servers and the cost of sending data over that link. If two Microsoft Exchange Server computers are connected through a slow link, consider placing the servers in separate sites so you can control when directory information is replicated. You can then configure directory replication between these two sites so that the slow link is used only occasionally, minimizing the use of that link and improving performance.

Organizational Considerations

In addition to the technology issues, you should consider organizational factors when planning your sites. Grouping people that work together on the same servers and sites will improve overall performance of the system, reduce network traffic, and reduce resource utilization. For example, if members of the research team are located at different sites, you may have to replicate public folder information between the two sites. However, if the research team can be hosted on a single server, replication would not be required.

Determining the Number of Sites

To determine the appropriate number of sites for your company, keep the following factors in mind. They should be considered along with the guidelines for determining site boundaries.

- The type of network links you have.

- The net network bandwidth available on your WAN and LAN connections.
- The number of users at each location and their usage profiles.
- The established administrative policies and procedures of separate groups within your company. (For example, if San Francisco and Los Angeles have different system administrators with independent local administrative procedures, you might want to place San Francisco and Los Angeles in different sites, even though they share a high-bandwidth network.)
- The network traffic patterns at each location.

Other factors to consider when planning the number of sites include:

- Minimizing the number of sites simplifies configuration and administration.
- The geographical locations of your company is important, but it is not necessary to have a one-to-one correspondence between number of sites and geographical locations.

Step 7: Linking Sites

Sites can be configured to exchange directory information, public folders, and messages. This section explains how to link your sites, locate the connections in your site and how this affects the Microsoft Exchange Server. It is important to understand these details before planning your servers.

The administrators in either site can control the information that is transferred. Information flow can be slowed if the connection speed between sites is not fast enough to handle the volume of data.

Planning Your Routing Strategy

Routing within a site is point-to-point and requires no planning or configuration. Routing between sites or to another mail system, however, does require planning and configuration. This section helps you plan your connections to other sites and systems while minimizing the effect on Microsoft Exchange Server within your site.

Methods of Connecting Sites

Site Connector

The site connector is the most efficient way to connect two sites because it uses RPC for site-to-site communication. Site connectors require permanent connections with higher bandwidths than the other connectors do. However, they are easy to configure because you do not have to configure a network transport for it since it uses RPC.

This table lists advantages and disadvantages for using a site connector.

Advantages	Disadvantages
Easy to configure because it does not require configuration of the network transport and because you do not have to schedule connections.	Requires permanent connections of higher bandwidth. Cannot control message size sent through the site connector.
Most efficient because there is no message translation and because message take fewer "hops" to get to its destination.	Cannot schedule when connections are to be made.

RAS Connector

The RAS Connector is a special case of the site connector. It uses RAS, asynchronous communications, instead of a permanent network connection between sites. You can configure when the connection should be made and at that time Microsoft Exchange Server will make the connection to the other site.

Advantages	Disadvantages
Administrator controlled dial-up connectivity. Works over slow, non-permanent connections.	Data transfer is dependent on the speed of the modems.

X.400 Connector

This is used when there is no network connection between your sites, when you want to take advantage of your existing X.400 backbone, or when you want to access a public X.400 system. For this connector you must configure one of the following Network transports: TP0/X.25, TP4/CLNP, or TCP/IP.

Advantages	Disadvantages
Can schedule when connection happen. Can control message size through the connector. Can control how messages are routed through the Microsoft Exchange Server topology.	Must configure network transports. May not be able to use this connector if you have bridges that do not support the same network transports on both sides of the bridge.

To connect two sites, identify a Microsoft Exchange Server in each site to support that connection. Configure the message transfer agent (MTA) on each Microsoft Exchange Server to connect to the other server's MTA or intermediate MTAs through the appropriate network transport.

You can have one or more connections configured between sites to establish communications between them. You should consider redundant routes in your routing strategy for load balancing and least cost routing purposes. With each route you can assign costs, and through these costs, the connectors can intelligently route information over the route with the lowest cost. In addition, if one route should go down, messages could continue to be routed through one of

the other connections, and, based on the connections assigned costs, the connectors are able to load balance routing over the remaining connections.

Tailoring Traffic between Sites

Traffic between sites is divided between replication messages and other types of messages. While it is difficult to plan for the precise amounts of each type of traffic, you can use some generalities to reduce traffic between sites.

Message Traffic

The number and size of messages users send between sites can vary greatly. While you can't limit the number of messages, you can limit their size to prevent users from sending large enclosures.

Directory Replication Between Sites

Replication is the process of copying new and updated information from one site to another. This includes directory information about mailboxes, distribution lists, public folder addresses and contents, and addresses of users in foreign systems. The first time replication occurs, all information is sent to other sites. After that, only modifications and new entries are exchanged.

By setting connection schedules between sites, you can schedule the flow of messages between them. If your bandwidth is limited, you can adjust directory updates to occur during off-hours so they do not impact message flow.

Public Folder Replication

Public folders that are replicated send all changes to all other replicas of that folder in the organization. Public folder replication can be controlled to send only during off-hours. Replication messages can be limited in size, so large messages do not cause delays in a gateway or MTA transmission queue when traveling over slow links.

Instead of replicating a public folder to another site, the administrator can specify a parameter called the *Public Folder Affinity*. Public folder affinity allows users from one site to connect to public folders in other sites. This reduces network traffic caused by replication, reduces required storage space, and reduces or eliminates replication latency, but can cause more network traffic than configuring the additional replicas if people in the site read items in the public folders very often.

Planning Communication Between Sites

The most important considerations in planning replication between any two sites are the characteristics of the physical link and the relative importance of sharing information.
For example, when any two sites are connected over an expensive link (as defined by speed, cost, or both), you can limit how often the sites connect to exchange mail or directory information and control the maximum size of messages that are sent through the expensive link.

When directory information is critical, you can increase the frequency with which the sites exchange information and you can specify full replication, even if the sites are connected by an expensive link. As we described earlier, you can also specify multiple methods of communication, even if it causes redundancy. For example, if the Systems Network Architecture (SNA) backbone is down, you can link the sites over more expensive phone lines or a public X.25 connection. This happens dynamically and is based upon least-cost routing.
If you are using a permanent connection between sites—but the connection is a slow-speed link—you can restrict directory service replication and traffic by setting a maximum message size. You can augment this bandwidth during the day with a scheduled X.400 connection.

Step 8: Site Plans

Planning sites involves a number of factors, including determining how many servers are required for each site, the physical location of each server, how to administer servers, and how many and what type of gateways your site needs. This is covered in detail in Part 2 of this white paper.

Step 9: Server Plans

Planning servers involves determining the function of the server and its software and hardware requirements. For example, you can dedicate a Microsoft Exchange Server for public folders or to expand distribution lists. If you have advanced security features that Microsoft Exchange Server provides, you will have to determine which Microsoft Exchange Server computer in your organization will manage your advanced security keys. Hardware and software requirements directly impact the performance of each server. Part 2 of this white paper covers this in detail.

Step 10: Planning Connections to Other Systems

To connect to other systems, Microsoft Exchange Server supports a number of Windows NT gateways as well as the suite of Microsoft Mail Server gateways that are currently available. In addition to rich gateway connectivity, Microsoft Exchange Server will natively support four key connectivity components: a 1988 X.400 MTA described earlier; the Microsoft Mail Connector for rich connectivity with Microsoft Mail users; the cc:Mail Connector for connectivity with cc:Mail users; and the Internet mail connector, which connects Microsoft Exchange Server users to the Internet. Planning for these connectivity components is very important, but is beyond the scope of this paper. The following table provides a brief summary of how you can connect your sites to Microsoft Mail and the Internet. The table also includes the network transports they support.

Connector	Network transport	Use this connector to
Microsoft Mail connector	• LAN • X.25 • Asynchronous • Microsoft Remote Access Service (RAS)	Take advantage of existing Microsoft Mail 3.x gateways such as PROFS, SNADS, NetWare MHS, and FAX.
cc:Mail Connector	• LAN	cc:Mail postoffices
Internet Mail Service	• TCP/IP • Asynchronous • Microsoft Remote Access Service	Connect to the Internet or to an SMTP backbone. Supports RFC 822 plus MIME/RFC 1521 extensions.

Step 11: Validating and Optimizing the Design

Planning and design optimization requires designing a prototype topology with all the design elements described in this chapter, then validating and optimizing that design until it meets the user requirements in your organization.

These requirements may include:

- Guaranteeing message delivery.
- Guaranteeing message integrity.
- Providing a rich level of service that supports different types of documents, formats, multimedia, and applications, such as calendaring and electronic forms.

Validating your design includes checking your decisions against projected loads, error rates, peak-to-average message traffic ratios, and sustainable forwarding rates by various Microsoft Exchange Servers.

Optimizing the design means:

- Designing several topology options for both Microsoft Exchange Server and your implementation of Windows NT.

  Each option can include a brief overview of the topology plan, network maps showing the data path, routing diagrams, and an outline of the benefits and the drawbacks for that option.

- Analyzing, reviewing, and testing each option to develop the best alternative.
- Modifying your plans as needed to maximize performance and service to users.

Step 12: Rolling Out the Plan

The roll-out plan comprises the steps and procedures that you will follow to implement the new system in the organization and migrate users from existing systems to the new system. It's a good idea to inform employees about the roll-out plan so they know when they will be migrated from their current system to Microsoft Exchange Server.

Site and server planning builds on the work done in Microsoft Exchange Server topology planning. When planning your Microsoft Exchange Server topology, you looked at ways to meet your current and future needs, minimize impact on your existing network, and stay within your budget. Site planning has the same goals.

This part of the white paper describes Microsoft Exchange Server site and server planning. It assumes you have made at least a draft plan for your company. Here are some of the details to keep in mind to complete your plans:

- **Physical network layout**. Locating servers on the same LAN segments as the users reduces traffic across bridges and routers.
- **Types of users and their needs**. Planning for server hardware and gateways requires knowing which users plan to use which features of Microsoft Exchange Server.
- **Special service needs.** Special services—such as gateways, news feeds, security and other applications—impact planning for server loading and hardware.
- **Mobile client access.** Planning for mobile clients includes deciding on the type and quantity of remote services your site must support.

Part II: Planning Your Microsoft Exchange Server Sites and Servers

Laying Out Your Microsoft Exchange Server Sites

In Part 1 of this white paper, you defined the number, location, and types of connections between sites in your Microsoft Exchange Server topology. Now you can determine the number, type, and configuration of Microsoft Exchange Servers required in this site. This design work is presented for sites that require more than one Microsoft Exchange Server. If your site requires only one server, Part 2 is useful for planning the hardware you need for that server.

To begin planning your site, you need a description of your site's physical network layout. While working through Part 2, you should be able to enhance this site network layout by providing information about your company's:

- Physical network.
- Groups of users on the local area network (LAN).
- Data and messaging traffic.
- Location and connection method of mobile users.
- Location and method of connections between sites.
- Location and types of gateways.
- Location of servers.

You can also use this site layout after installation for troubleshooting problems and planning for the future.

Network Layout Inside the Site

The physical network is the groundwork on which to lay the foundation for your site. You used information on your physical network in "Defining Site Boundaries" in Part 1 to establish the boundaries of the site. In this section, you will examine the physical network within each of those sites to see the network influences that affect the design of your site.

LAN Segments

All data that moves on a LAN is transmitted, carried, and received. In the simplest LAN, the data travels directly from the transmitter to the receiver. In more complex situations, the data must travel through routers or bridges. Each part of the network that connects into a router or bridge is a segment of the network.

Start your site layout with a drawing of your physical network. If there are no routers or bridges within your site, or if a drawing is not available, start your layout with a straight line. You can use this information to minimize the effect Microsoft Exchange Server has on your network.

Parameter	Light User	Medium	Heavy
Max Inbox size (in messages)	20	125	250
Other old mail processing (per day)	[illegible]	[illegible]	[illegible]
Total receipts per day (computed average)	20	56	119

Naturally, there are differences among users in every group. For the sake of analysis, try to determine the average for each group. There are several ways to collect this data. If your current mail system has administrative accounting features, generate a report on current use for members of these groups. If your current mail system allows you to save all sent mail, survey several users in each group to get an idea of how many messages are sent in a day. Another method is to survey people who were out of the office for a day or two to determine how many new messages were waiting for them when they returned. This survey methodology can also be used to collect other relevant data such as how much mail is saved by users.

Message Storage

Microsoft Exchange Server allows personal folders to be stored either in the server information store, in a personal folder store on the client workstation, or both. Public folders are always stored in the information store. The Microsoft Exchange Server information store uses a single-instance storage architecture to reduce disk usage; for example, if a user sends one message to ten recipients on a server, each recipient's mailbox gets a pointer to the single shared copy of the sent message. To further limit disk usage on the server, you can control the volume of private mail in the information store by setting administrative disk quotas. Keep in mind, however, that server backup only archives messages stored in the server information store; if users store mail in personal folders on their client workstations, that data cannot be backed up administratively. In addition, you can control storage requirements by implementing policies for sent and received message size and age limits.

Even if you decide to implement storage limits for mailboxes, the storage needs for each group of users can be different. A survey of your current e-mail system is a good way to understand current storage use or needs.

Message Traffic

You should categorize data and message flow within your organization and to other systems. In your layout, you can draw or add notes describing each group's typical or expected traffic pattern. Is mail sent mostly within the group, to other specific groups, to other specific sites, or to specific gateways? You can assume that someone in a group eventually sends mail to every other group, but you are looking for major traffic trends. You can get the data if your existing e-mail system has reporting capabilities that describe this flow. You can also examine the pattern by using a sample survey of sent mail or inboxes.

Messages addressed only to local users require fewer resources to deliver. By understanding traffic between groups, you can plan for groups that most often

exchange mail to share the same server and decrease the load on the network and servers.

Public Folder Needs

Defining the public folder needs for each group will help you later in planning server hardware and software. Besides describing the public folder needs of each group, you should also decide which administrative policies you plan to implement in regard to public folders.

You can assess the public folder needs of each group by evaluating each folder this group will use exclusively. For each folder, estimate:

- Volume of new information.

Estimate the number and size of the messages or forms that will be created each day.

- Longevity of information.

Determine how many days this information should be retained. For example, a public folder with weekly schedules and announcements would not need to be retained for more than two weeks, but a customer tracking application might require data to be kept indefinitely.

- Load.

How many users are going to access this public folder? How many times a day? Will they read all new items? Will they search, sort, and change views?

Public folders do not need to reside on the same server as the users, so a group's public folder use does not necessarily impact the design of its server. However, if their load is high enough, the network traffic they generate may cause you to place their public folder on their server or another on the same LAN segment.

Additional Services in a Site

All Microsoft Exchange Servers that are members of the same site perform an identical set of core functions, including directory services, mail transfer, and message storage. Some Microsoft Exchange Servers can contain additional software or perform specialized services. Before planning server hardware, users, and placement on the network, you should assess which of these services you need in your site and how they impact your plans.

You can designate some Microsoft Exchange Servers to include the following Microsoft Exchange Server software:

- Administrator program software.
- Client installation points.

You can designate other Microsoft Exchange Servers to perform these Microsoft Exchange Server services:

- Gateway server.
- Public folder storage.
- POP3 Server.

- NNTP Server.
- Links to other sites.

The Windows NT Server can also perform other tasks that are not directly related to Microsoft Exchange Server. For example:

- Primary domain controller (PDC).
- Backup domain controller (BDC).
- Remote access server (RAS).
- Structured query language (SQL) server.
- Microsoft System Management Server.
- Microsoft SNA Server.

Because the first server in a site has a hidden public folder that contains the free and busy time information for every Microsoft Schedule+ user both in the site and at other sites, it can influence which server you install first. When a user is trying to schedule a meeting and uses the Planner, Schedule+ reads the free and busy time information from this public folder for each invited recipient who is not on his or her home server. The volume of this public folder should be 3K per user in the organization. The load on this public folder depends on your use of Schedule+ to schedule meetings with people or resources outside your home server.

If a Microsoft Exchange Server is underutilized, you can designate it to perform additional services. For example, if all servers in the site except one are single processor computers and they each have an equal load of users, the multiprocessor computer is a good choice for processor-intensive activities. If one server has more available hard disk space than others do, you can use it as the home server for public folders.

If all your servers use a standardized configuration and have an even user load, distribute these services evenly among all servers in the site. Monitoring your servers after installation is the only way to determine where to add gateways, new users, and public folders.

Planning for Mobile User Access

Some electronic mail programs have separate client programs for mobile access. However, Microsoft Exchange Server allows all clients to access private and public folders remotely. Clients can be used offline to work with personal information stores and connect to the server by making a remote network connection with a variety of software and hardware. Once connected to the network, the client can connect to the server, send outgoing mail, and retrieve waiting mail.

In planning your Microsoft Exchange Server site, evaluate the needs of your mobile users. This includes managing remote access, having sufficient modems, phone lines, and ISDN or X.25 connections for the expected volume of traffic, and incorporating flexibility for future growth. Security requirements can also be taken into consideration.

Connecting to Microsoft Exchange Server

Microsoft Exchange clients need network access to the Microsoft Exchange Server. If they are at a remote location, they need some means of connecting to the network so they can send RPCs to the Microsoft Exchange Server as if they were on a LAN.

Connecting: Client Side

To connect to the network, Microsoft Exchange clients can start and end communications programs that are included with the client or network operating system. You do not need to use this software to make the network connection—it is provided as a convenient default.

Client	Default communications
MS-DOS	Shiva: included with the Microsoft Exchange client
Windows® 16-bit	Shiva: included with the Microsoft Exchange client
Windows for Workgroups	RAS: included with operating system
Windows 32-bit	RAS: included with operating system
Windows 95	Dial-Up Networking: included with operating system
Web Browser	Active messaging through ISP or Dial-Up Networking

Connecting: Server Side

The server side of remote access to Microsoft Exchange Server gives you three options:

- Windows NT Remote Access Server (RAS).

RAS is built into Windows NT servers and supports connections from RAS and Shiva clients. RAS is a Microsoft product that allows a remote workstation to connect to a network. You can use any of the following connection methods with RAS: modem, X.25 network directly or through a modem and packet assembly and disassembly (PAD), modem pool, ISDN, SNA, security hosts and switches, or RS-232 null-modem cable.

A Microsoft Exchange Server can also host a RAS server. Or, depending on your remote access needs, you could install a RAS server on a dedicated Windows NT server. For more information on the capabilities of RAS, see the Windows NT Remote Access Server documentation.

- Shiva LanRover.

Shiva LanRover supports connections from Shiva, and RAS.

- Other.

Any remote access server software that is compatible with RAS or the network software that is currently used by your remote workstations.

Assessing Needs

As you plan remote access hardware requirements, examine your mobile user traffic patterns. These factors can affect your decisions:

- Number of remote clients.

- Frequency and length or duration of connections.
- Volume of data sent and received.
- When calls occur.
- Convenience for remote clients.
- Connection speed.

Several mobile users can be served by one RAS server, unless they call frequently. If all mobile users call to pick up mail at the same time, you will need more lines to handle the load or encourage them to spread out their calls over a longer time period.

If you want to support multiple connections in the site, you should decide if you need a hunt system in your company's phone system. With a hunt system, a call to a single phone number is switched to an available modem, as opposed to having a separate phone number for each modem. A hunt system makes it easier and quicker for mobile users to connect.

A more important consideration is the speed of the connections. A remote client connecting at 9600 bits per second (bps) keeps a connection busy longer than a remote client connecting at 19,200 bps does. This speed is limited in asynchronous connections by the types of modems used and the highest transfer rates at which the two can connect. In X.25 connections the speed is limited by either the bandwidth of the leased line or the modem speed of the PAD (if a PAD is used), whichever is lower.

Determining the Number of Connections

If your current e-mail system supports mobile user access, you can use your experience with these connections as a guide in planning Microsoft Exchange Server mobile user access. This is a good first step, but may not provide an accurate estimate of your needs. These factors can increase your need for connections:

- All Microsoft Exchange Server users now have clients capable of mobile use.
- The number of portable and home computers is increasing.

The following options available for Microsoft Exchange Server can decrease the number of connections needed:

- High-speed connections, such as X.25 and ISDN.
- Ability to preview message headers for review before downloading.
- Server-based auto assistants sorting and forwarding new mail.
- Automated late-night connection features.
- Automatic compression of all messages (but not attachments).

Planning Site Servers

The number of Microsoft Exchange Servers required for a site depends on the number of users, public folders, and gateways you plan to support and the kind of hardware you plan to use. You can use the scaling information, the site layout you completed, and the recommendations in the following sections to plan your hardware and software requirements.

Performance Factors for Servers

Five key factors affect server performance:

- Number of disks.
- Optimized input/output.
- Amount of memory.
- Processor speed and number of processors.
- Network cards.

These factors will be discussed throughout this section on planning site servers.

The Microsoft Exchange Server Performance Wizard

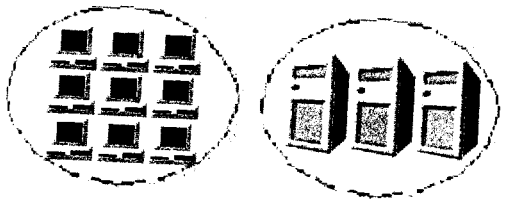
Microsoft Exchange Server includes a planning and system optimization tool that will ensure that you get the most from your Microsoft Exchange Server computer. Based on your system configuration, the easy to use Performance Wizard will make recommendations concerning Microsoft Exchange Server file locations, memory usage and various other system parameters which will affect the performance of your Microsoft Exchange Server. Be sure to run Performance Wizard when you install Microsoft Exchange Server and whenever you change your system configuration.

In addition, proper planning of your server can also increase performance. For example, if you group users onto servers based on to whom the users primarily send mail, the percentage of messages addressed exclusively to recipients on the same server increases. These messages are delivered by local delivery. This means that the information store delivers the message and the MTA is not involved, reducing disk and CPU load on the server.

Distributing or Concentrating Servers

The site layout provides many different views of the site and all factors that affect its design. Because Microsoft Exchange Server is a system, designing the system to meet the needs of the Microsoft Exchange Server site and organization will meet the needs of the individual users. Poor performance on one Microsoft Exchange Server can affect users at other Microsoft Exchange Servers and sites.

As this figure illustrates, there is more than one hardware configuration that can meet the needs of your site. Based on your desired cost-to-performance ratio, you may want to either implement a greater number of smaller servers or a smaller number of more powerful servers.



There are advantages and disadvantages to each configuration. The following table summarizes the advantages and disadvantages of using *a number of less powerful computers*.

Advantages	Disadvantages
Single failure impacts fewer users.	More hardware to maintain.
Can customize each server to the users it serves.	Customized hardware increases support costs.
Generally less expensive to add incremental increases in capacity.	Increases in users or load require more hardware.
More choices in off-the-shelf small hardware available.	Greater network overhead and storage for replicated data.

This table summarizes the advantages and disadvantages of using *fewer, more powerful computers*.

Advantages	Disadvantages
Designed for upgradability of processors and disk arrays.	Fewer vendors from which to choose; may not be able to use hardware that existing mail system is using.
Less network traffic with more users per server; more likely all recipients are on the same server. Also directory service has fewer servers to replicate directory changes resulting in less network traffic.	Network adapter card must be able to handle high volume of user traffic to each server.
Lower overall disk storage requirements because of single instance store architecture.	Information store is larger and takes longer to back up and restore.
Better fault-tolerant designs and error correction possible with more powerful hardware.	Increased vulnerability to a single point of failure.
Reduced administration.	

In some sites, a mixture of large and small servers can best meet the needs of large and small workgroups. However, there is no perfect solution that meets the needs for all sites and their users, and you can always consolidate or distribute users later if strategies change or you want to adjust loads.

Estimating Server Hardware Requirements

This section provides guidelines for determining necessary system resources and describes how Microsoft Exchange Server uses system resources. Use this information to plan the Microsoft Exchange Server computers in your site.

- System memory for processing user requests to the directory, for user connections to their Microsoft Exchange Server mailboxes, and for transferring information to and from the user mailboxes stored on a server.

- Disk space for the server software and for the Microsoft Exchange Server information store, directory service, and transaction log files.

- Disk transfer bandwidth to handle the reading and writing of information to disk.

- Fast bus architecture sufficient to support disk and other I/O requirements.
- CPU processing time for all the services to handle requests from clients, gateways, and other Microsoft Exchange Servers.
- Network adapter card bandwidth to handle network traffic. Multiple network cards are possible.
- Optional outside communication hardware for remote clients.

More about transaction log files

In general, transaction-based databases, such as the Microsoft Exchange Server database, are structured to first write from memory (RAM) to a fast, sequentially organized transaction log file and not directly to the information store. Later, when there is less disk activity, they will write from memory to the actual information store. This is done primarily for performance reasons because data can be written to the transaction log file very quickly. However, it is also helpful in crash recovery scenarios because the database files can be fully recovered from these logs.

Adding gateway software to a Microsoft Exchange Server uses additional disk space, disk transfer bandwidth, and system memory. When adding physical network connections to a Microsoft Exchange Server for use by gateways, plan to have extra system memory available to handle peak traffic loads during the times of the day when users connect to and disconnect from the system, and whenever you have scheduled gateway connections.

When choosing hardware for Microsoft Exchange Server computers, plan ahead for future needs. That way, as the number of users and gateways in a site grows, you can reconfigure the existing hardware on current servers instead of adding more servers. There are several ways to make the most of existing server hardware for Microsoft Exchange Servers:

- Increase the number and speed of the disk or disk arrays.
- Optimize the I/O system because disk intensive processes take more time if the I/O system is slow. Use a fast caching controller with a high-performance interface such as a PCI SCSI.
- Increase the amount of system memory for each Microsoft Exchange Server computer.
- Buy the fastest single processors.
- Replace disk drives and volume sets with striped drive arrays. Striped, mirrored drives can provide maximum data protection and optimum read access at the cost of disk space.
- Manage the number of non-Microsoft Exchange Server software processes that run on the server hardware. Although the Microsoft Exchange Server computer can support other processes, for best performance it is generally best to dedicate the server for Microsoft Exchange Server processes.

- Upgrade the processors on existing servers or use multiprocessors in existing servers.

By planning ahead before installation, you can select hardware that can be upgraded easily. If a bottleneck is identified after installation, you can eliminate it with a minor upgrade rather than a new server or change in site layout.

For example, many RAID arrays support adding or upgrading the disk drives within them. Some computers have slots to add additional symmetric processors. Computers have different limits on the maximum amount of RAM memory that can be installed. Even if you don't need this capability immediately, it can make it easier to handle future growth.

This is an ongoing process, and, with some planning, analysis, and fine tuning, you should be able to match the needs of your users with the resources you have available.

Assigning Users

The site layout provides many different views of the groups of users and their needs. You can use the general guidelines listed below in designing the servers. However, note that it is impossible to follow all these guidelines at the same time because some conflict with each other. They are presented here as factors to consider in your design so you can make the tradeoffs that fit your site's needs.

- Concentrate mailboxes and groups that most often send mail to each other to take advantage of local delivery.
- Make all the users for a server come from the same network segment. You can gain efficiencies if most of your data does not have to flow outside of a network segment.
- On a WAN, spread out copies of the client installation points and the Administrator program.
- Spread out mailboxes (e.g. administrators' mailboxes) and critical public folders of mission critical people so a single failure doesn't stop business.
- Concentrate mission critical mailboxes, public folders, and gateways on servers with hot-swappable hardware.

System Memory

Microsoft Exchange Server executables are multithreaded processes that run as Windows NT services. Each process allocates and de-allocates system memory dynamically and can use as much system memory as the server hardware has available.

When physical memory is exhausted, new processes and programs are forced to use virtual memory. Virtual memory is simulated RAM created by using a portion of the hard disk as a swap file. This slows down the processes and programs on the Windows NT Server computer that use the virtual memory and those that need to read and write to the hard disk.

For optimal performance, your Microsoft Exchange Server computers should have at least enough physical system memory to avoid constant heavy use of virtual memory. You should consider increasing server memory as client usage of the server increases, and increasing server memory as more services are run on the server.

Use the Microsoft Exchange Performance Wizard to optimize memory usage on your Microsoft Exchange Server computer. If you add physical memory (RAM) to your Microsoft Exchange Server computer, you should re-run the Performance Wizard.

Disk Usage

Over time, the size of the Microsoft Exchange Server's information stores grow. The files increase in size as the following increase:

- Mailboxes.
- Distribution lists.
- Public folders.
- Gateways.
- Remote users.
- Mail messages.
- Public folder items.
- Outbound mail in queue for gateway or other site.

To better control hard disk needs and improve performance, plan administrative policy to limit space by:

- Imposing storage limits on all users to limit the size of their mailboxes.
- Limiting the maximum age for material in public folders to decrease their volume.
- Imposing storage limits on public folders.
- Limiting the maximum message size.

If your needs grow beyond your initial estimates, you can adjust your available disk space later using these strategies:

- Add another Microsoft Exchange Server to the site and add new users to it.
- Add another Microsoft Exchange Server to the site and move a group of mailboxes to the new server.
- Move public folders to other Microsoft Exchange Servers in the site and do not replicate them within the site.
- Consider dedicating a Microsoft Exchange Server for public folders.

- Increase frequency of connections to other sites and systems to keep outbound queues small.

- If you have a lot of MTA traffic, consider dedicating a Microsoft Exchange Server to routing those messages.

- Monitor the amount of disk space that is allocated to individual mailboxes and ask specific users to delete outdated mail messages. If disk space is a problem, you consider preventing users from using the Sent Mail folder because it can get very large over time. You could also consider the Clean Mailbox option in the Microsoft Exchange Server administration program to delete old messages from the personal folder store.

- Add hard drives.

Windows NT Server enables you to configure multiple physical drives into one virtual drive or volume set. Before installation, partition one drive into drive C for Windows NT Server and drive D for Microsoft Exchange Server. You can later add a second hard drive and expand drive D to include some or all of the second drive. You can connect up to 32 hard drives to form one volume set. However, drive C cannot be expanded into a volume set with this method, so it is important to plan ahead before Windows NT Server is installed.

If your computer has multiple disk drives, consider some of the other available disk administration options before installing Microsoft Exchange Server:

- Disk striping.

Disk striping creates a virtual drive over two or more hard drives and can greatly improve private and/or public information store I/O performance. When writing to a file, some of the data is written to each hard drive in the virtual drive to reduce the writing time. Reading gets a similar boost in speed by reading simultaneously from multiple sources.

- Disk striping with parity.

Disk striping with parity requires at least three hard drives. This is similar to basic disk striping because the read and write operations to a file are spread out over the hard drives. However, for each piece of data that is written to a hard drive, a parity stripe is also written. If one hard drive in the virtual drive fails, the data on that drive can be recreated from data and parity stripes on the other drives. This takes more hard disk space to save information stores of the same size, but provides fault tolerance.

- Disk mirroring.

Disk mirroring makes a duplicate copy of the hard drive on a second drive. If the first drive fails, all the data is on a second drive. This does not improve the write operation speed, but does improve reading speed as you can read from either of the two drives. It also provides the fault tolerance of disk striping with parity without requiring three hard drives. After Microsoft Exchange Server is installed,

disk mirroring is the only option you can implement without backing up all the data and reformatting the drives.

When you decide on a storage solution, use the Microsoft Exchange Performance Wizard to benchmark your I/O subsystem and have it recommend locations for relevant Microsoft Exchange Server files. If you are adding new disks to your Microsoft Exchange Server computer, you can also use the Performance Wizard to experiment with I/O setup.

Processors

Microsoft Exchange Server benefits from symmetric multiprocessor support in Windows NT. If processing speed is limiting your Microsoft Exchange Server's performance, we recommend that you consider purchasing a faster processor. If you are already using the fastest processor for your server, consider adding additional processors.

Your Microsoft Exchange Server computer needs enough processing power to handle requests from clients, other servers in the site, and optional special services such as gateways, links to other sites, RAS servers, and file servers for client installations.

Not all servers need multiprocessor support, and not all hardware is easily upgradable to multiprocessor support if it is needed later. Plan your processor choices accordingly.

Network Connections

A Microsoft Exchange Server must have at least one physical connection to the network. You may want your Microsoft Exchange Server to have multiple network adapter cards, 32-bit adapter cards, and/or PCI adapter cards. You can maximize network throughput with multiple, high speed network cards. Server hardware that separates I/O on different channels will also help optimize network performance.

Conclusion

In the implementation of mission critical systems, initial planning often determines whether the project will be a success. This is certainly the case for Microsoft Exchange Server.

As we have pointed out throughout this document, the planning and design process is an iterative one that will require fine-tuning even after the first Microsoft Exchange Servers are installed. We hope this guide has given you a good starting point for your planning and will make your implementation experience a positive one.

Migrating Exchange Server 5.5 to a Windows 2000–Based Computer

White Paper

Rabih Andari

This is a preliminary document and may be changed substantially prior to final commercial release of the software described herein.

The information contained in this document represents the current view of Microsoft Corporation on the issues discussed as of the date of publication. Because Microsoft must respond to changing market conditions, it should not be interpreted to be a commitment on the part of Microsoft, and Microsoft cannot guarantee the accuracy of any information presented after the date of publication.

This White Paper is for informational purposes only. MICROSOFT MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AS TO THE INFORMATION IN THIS DOCUMENT.

The example companies, organizations, products, people and events depicted herein are fictitious. No association with any real company, organization, product, person or event is intended or should be inferred.

Abstract

This white paper describes migrating Microsoft® Exchange Server version 5.5 to Microsoft Windows® 2000 and installing Exchange in a Windows 2000 environment. This paper also discusses Active Directory Connector (ADC), a new component of Windows 2000 that replicates the Exchange directory to the Windows 2000 Active Directory™ directory service and vice versa.

Content Contribution

Paul Bowden
Alex Ziegler
Jason Nixdorf

Contents

Introduction

The Microsoft® Windows® 2000 operating system introduced significant enhancements over its predecessor, Microsoft Windows NT® version 4.0. Applications such as Microsoft Exchange Server can benefit greatly from the new features offered by Windows 2000, such as the new scalable and rich directory architecture, and the networking, security, and management enhancements.

As with any major upgrades, you must follow a few important steps, preparations, and special procedures to ensure a smooth and trouble-free transition to the new operating system. You must also follow special steps to facilitate coexistence with previous versions of Window NT on the network or with third party network operating environments.

The close integration of Exchange with Windows NT makes the planning and upgrade process of the Exchange messaging environment an integral part of the overall Windows 2000 deployment strategy. It is important to learn about all of the new services provided by Windows 2000, such as Simple Mail Transport Protocol (SMTP), security enhancements, and other network services. It is also important to examine how these new services will fit and coexist with Exchange.

Maintaining messaging connectivity to foreign mail systems is another area to investigate when upgrading to Windows 2000. In cases where connectivity to foreign systems requires a third-party application or protocol, you should take steps to ensure the compatibility of the third-party software or protocol.

Disaster Recovery, Backup and Restore, and Active Directory Connector (ADC) are discussed later in this paper.

For most scenarios, troubleshooting Exchange in Windows 2000 should not differ significantly from troubleshooting Exchange in Windows NT 4.0. All techniques and resources continue to apply to Windows 2000. This paper lists all of the relevant Knowledge Base articles related to each topic.

Supported Versions

Windows 2000 supports the following versions of Exchange:

- Microsoft Exchange Server version 5.5 Standard Edition with Service Pack 3 (SP3)
- Microsoft Exchange Server version 5.5 Enterprise Edition with SP3

Note: If you plan to use Active Directory Connector, your target Exchange server must run Exchange 5.5 with Service Pack 1 or later if running on Windows NT 4.0 Platforms. Service Pack 3 is required only if the Exchange server is on Windows 2000 regardless whether you are using the ADC or not. Exchange-to-Exchange connectivity is independent of Windows 2000.

Unsupported Versions

The following versions of Exchange are not supported in Windows 2000. However, version(s) running on Windows NT 3.5x and Windows NT 4.0 can function properly in the Exchange organization with proper service packs installed. The latest Exchange service pack for each version of Exchange is recommended. There are no current or future plans to support these versions on Windows 2000.

- Exchange Server 4.0 Standard Edition
- Exchange Server 4.0 Enterprise Edition
- Exchange Server 5.0 Standard Edition
- Exchange Server 5.0 Enterprise Edition

General Planning

This paper describes planning the installation of Exchange in Windows 2000. Windows 2000 separately. Most examples will illustrate upgrading an existing Microsoft organization. The following section discusses some general and specific items to consider when planning the upgrade.

Which edition and role of Windows 2000 should I use?

It is important to determine which edition of Windows 2000 to use when upgrading or installing Exchange Server because Windows 2000 does not support upgrading different editions. For example, you cannot upgrade a Windows 2000-based server to Advanced Server or vice versa. For Exchange server in networks that are expected to grow substantially and possibly require future clustering or support for four or more processors, you need Windows 2000 Advanced Server to avoid a future reinstall of the entire server.
Exchange Server can run on a server that is configured as a domain controller or member server. It is recommended that you run Exchange on a member server simply because of performance issues. Exchange Server running on a Windows 2000 backup domain controller (BDC) can be upgraded to a Windows 2000 domain controller and then demoted to a member server role by removing Active Directory™ directory service by using DCPROMO. Before removing Active Directory, you must ensure that you have another domain controller in the domain to assume the services for the removed domain controller.

Native and mixed mode is a Windows 2000 term for allowing Windows NT 4.0 backup domain controllers to participate in the domain. It is of no consequence to the Exchange server if the Windows 2000 domain is in either mode. Mixed mode allows a Windows NT 4.0 BDC in a Windows 2000 domain.

Domain Name System

The Windows 2000 primary and preferred name resolution mechanism is Domain Name System (DNS) or the DNS dynamic update protocol. Proper implementation of DNS services is extremely important to operate Microsoft Exchange in a Windows 2000 environment. In fact, most general problems you may encounter in running Exchange in Windows 2000 will stem from either improper DNS configuration or registration.

An in-depth discussion of DNS is a separate subject that requires much detail and is outside the scope of this paper. Please refer to Windows 2000 Help for additional details and information on how to configure DNS.

Note that when troubleshooting communications and authentication problems, successful pinging of a server does not guarantee that DNS is configured properly. Ensure that the originating server is pointing to the right DNS server and registering properly in correct zone.

Connections to Legacy Systems

Evaluate your mail connectivity to legacy and foreign mail systems and determine if it is appropriate to upgrade the entire Exchange organization to Windows 2000. In some cases, and as you will see later in this paper, Windows 2000 may not provide connectivity with particular network protocols. In this case, you may want to keep Exchange Server on at least one computer running Windows NT 4.0.

Potential Conflicts with Services

Plan the deployment of Exchange Server to avoid conflict with the services on the same server, such as SMTP, as well as to avoid Lightweight Directory Access Protocol (LDAP) port conflicts and changes. A Windows 2000 domain controller that runs Exchange Server might present some conflicts that need to be addressed using same ports and services.

Windows 2000 Active Directory uses the standard LDAP port 389 for LDAP access. Using the standard port number (389) overrides Exchange Server residing on the same server also trying to listen to LDAP port 389. You must reassign the Exchange LDAP port to grant the Exchange server LDAP access to its directory.

Server Upgrade Order

You need to upgrade the primary domain controller (PDC) in the Windows NT network first. Then you can upgrade member servers and backup domain controllers. The order in which you do this, however, depends on many factors related to your specific network environment. From the Exchange Server prospective, servers can interoperate regardless of the operating system. An Exchange organization may spread across different versions of Windows NT and Windows 2000 as well as across different versions of Exchange Server.

It is very important to note that Exchange Server must be version 5.5 SP3 (or later) to run on Windows 2000.

You should perform the upgrade in a fashion that minimizes possible down time to the user. In an Exchange organization in which mail volume is heaviest on local servers, you should upgrade the local server last after successfully upgrading the bridgehead server and gateway server. You should implement the same concept for multiple site organizations.

Before You Start

Upgrading or installing Microsoft Exchange Server in a Windows 2000 environment should be a relatively uncomplicated task. To make sure the upgrade process proceeds smoothly, please review this document prior to starting the upgrade. It is also strongly recommended that you:

1. Ensure that proper backup and recovery procedures are in place
2. Make sure that the required Exchange service packs are installed and available.
3. Review all relevant Knowledge Base articles in advance to resolve possible problems quickly and efficiently.
4. Consult the Microsoft Knowledge Base at http://www.micorsoft.com/support for the latest technical information

Starting the Upgrade

After you have determined the order in which you are upgrading the computers running Exchange Server and you have determined the appropriate edition of Windows 2000 for each computer, you are ready to proceed. Follow these steps:

1. Run the Windows 2000 upgrade.
2. Ensure proper DNS configuration. (Consult Windows 2000 Help for more details.)
3. Review the following Knowledge Base articles if applicable:
   - Q218158, "Upgrading to Windows 2000 Upgrades Existing Novell Client"
   - Q242157, "XCON: TP4 Transport Protocol Not Supported Under Windows 2000"
   - Q169668, "XCON: X.25 Support for SAT Cards"
   - Q169667, "XCON: X.25 Support for CIREL Cards"

New Installations

Performing a clean install of Exchange Server on Windows 2000 can present a few more issues to consider. In general, most installation problems are not specific to Windows 2000 but independent of the operating system. However, some of the same problems may be presented differently and error messages may vary slightly. Windows 2000 may also present additional setup problems that are unique to it.

This section discusses top issues to consider when installing Exchange on Windows 2000.

Running Setup

- Windows 2000 Terminal Services is a part of Windows 2000. If the service is enabled, you must run setup by using Add/Remove Programs in Control Panel This puts the server in installation mode.

- When running Exchange setup for the first time, Windows 2000 may warn you that the application may not be compatible. It is safe to ignore the message and continue Exchange setup. This happens because SP3 is not installed yet.

Security and Accounts

- Ensure that the service account you are using for Exchange is a member of your local administrator group or at least a member of the Power Users group on the local computer.

- Ensure that you are logged on to the domain from the server on which you are running setup.

The following articles may prove to be helpful. Please check the Microsoft Knowledge Base at http://www.microsoft.com/support for the latest troubleshooting articles.

Q247407, "XADM: Network Path Not Found Installing Exchange Server 5.5"

Q238541, "XADM: Exchange Setup Fails Joining a 5.5 Site on Win2000 DC"

Q235669, "XADM: Exchange Server 5.5 Setup Fails on Windows 2000 Server"

Q224447, "XADM: How To Change LDAP Port Assignments in Exchange Server"

Q240135, "XFOR: Creating WinNT Account in Win2000 Domain Stops Migration"

Q224447, "XADM: How To Change LDAP Port Assignments in Exchange Server"

Q233400, "XGEN: Using Windows2000 Encrypted File System to Encrypt Mdbdata"

Installation

To install Exchange Server 5.5 on a server with Windows Clustering, you need to already have Windows 2000 Advanced Server or Data Center Server installed, and Windows Clustering installed and configured with a shared physical disk, IP address, and network name. Consult Windows 2000 help on how to configure Windows Clustering.

After both nodes have Windows Clustering running, you are ready to install Exchange on the first node. Follow the instructions from Cluster.doc located on the 5.5 Enterprise CD in the folder:

<CD-ROM>:\Docs\Word_docs\Clustering

Important note: Microsoft Outlook® Web Access is not supported with Exchange Server 5.5 running in a clustered environment.

After Exchange 5.5 is installed on both nodes, install Service Pack 3 for Exchange 5.5 on the active node. For more information on Service Pack 3, see http://www.microsoft.com/exchange/DeployAdmin/sp3.htm.

After the service pack installation has completed successfully on the active node, install the service pack on the inactive node.

Upgrading a Cluster

To upgrade a computer running Exchange 5.5 Server on Windows NT 4.0 with Clustering Service to Windows 2000 with Windows Clustering, you need to first install Service Pack 3 for Exchange Server 5.5 on the active node.
After the service pack installation has completed successfully, install the service pack on the inactive node.

To upgrade a computer running Exchange Server 5.5 SP3 on Windows NT 4.0 with Clustering Service to Windows 2000 with Windows Clustering:

1. Obtain Windows 2000 Advanced Server or Windows 2000 Data Center Server.
2. Shut down the inactive node.
3. If you are installing Windows 2000 from a CD, you are asked if you would like to upgrade to Windows 2000. Choose **Yes**.
4. If you are installing from a network share, run Winnt32.exe, and choose **Upgrade to Windows 2000**.

After the successful completion of the installation on the primary node, upgrade the second node to Windows 2000 by repeating steps 1 to 4.

It is *not* possible to upgrade a computer running Exchange Server 5.5 on Windows NT 4.0 with Clustering Service on the Alpha platform to Windows 2000 because Windows 2000 no longer supports the Alpha platform. For more information about this topic, please see:

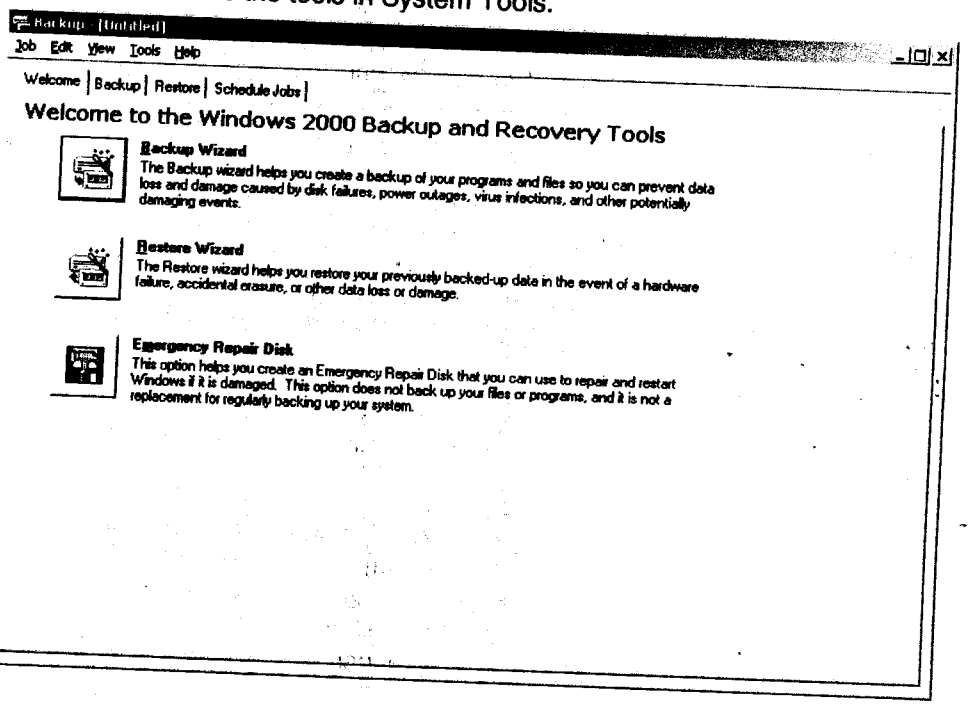
http://www.microsoft.com/ntserver/nts/news/msnw/compaq.asp.

It is possible to transfer the Exchange databases from the Alpha-based cluster to an i386-based cluster by following the instructions described in the following Knowledge Base article:

Q155216, "XADM: How to Move Exchange Server to a New Computer with the Same Name"

Backing Up Exchange with Windows 2000

The Windows 2000 new Backup and Recovery Tools are a significantly enhanced version of the Windows NT Backup program. Using a Backup Wizard and Restore Wizard makes backup and recovery easier and quicker. In addition, the new Backup and Recovery Tools are natively Exchange aware. You can access the tools in System Tools.



To perform a backup using the Backup Wizard:

1. Click **Backup Wizard**, and then click **Next** to begin the wizard.
2. Click **Back up selected files, drives, or network data**, and then click **Next**.
3. Find Microsoft Exchange, and select the organization, site(s), server(s), or database(s) you want to back up, and perform the backup.

Or you can use the **Backup** tab instead to simply find Microsoft Exchange, and select the organization, site(s), server(s), or database(s) you want to back up, and then perform the backup.

Windows 2000 Backup and Recovery Tools provide the ability to back up to a *.BKF formatted file as opposed to backing up to a tape drive. This feature is an extremely flexible and cost-effective backup and recovery mechanism for Exchange. You can back up and restore the Exchange Server database on any accessible

network drive, local drive, or universal naming convention (UNC) path.

To perform online backup to a file rather than a tape device by using the Backup Wizard, in the **Backup Media Type** list on the **Where to Store the Backup** screen, click **File**. Alternatively, on the **Backup** tab, choose **File** as the backup destination.

Restoring Your Exchange Server

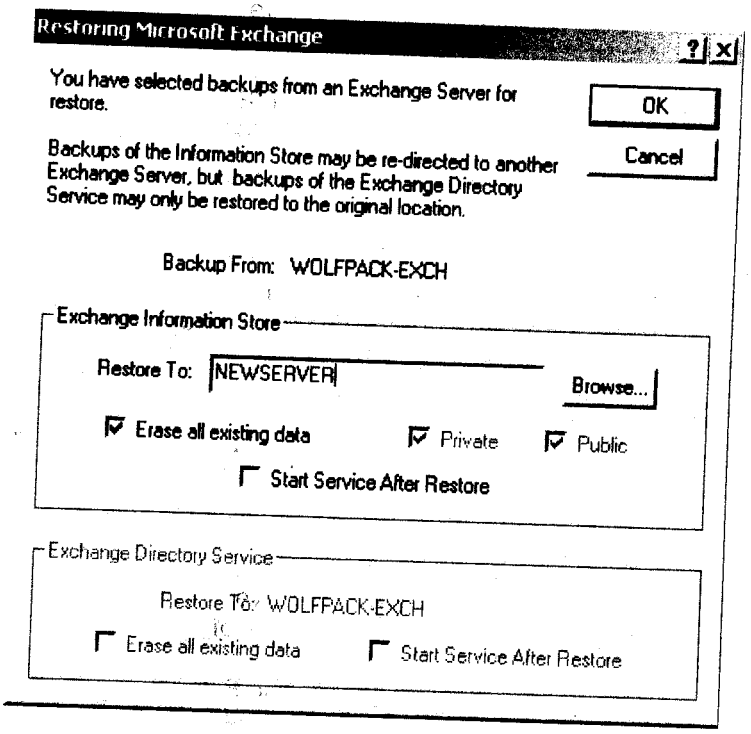
You can restore backups performed by the previous Windows NT Backup program by using the Restore Wizard. To restore Exchange from a previous backup with the new Restore Wizard, simply choose the media containing the backed up Exchange files. The backup program catalogs the media and displays the contents of the backup media. Select the objects you want to restore, and complete the restore operation.

To restore Exchange from a previous backup with the Backup and Recovery Tools by using the **Restore** tab:

On the **Tools** menu, click **Catalog a backup file**.
Choose which objects you want to restore and complete the restore operation.

To restore a backup to a server other than the server from which it was backed up, you need to do the followings:

After choosing which objects you want to restore, select the **Erase all existing data** check box in the **Restoring Microsoft Exchange** dialog box.
This allows you to type the name of the computer to which you want to restore in the **Restore To** box.



Backup and restore procedures as well as disaster recovery procedures and scenarios are the same as they were for Windows NT 4.0. Review the Microsoft Exchange Disaster Recovery Whitepaper available at http://www.microsoft.com/exchange/55/whpprs/BackupRestore.htm for more information.

You can restore a backup of Exchange Server running on a Windows 2000-based computer to Exchange Server running on a Windows NT 4.0-based computer just as you would any other time. You may, however, need to run an offline defragmentation on the databases to start them. Review Knowledge Base article:

Q224977, "XADM: Store Fails to Start: 4294965882, FFFFFA7A, Event 177"

Internet Mail Service (IMS)

Windows 2000 provides a native SMTP service. Installing the SMTP service on a computer running Windows 2000 Server and Exchange Server and using Internet Mail Connector causes the connector to fail to start, which disrupts Internet mail delivery.

Exchange cannot use the Windows 2000 SMTP service to send or receive Internet mail, so you need to remove the Windows 2000 SMTP service for the Exchange IMS to start.

To remove the SMTP service:

1. In Control Panel, click **Add/Remove Programs**.
2. Click **Add/Remove Windows Components**.
3. Select the **Internet Information Services (IIS)** check box, and then click **Details**.
4. Clear the **SMTP Service** check box, and then click **OK**.

You can use the Windows 2000 SMTP service as a transport choice for inter-site replication between Windows 2000 domain controllers. You can also use it for general SMTP mail functionality. Disabling this service does not affect the ability of Windows 2000 to use SMTP protocols for inter-site replication or general SMTP mail functionality. The Exchange IMS makes the service available directly to any application including Windows 2000 Active Directory replications.

Performance Considerations

The upgrade of a Windows NT 4.0 domain controller to a Windows 2000 domain adds new tasks for the server that did not exist under Windows NT 4.0, mainly management of the Active Directory services. In a small implementation that uses a single server, it is important to note that the memory and processor overhead will increase. Depending on the overall performance requirement and changes, a memory or processor upgrade may be required to bring performance to acceptable levels. For multi-server organizations, running the IMS on a non-domain controller server yields better performance because the server is free from the intensive Active Directory service overhead.

Dial-Up Connections

Upgrading Exchange servers with IMS dial-up connection should pose no problem to Internet Mail Service if Exchange 5.5 service pack 3 is properly installed.

The IMS dial-up mechanism may encounter a possible problem that is caused by the inability to find the Phonebook entry. This is described the in the following Knowledge Base article:

Q236910, "XIMS: Cannot Open IMS Dial-Up Connections Tab"

Another IMS-related article is:

Q247063, "XFOR: Unable to install the Exchange 5.5 IMS on Windows 2000"

New Installations

Setting up Microsoft Exchange Server with Internet Mail Service on a new Windows 2000-based server should follow the same rules as the upgrade. However, for a new server, you must consider the basic Windows 2000 configuration issues.

1. Ensure proper DNS configurations. Refer to Windows 2000 documentation.
2. Ensure that you use proper security credentials and account memberships when installing Exchange.
3. If installing on a Windows 2000 domain controller, make sure that the SMTP service is removed or disabled.
4. Install Exchange Server service pack 3.
5. Configure Exchange and Internet Mail Service.

Novell GroupWise Connector

Upgrade

If you are using Novell Client for Windows NT version 4.7, the Windows 2000 setup program automatically upgrades your existing client to the new Windows 2000-compatible version.

Windows 2000 ships a scaled-down version of the Novell client and installs it to ensure compatibility. However, this version has a few limitations. For the full functionality, obtain a complete version of the client from Novell and install it after the upgrade concludes. The scaled down version that ships with Windows 2000 is also supplied and supported by Novell. It is important to note that the automatically-upgraded version still provides e-mail and basic Novell GroupWise connectivity and should continue to function properly.

Steps:

1. Upgrade Exchange Server to service pack 3
2. Upgrade to Windows 2000.
3. Upgrade to the full version of Novell Client.

Please review the following Knowledge Base article for additional details:

Q218158, "Upgrading to Windows 2000 Upgrades Existing Novell Client"

New Installation

Installing Exchange Server and Novell GroupWise connector on Windows 2000 requires connectivity to Novell GroupWise.

The Gateway (and Client) Service for NetWare by Microsoft and the Novell NetWare client for Windows 2000 by Novell provide connectivity to Novell NetWare.

Although the Microsoft-provided client can accomplish basic administrative and connectivity tasks, you may want to choose the Novell client because it includes more advanced management features and tools.

It is important to note that when Windows 2000 setup detects the presence of the Novell 5.7, it upgrades it with the scaled-down version of the Novell supplied client to ensure compatibility. However, when you try to add support for Novell using the

Network utility in Control Panel, the only built-in option is the Microsoft version of the client.

The files for the Novell-supplied client can be found in the Windows 2000 distribution CD under \I386\Winntupg\Oem\Novell.
However the client is designed to run with the upgrade only; you cannot run an independent setup of this version of the client.

X.400 Connector

Upgrading computers running Exchange Server that provide X.400 mail connectivity to another computer running Exchange Server or to a foreign mail system should not require any special consideration, unless the TP4 protocol is being used for any of the X.400 connections.

TP4 protocol support is not available in Windows 2000 and it is no longer possible to use the TP4 protocol on a Windows 2000-based server. In an Exchange messaging environment, substitution with TCP/IP is the only alternative solution.

In very rare cases, TP4 is required to maintain X.400 connectivity to older X.400 foreign systems or to Microsoft Mail X.400 gateways. Unfortunately, there is no work-around for such scenarios. You must either upgrade to TCP/IP or maintain this connector on an operating system that supports it, such as Windows NT 4.0. It is strongly recommended that you migrate any connection using TP4 to TCP/IP to maintain future support.

Windows 2000 setup detects the presence of TP4 and instructs the user to remove the protocol before setup can proceed. The following are the steps to remove TP4 from Windows NT.

1. Open Network in Control Panel
2. Click the **Protocols** tab, click **TP4**, and then click **Remove**.
3. Restart the server and start the upgrade

For more information, refer to the following Knowledge Base article:

Q242157, "XCON: TP4 Transport Protocol Not Supported Under Windows 2000"

X.400 Over X.25 Networks

If you are using X.400 mail connectivity over the X.25 protocol, you may need to ensure that Windows 2000 supports your X.25

adapter(s). The following EICON adapters are compatible with Windows 2000.

Eicon Card C20
Eicon Card C21
Eicon Card P92
Eicon Card S50
Eicon Card S51
Eicon Card S52
Eicon Card S90
Eicon Card S91
Eicon Card S94

If you are using an earlier version of an EICON adapter or a version that is not on the Windows 2000 compatibility list at the time of this paper publication, please check with EICON for possible Windows 2000 updated drivers. Also check the Windows 2000 Hardware Compatibility List (HCL) at the following location for the latest supported adapters: http://www.microsoft.com/windows2000/upgrade/compat

The following Knowledge Base articles relate to X.25:

Q169668, "XCON: X.25 Support for SAT Cards"
Q169667, "XCON: X.25 Support for CIREL Cards"
Q182758, "XCON: X.25 Cards Supported Through Direct Hardware Interface"

MSMail, cc:Mail, and Lotus Notes

Lotus cc:Mail connectivity is not affected by migrating Exchange Server to a Windows 2000-based computer. Message connectivity and directory synchronization with cc:Mail requires direct network connections to the cc:Mail post office, as well as the ability to run the cc:Mail-supplied Import and Export programs in either the old 16-bit version or the new 32-bit version release. The ability to do the above has not changed in Windows 2000. The Microsoft Exchange 5.5 cc:Mail connector does not require any special configuration after the upgrade or in the case of new install.

Microsoft Mail messaging and directory synchronization components, including the Microsoft Exchange PC MTA service, do not require any changes when upgrading or performing a new Exchange installation.

No changes are required for upgrading Exchange Server with Lotus Notes connector. The Lotus Notes client is based on the Lotus server requirement, however the client version 4.6 or later is recommended.

SNADS and PROFS

SNADS and PROFS connectors are not impacted by a Windows upgrade as long as host connectivity is maintained. Consult your SNA documentation for further information regarding host connectivity.

Dynamic RAS Connector

The Dynamic Remote Access Service (RAS) connector should continue to work properly after the Windows 2000 upgrade if Exchange service pack 3 is properly installed. For more information, see the following Knowledge Base article:

Q236910, "XIMS: Cannot Open IMS Dial-Up Connections Tab"

For more information on how to configure the Dynamic RAS Connector, please review the following "How To" document: http://www.microsoft.com/support/exchange/howto.htm

Routing and Remote Access

The Windows 2000 Routing and Remote Access feature provides an alternative to the Dynamic RAS connector by making all dial-up and remote connections a part of the network rather than the server running Exchange.

When using Routing and Remote Access, connections to remote sites are established through site connectors, or X.400 connectors, as any other Exchange site on the LAN. However, it is important to point out that by using Routing and Remote Access, you lose the dial-up schedules feature available in the dial-up Exchange connector. In addition, depending on the initial connection latency, some link parameters on the X.400 connector may need to be adjusted to account the initial latency

For additional information on how to configure Routing and Remote Access, see your Windows 2000 documentation.

Active Directory Connector

Overview

Active Directory Connector (ADC), is the component that replicates the Windows 2000 Active Directory with the Exchange Server 5.5 directory. This replication can be used to aid in the implementation of Active Directory for organizations that have already deployed Exchange Server 5.5 and is a necessary stage for achieving coexistence between Exchange Server 5.5 and Exchange 2000 Server.
In the future, ADC technology may be extended to support replication of other directories, such as Netscape Directory Server, DCL X.500, generic LDAP directories, and other Windows 2000 Active Directories.
ADC works in the following ways:

- Uses the LDAP application programming interface (API) to perform fast replication between the two directories
- Hosts all active replication components on Active Directory, not on the foreign system
- Replicates only changes between the two directories whenever possible
- Maintains object fidelity through replication (for example, the Active Directory Group object maps to the Exchange Distribution List object)
- Hosts multiple connections on a single Active Directory server and manages these using Connection Agreements

ADC Versions

The basic replication functionality of ADC is included with Windows 2000; however, when you install Exchange 2000, an update is installed.

Windows 2000 ADC

The version of ADC included in Windows 2000 replicates directory information in Exchange 5.5 to Active Directory and vice versa. Many customers have already invested heavily in the Exchange directory, and much of this data can be uploaded in bulk to Active Directory, which decreases implementation time. Through replication, the Active Directory administrator can also perform basic management functions for Exchange 5.5 users.

Exchange 2000 Server ADC Update

The Exchange 2000 Server ADC update is an enhanced connector included with Exchange 2000 Server. Whereas the Windows 2000 ADC simply replicates objects in the Exchange site-naming context (for example, Recipients containers) to Active Directory, the

Exchange 2000 ADC also replicates data from the configuration-naming context, thus providing support for mixed-vintage Exchange sites and downstream routing.

The upgrade path between the two versions of ADC is seamless. Customers can deploy Windows 2000 ADC to build their basic Active Directory very quickly, and when ready, they can install the updated ADC when installing the first Exchange 2000 Server.

Appendix F
Utilities for Exchange Server Mailbox Move

Moving individual mailboxes between Exchange sites - Xmerege

Jul 19, 1999
Brien M. Posey

Many times, various departments keep accounts on a single Exchange server. In a corporate restructuring, you may want to move mailboxes belonging to one department to a different site while leaving mailboxes belonging to another. Fortunately, there's a way you can move single mailboxes or a group of mailboxes from one site to another. In this article, we'll explain this procedure in detail.

Saving server space

If you're still using Exchange Server version 5.0, you can recover some lost hard disk space. During the installation process, the Exchange Setup program copies a file called Exg32l.dll to your hard disk. You can safely remove this 33-MB file with no adverse effects to your system. You can do so because the file isn't actually a DLL. If you rename the file from Exg32l.dll to Exg32l.avi, you'll have a two-minute movie that you can play on your PC. The movie displays the names of the Exchange 5.0 development team along with some funny pictures.

Background

This procedure involves using a utility that looks at a user list to determine which mailboxes should be moved. Each mailbox's contents—including the inbox, calendar, contact manager, and so on—are copied to a personal folder. The contents of the personal folder are then migrated into a mailbox on the destination server, which you must have previously created. When the utility finishes, it's up to you to delete the mailbox from the original server and to redirect Exchange clients to look at the new server.

Before you begin

Although the idea behind moving mailboxes may sound simple, the actual procedure is quite complicated. The procedure works well—but only when you follow it *to the letter*. If you leave out a step, you can destroy a mailbox or multiple mailboxes. Even if you're already familiar with this utility, we recommend reading this article in its entirety before attempting a move, because a lot of incorrect or incomplete information is floating around.

Creating the destination mailboxes

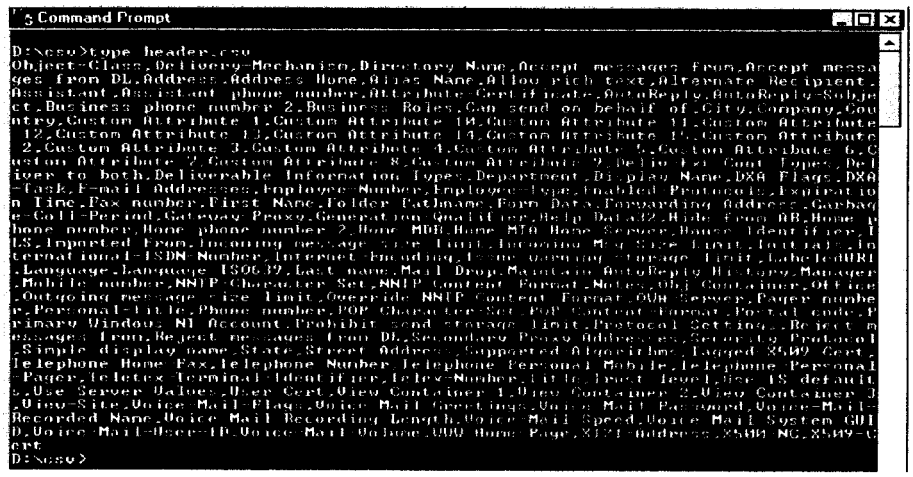
As we mentioned earlier, the mailboxes you're moving must already exist on the destination server before you can move them. Although you can create these mailboxes manually, it's much more practical to use a Comma Separated Value (CSV) file to create them—because later, you'll have to create other CSV files that are very similar to the one you'd use to create the mailboxes.

Creating a CSV file

A CSV file is essentially ASCII text containing various database values separated by commas. You can open a CSV file directly into Microsoft Excel for viewing and editing. To create this CSV file, go to your source server (the one containing the mailboxes you want to move) and create a CSV folder. Next, use the Header tool from the Exchange Resource Kit to create a file called *Header.csv* and copy it to this folder. As you can see

in **Figure A**, the Header.csv file contains a list of each field in the Exchange database, separated by commas. (If you have difficulty locating the header tool, you can create your own Header.csv file by keying in the text shown in Figure A.)

Figure A

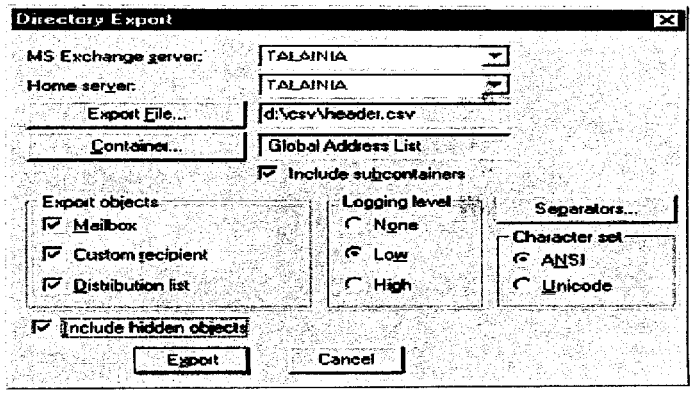


The Header.csv file lists each field of the Exchange database.

Exporting account information

Once you've created your Header.csv file, you must export account information from the source server to the file. To do so, open Exchange Administrator and connect to the source server. Next, select the Directory Export command from the Tools menu. When you do, the Directory Export dialog box will open; fill in the options shown in **Figure B**. It's important that you export only from your source server (the default is all servers in the site), and that you specify the correct location of the Header.csv file. When you're done, click Export to begin the export process. It's normal for this process to generate large numbers of warnings and the occasional error.

Figure B



Select these options and click Export.

Now, open the Header.csv file in Microsoft Excel. When you do, you'll notice that Exchange has entered the export information into the file. Exchange backs up the original Header.csv file as Header.c01 (or another numeric trailer if you've performed more than one export). Use Microsoft Excel to remove all empty columns from the Header.csv file. It's okay to have blank cells, as long as at least one cell in each column contains data. You should also delete the HOME-MDB, HOME-MTA, and HOME-SERVER columns if they exist.

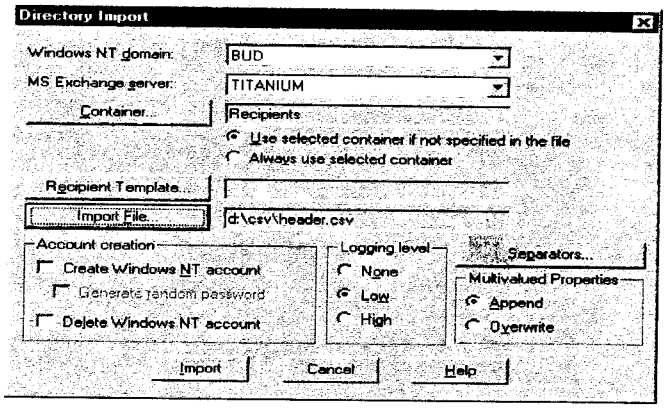
It's also important to note that in most cases users in different sites have different SMTP addresses. If you need to change a user's SMTP address to match the server you're moving them to, you can make the change in the Header.csv file.

Now that you've cleaned up your Header.csv file, it's time to decide which users you want to migrate. By default, the Header.csv file will list every mailbox that resides on the source server. You need to delete from the file each row that references a mailbox you don't want to migrate. You should be left with a CSV file containing only the users you plan to migrate.

Creating destination accounts

When you've created a valid Header.csv file, you can use it to create accounts on the destination server. To do so, open Exchange Administrator on the destination server. Select the Directory Import command from the Tools menu. When the Directory Import dialog box opens, fill in the options shown in **Figure C**. Click the Import button to begin the mailbox creation process. Again, it's normal to see a substantial number of warnings and a few errors. If you have doubts about how the import process went, you can use Exchange Administrator to verify that the accounts actually exist on the destination server.

Figure C



Select these options and click the Import button.

No NT account

You probably won't want to select the Create Windows NT account option in the

Directory Import dialog box, because you're migrating mailboxes that already exist. Each user's current Windows NT account will still be valid with their newly migrated mailbox.

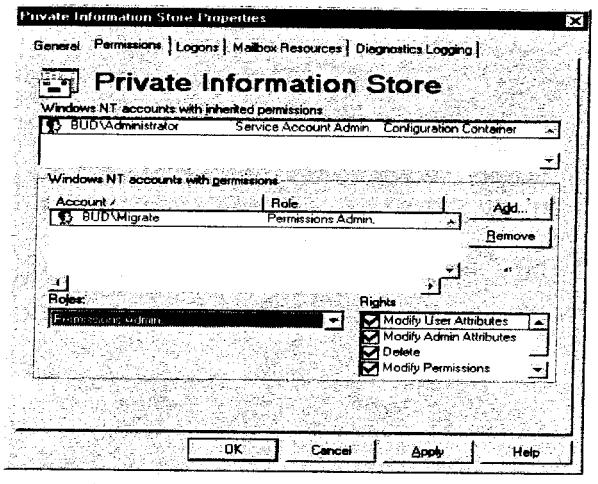
Preparing mailbox permissions

Before you can begin migrating mailboxes, you must have owner privileges to each mailbox on the source and destination servers. The ideal situation is for the source and the destination servers to both use the same service account. If this is the case, the service account already has all of the necessary permissions. If the two servers use different service accounts, you must create an account to use specifically for the migration process and assign it the necessary privileges.

Whichever account you decide to use, you can grant the necessary permissions by going into Exchange Administrator and selecting the Options command from the Tools menu. When the Options Properties sheet opens, click the Permissions tab. Next, check the Show Permissions Page For All Objects check box and the Display Rights For Roles On Permissions Page check box. Click OK to continue. Enabling these options lets you alter the permissions for each individual mailbox.

The next step is to actually assign the necessary permissions. Because you may be migrating a large number of mailboxes, it's usually easier to set permissions for all the mailboxes at once rather than trying to set the permissions on individual mailboxes. To do so, select the Private Information Store under the source server. Next, choose the Properties command from the File menu. When the Private Information Store Properties sheet opens, click the Permissions tab. Now, add the account you chose to use, and assign it the Permissions Admin role, as shown in **Figure D**. If you chose to use the service account, you don't have to add any additional permissions. Repeat this process on the destination server.

Figure D



Your migration account must have at least Permissions Admin access on both servers.

Creating a migration profile

The next step in preparing for the migration is to create an Exchange Client profile. The migration account uses this profile to attach to each mailbox and to move data between mailboxes and personal folders. To create this profile, simply log on to a Windows NT Server or a Windows NT workstation as the migration account and install Exchange Client. Next, create a profile for the migration account in the same way you'd create a profile for any other user. The only stipulation is that you must create a personal folder and link it to the profile. Make sure that the computer you use for this profile has plenty of free hard disk space; the migration process will deal with only one mailbox at a time, but some mailboxes are very large.

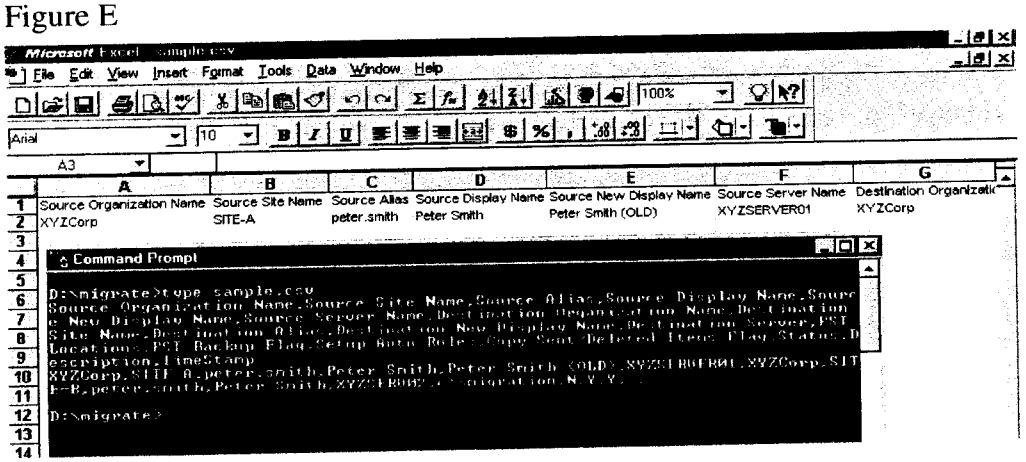
Sizing up disk space for migration

When you're choosing a computer for your Exchange Client profile, look at the size of the largest mailbox. As a rule, you should make sure that the PC you use has at least one and a half times that much free disk space.

Creating a migration template

The next step in preparing to move mailboxes involves creating a migration template. A *migration template* is a special CSV file that tells the migration utility which mailboxes to move and how to move them. To create this file, begin by copying the Mailbox Migration Tool (Migrate.exe) from the BackOffice Resource Kit 2 CD-ROM to a directory on your hard disk. The path of the utility is \Exchange\Winnt\I386\Admin\Mbmigrat. This directory also contains a file called Sample.csv, shown in **Figure E**. The various fields in the Sample.csv file are as follows:

Figure E



You can build your migration template on the Sample.csv file.

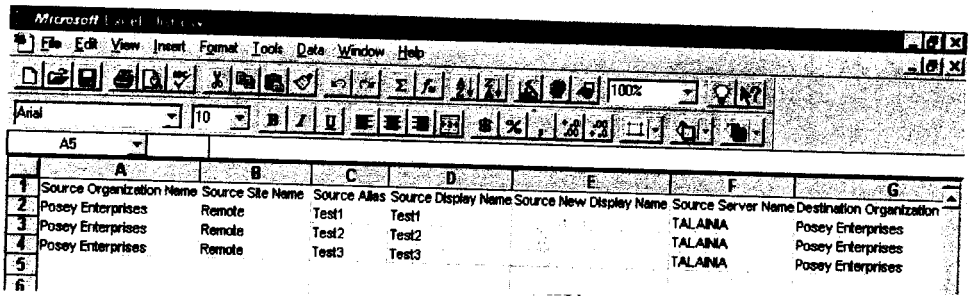
- **SrcOrgName**—The name of the organization where the original mailbox resides.
- **SrcSiteName**—The name of the Exchange site containing the original mailbox.
- **SrcAliasName**—The alias associated with the mailbox being moved.
- **DisplayName**—The display name of the mailbox being moved.
- **SrcNewDisplayName**—Gives you the option of renaming the source mailbox after it's been moved. For example, when you move a mailbox you must manually

delete it, although the original mailbox is empty. By entering a value in this field, you could change a mailbox name from MAILBOX to OLD_MAILBOX so that you can distinguish it from the migrated mailbox. This field is optional.

- **SourceServer**—The name of the server containing the original mailboxes.
- **DestOrgName**—The name of the organization containing the destination mailbox.
- **DestSiteName**—The name of the site containing the destination mailboxes.
- **DestAliasName**—The alias name of the destination mailbox.
- **DestNewDisplayName**—Similar to SrcNewDisplayName; lets you change the display name of the destination mailboxes.
- **DestinationServer**—The name of the server housing the destination mailboxes.
- **PstUNCName**—The location of the PST file that will be used for mailbox migration. You can specify this name in UNC format.
- **PstBackup**—Set this field to a value of Y to make the migration tool back up each mailbox to a PST file named after the mailbox's alias. This setting requires you to have more available hard disk space, because each mailbox is backed up to a separate PST file. Also, note that these PST files aren't automatically migrated to the destination mailboxes. We recommend setting this value to N so you can conserve disk space and enable automatic migration.
- **SetupAutoRules**—Set this field to Y to apply two rules to each mailbox before migration. The first rule automatically forwards new messages to the new server; the second rule causes Exchange to send an automatic reply to new messages indicating that the mailbox is currently being migrated and that message delivery will be delayed. If you use any other value in this field, the migration tool won't apply these rules.
- **DoSentDeletedItems**—Set this value to Y to make the migration tool migrate the contents of the Sent Items and Deleted Items folders. If this field contains any other value (including no value) the migration tool will ignore these folders.
- **Status**—As each mailbox migrates, the migration tool will enter in this field a value indicating whether the migration was successful. The possible values are: PARTIAL (the mailbox has been migrated to a PST file), COMPLETE (the migration is complete), FAILURE (an error occurred and the mailbox couldn't be migrated), and CRITICAL (an error occurred that left the Exchange database in an inconsistent state; such an error requires immediate attention).
- **Description**—Describes any error messages generated during migration.
- **TimeStamp**—After the migration, this field will contain a time stamp that indicates when the mailbox move was completed.

Copy the Sample.csv file to a file named List.csv and open List.csv in Microsoft Excel. Now, import the display names and alias names from the Header.csv file you created earlier. Manually fill in the first row with all remaining information. After you've filled in the remaining fields, you can easily copy them to all remaining rows. **Figure F** shows a sample of what your List.csv file should look like.

Figure F

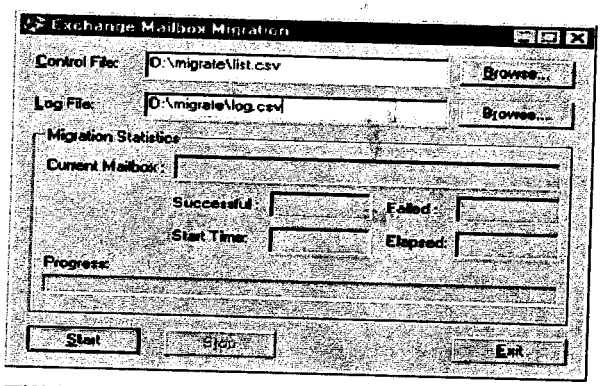


	A	B	C	D	E	F	G
1	Source Organization Name	Source Site Name	Source Alias	Source Display Name	Source New Display Name	Source Server Name	Destination Organization
2	Posey Enterprises	Remote	Test1	Test1		TALAINIA	Posey Enterprises
3	Posey Enterprises	Remote	Test2	Test2		TALAINIA	Posey Enterprises
4	Posey Enterprises	Remote	Test3	Test3		TALAINIA	Posey Enterprises
5							
6							

Moving the mailboxes

Now that you've done all the preparation work, it's time to move the mailboxes. To do so, open the Migrate.exe file that you copied to your hard disk earlier. When you do, the Exchange Mailbox Migration dialog box will open. Simply fill in the appropriate information, as shown in **Figure G**. You can specify any name for a log file as long as a file by that name doesn't already exist. Now, click Start to begin the migration.

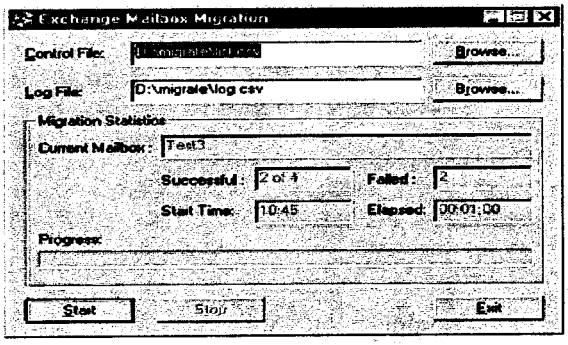
Figure G



Fill in the appropriate migration information.

After the migration completes, the migration tool will display a summary of the mailbox migration, as shown in **Figure H**. It's normal to see at least one failure, because the top row of the List.csv file contains header information rather than mailbox information. In this example, we've also intentionally provided the migration tool with incorrect information for one mailbox. If some of your mailboxes don't migrate correctly, you can load your log file into Microsoft Excel to view the error in more detail.

Figure H



The migration tool displays a summary of the migration process.

Conclusion

In this article, we've discussed the technique behind moving individual mailboxes or groups of mailboxes between Exchange sites. You should always remember to use caution when performing such a procedure, because skipping steps or using incorrect parameters can destroy Exchange mailboxes.

Brien M. Posey is an MCSE and a freelance technical writer. He also works as a network engineer for the Department of Defense. You can contact him via e-mail at Brien_Posey@xpressions.com. (Because of the large volume of e-mail that he receives, it's impossible for him to respond to every message. However, he does read them all.)

Moving an Exchange Server to a Different Site – Move Server

By Brien M. Posey, MCSE

Published in TechRepublic's *Windows NT Administrator Report* (TechRepublic.com)

Often, business can be more chaotic than practically any other aspect of our lives. It's become commonplace for companies to restructure about every other week. All this restructuring can be a major headache for the IT staff, because it usually means moving computers around and can sometimes mean restructuring your entire domain model. Because of its complexity, Exchange Server has always been one of the most difficult components to restructure. In this article, we'll try to make your life a little easier by showing you how to move an Exchange Server from one site to another.

The key to a successful migration is good planning. The migration utility is relatively easy to use, and in our tests, it had no problem moving the Inbox, Calendar, Contact Manager, Task List, and so on. However, you'll still have to do a lot of work.

Make a backup

Any time you're moving servers around, there's always the chance that something could go wrong. Before you begin, perform an on-line Exchange backup on each server in the two sites you're working with.

Preparing Exchange clients

Before you migrate the server, you need to understand how the migration will impact clients. Normally, you won't have to change anything on a client machine, because you aren't changing the name of the server. As you probably know, Exchange Client and Outlook use the server's name rather than the site name to attach to the server. In some cases, though, it may be necessary to re-attach the client to the appropriate mailbox—this is especially true when another server in the destination site has a mailbox with a similar name. However, if you plan to move the server to a different domain than the domain the clients are logging into, you'll have to make sure that the appropriate trust relationships exist.

E-mail addresses

It's also important to point out what happens to e-mail going to a migrated mailbox. Internal e-mail won't change, because all changes associated with the migration are automatically added to the Global Address List (assuming replication is functional).

However, Internet mail is handled differently. As you may know, normally the server's IP address is listed in the DNS server along with the server's domain name. When you migrate a server, each mailbox retains its original SMTP address. Because the server still has the same name and IP address, and because there's still a DNS reference to the server, the original address should continue to work. Each mailbox is also assigned a new SMTP address that corresponds to the bridgehead server in the new site's DNS entry. This address should also be functional.

Preparing the servers

Once you've planned your migration, you must prepare your servers. Make sure each server in both sites is running Exchange version 5.5 with Service Pack 2. This procedure won't work with older versions of Exchange or with Service Pack 1.

After you've verified your Exchange version, you must enable intersite directory replication between the two sites. This means that both sites know about each other and share a common Global Address List. To do so, you must create a Site Connector and a Directory Replication Connector.

Configuring a Site Connector

The Site Connector is responsible for forming a logical link between two sites. Before you can configure a Site Connector, a physical link between the sites must already exist. The sites you're trying to link must also be in the same organization. Keep in mind that organization names are case sensitive. To create a Site Connector, simply select the Connections object and choose New Other | Site Connector from the File menu, and fill in the appropriate information.

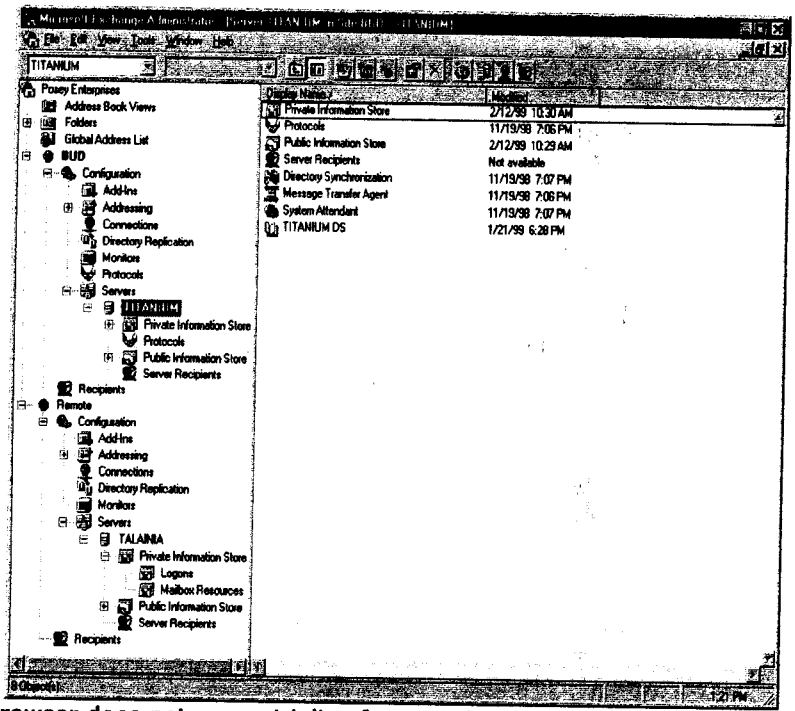
For the most part, configuring a Site Connector is simple and straightforward. However, we should point out one step, because it's absolutely critical. As you may recall, when you installed Exchange, the Setup program asked you for a logon name and password for the Exchange service account.

Exchange uses this service account to interact with Windows NT. As a result, both sites must have knowledge of the other site's service account and password. You can supply this information on the Site Connector Properties sheet's Override tab. Remember that if your bridgehead servers for the two sites exist in different Windows NT domains, you must have a two-way trust relationship between the domains for the Site Connector to work.

Configuring a Directory Replication Connector

When you've established a Site Connector, you must configure a Directory Replication Connector. Building a Directory Replication Connector requires you to select the directory replication container and choose New Other | Directory Replication Connector from the File menu.

Configuring the Directory Replication Connector is simple: Just fill in the information on the Directory Replication Connector Properties sheet. The only trick here is that like the Site Connector, the replication connector must be configured on both sites. As you configure the Directory Replication Connector, make sure that you select Always on the Schedule tab for both sites. Also, don't worry if nothing shows up on the Sites tab. This information will appear automatically later on, as replication begins. You'll know that replication has completed when you can view both sites through Exchange Administrator, as shown in **Figure A**.



(If your browser does not support inline frames, click here to view in a separate page.)

Figure A

You must enable intersite directory replication before you can begin the migration process.

Performing the migration

The first step in moving a server to a different site is to decompress the Move Server utility. To do so, insert your Exchange 5.5 Service Pack 2 CD. Now, create a directory on your hard disk called Movesrvr, and copy the contents of the CD's \Server\Eng\Server\Support\Movesrvr directory into it. Next, open the file Setupmvi.exe to decompress the files it contains. When the decompression program asks you for a location to copy the files to, install them in the Movesrvr directory on your hard disk.

Isolating the Exchange Server

Before you can use the Move Server program, you must isolate your Exchange Server. To do so, break the Directory Replication Connector between the two sites. Although this may seem counterproductive since you may've just created these connectors, it's been our experience that the sites must have known about each other at one time, or the migration process fails.

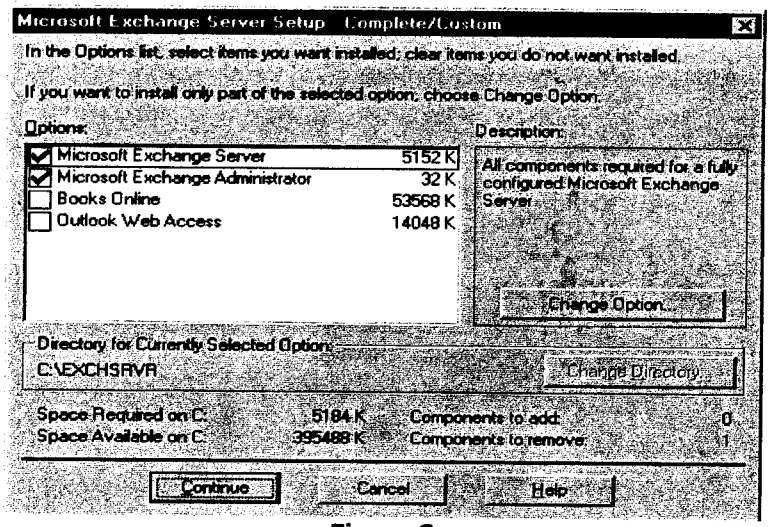


Figure C

Use the Microsoft Exchange Server Setup program to remove the Exchange Event Service.

Using the Move Server Wizard

At this point, it's time to perform the physical migration. To do so, open the file \Movesrvr\Mvexsrvr.exe. When you do, the Microsoft Exchange Move Server Wizard will start. Now, follow the onscreen prompts until you get to the window shown in **Figure D**. Notice the disk space requirements shown in the figure. These estimates aren't always accurate, so it's a good idea to select a drive with plenty of free space. A drive running out of space during a migration yields unpredictable results.

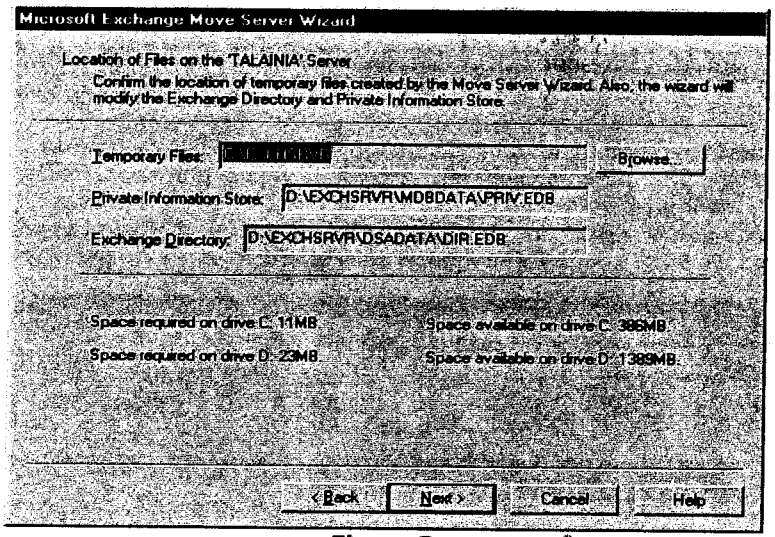


Figure D

Select drives with plenty of free disk space.

When you've selected the hard drives you want to use, click Next to continue. At this point, you'll see a window similar to the one used during the Microsoft Exchange Server Setup program. Since we're trying to make the server a part of another site, we've told the migration wizard to join an existing site and provided it with the appropriate information, as shown in **Figure E**. Click Next to continue.

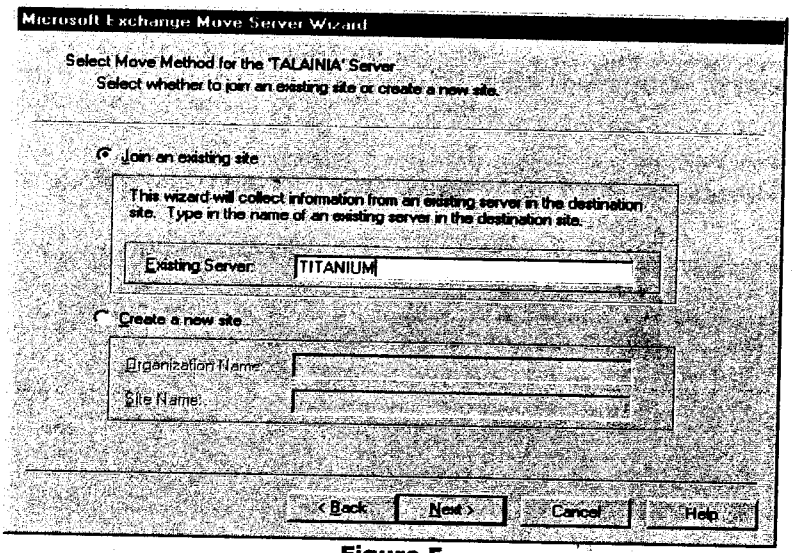


Figure E

Specify the name of a server in the site you want to join.

At this point, the Setup program will display a window asking you to confirm the site you want to join. If you want to migrate the server to the listed site, click Yes to continue.

Now, you'll see a warning indicating that the destination site is a part of the same organization and that you aren't replicating directory information between the two sites. Click Yes to acknowledge this message and continue with the migration.

The wizard will now ask you for the service account name and password for the destination site. When you've provided this information, click Next. Make sure the Move All Custom Recipients From This Site check box is selected and click Next. The next window asks how you want the wizard to handle distribution lists. Unless you have a special need, select the Move All Distribution Lists In The Site radio button and click Next.

At this point, you'll see the screen shown in **Figure F**. Unless you're doing something special, you should leave this screen alone and simply click Next. The reason is that each mailbox already has a primary Windows NT account associated with it. If you select a different domain, the existing accounts will no longer be able to access their corresponding mailboxes. When you click Next, the migration process will begin looking at the objects to be migrated.

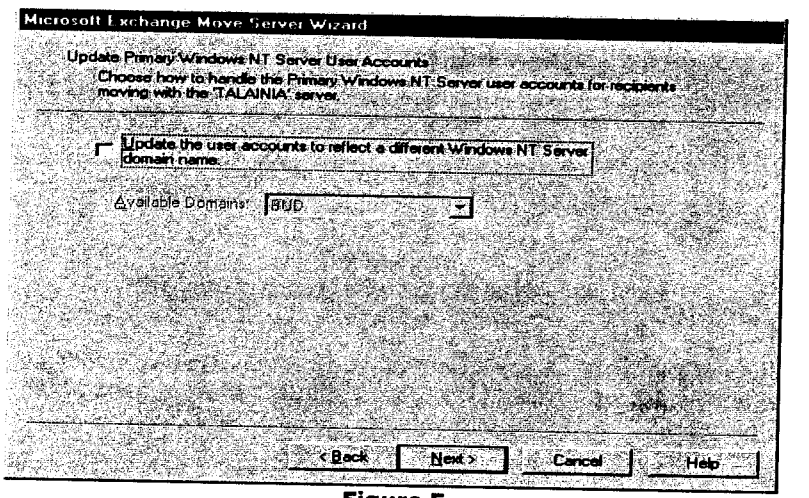


Figure F

Don't change Windows NT domains on this screen, unless you've got a special reason for doing so.

This phase of the wizard will give you the opportunity to change the names of duplicate objects, and will check to make sure everything is ready on both servers. It will also provide you with a report that explains exactly what the wizard will attempt to do. When you're ready to begin the migration, click the I Understand button followed by the Finish button.

The migration can take a long time, especially if you have many users on the server. The migration wizard displays the status screen shown in Figure G, so you can watch the progress of the migration.

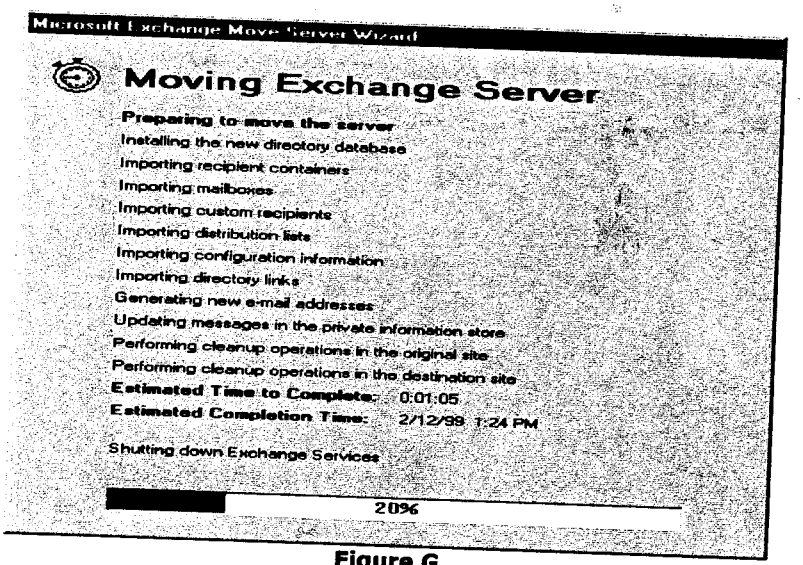


Figure G
This status screen allows you to watch the migration's progress.

When migration completes, click Finished. If you open Exchange Administrator, you should see the server as a member of the site you told it to join, as shown in **Figure H**.

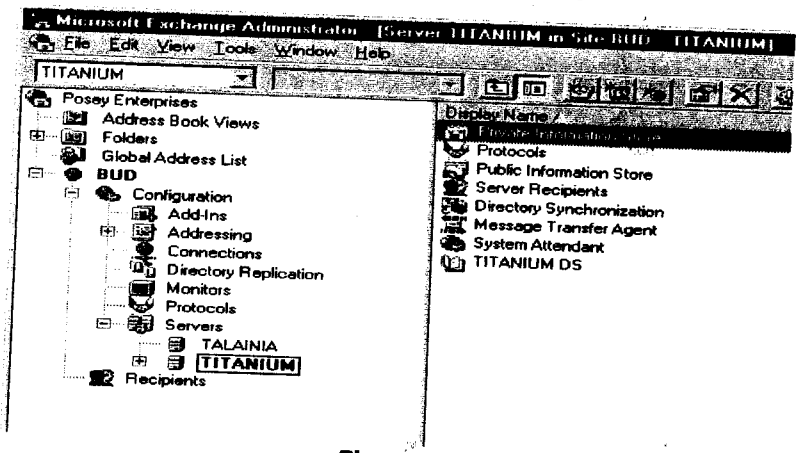


Figure H
The server should now appear in the new site.

Conclusion
In this article, we've shown you how to move an Exchange Server from one site to another. When performing such a task, keep in mind that there's no substitute for good planning to help things go smoothly.

Brien M. Posey is an MCSE and a freelance technical writer. He also works as a network engineer for the Department of Defense. You can contact him via E-mail at Brien_Posey@xpressions.com. Because of the large volume of E-mail that he receives, it's impossible for him to respond to every message. However, he does read them all.

Notes

[1]

[2] WAN stands for Wide Area Network. It is an internetwork that connects multiple sites as one network.

[3] Bandwidth is defined as the amount of data that can be transmitted in a fixed amount of time.

[4] A packet-switching protocol for connecting devices on a Wide Area Network (WAN). Frame Relay networks in the U.S. support data transfer rates at T-1 (1.544 Mbps) and T-3 (45 Mbps) speeds.

[5] T1 is a high-speed digital line that employs four wires in a two pair configuration to transmit full duplex data signals at a maximum rate of 1,544 Mbps. One pair of wires is used to transmit data and the other pair is used to receive data.

[6] Scalable is used to define that a network is prepared for more complex, high-speed requirements, and more equipment as the network grows.

[7] Microsoft Windows 2000 Advance Server and Data Center Server are currently the only versions of Microsoft's NOS that support Cluster environments.

[8] Exchange Server 2000 is still in Beta testing but the new hardware along with upgrade will provide the springboard needed to implement Exchange Server 2000 when it becomes available.

[9] In addition, this documentation should act as a spring board for future upgrades to the messaging environment.

[10] NOS stands for Network Operating System.

[11] A cluster is a group of independent computers that work together to run a common set of applications and provide the image of a single system to the client and application.

[12] Short for *Symmetric Multiprocessing*, a computer architecture that provides fast performance by making multiple CPUs available to complete individual processes simultaneously (multiprocessing). Unlike asymmetrical processing, any idle processor can be assigned any task, and additional CPUs can be added to improve performance and handle increased loads.

References

http://webopedia.internet.com/TERM/b/bandwidth.html

http://webopedia.internet.com/TERM/S/SMP.html

http://webopedia.internet.com/TERM/w/wide_area_network_WAN.html

http://webopedia.internet.com/TERM/T/T_1_carrier.html

http://webopedia.internet.com/TERM/F/Frame_Relay.html

http://webopedia.internet.com/TERM/s/scalable.html

Compaq Product Bulletin second Quarter 2000 North America © 2000 Compaq Computer Corperation: Developed by Desktop Assistance Inc. 16000 Stuebner Airline, Suite 140 Spring, Texas 77379

Bryan Pavy Senior Systems Engineer, Information Technology, Xerox Connect. Personal Interview May 9 2000.

http://www.microsoft.com/windows2000/guide/server/features/choosing.asp

http://www.microsoft.com/windows2000/guide/server/features/clusterintro.asp

http://www.microsoft.com/windows2000/library/planning/server/clustersteps.asp

http://www.microsoft.com/windows2000/library/howitworks/cluster/asoverview.asp

http://www.microsoft.com/windows2000/guide/server/features/clustering.asp

http://www.microsoft.com/windows2000/library/howitworks/cluster/introcluster.asp

http://www.microsoft.com/windows2000/library/howitworks/cluster/clusterarch.asp

http://www.microsoft.com/windows2000/library/planning/incremental/rollupgr.asp

http://www.microsoft.com/windows2000/library/operations/cluster/monitorrel.asp

http://www.microsoft.com/windows2000/library/howitworks/cluster/nlb.asp

http://www.microsoft.com/exchange/productinfo/datasheet.htm