IBM PC Server and Lotus Notes Integration Guide
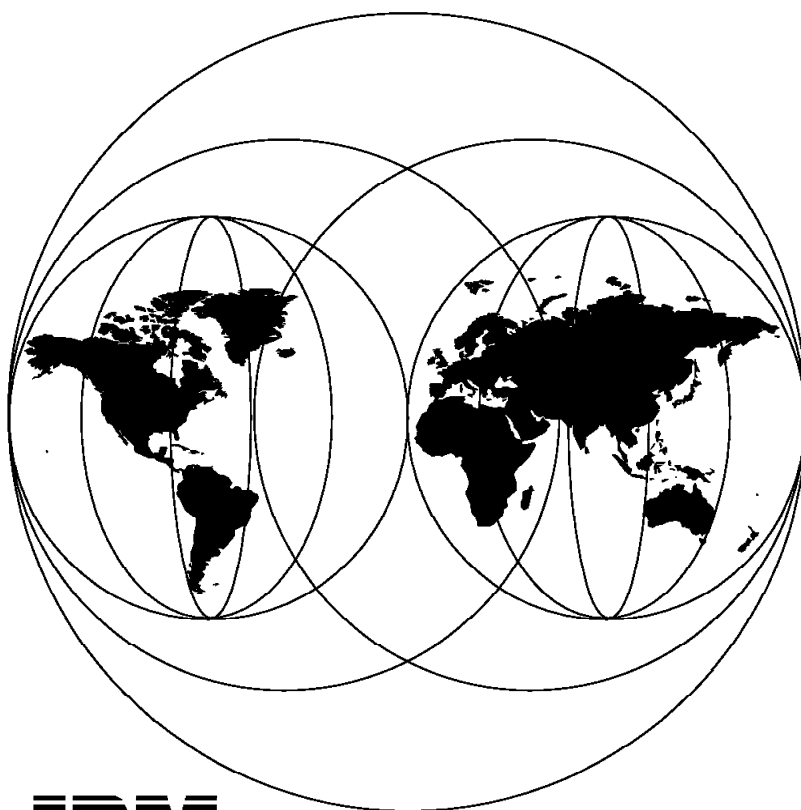
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IBM

International Technical Support Organization

Raleigh Center

> **Take Note!**
>
> Before using this information and the product it supports, be sure to read the general information in Appendix E, "Special Notices" on page 61.

First Edition (July 1996)

This edition applies to Lotus Notes Release 4.1 Server that is shipped with IBM PC Servers for use with OS/2 Warp and OEM operating systems.

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Contents

Preface

The purpose of the *IBM PC Server and Lotus Notes Integration Guide* is to provide a resource for defining the roles and capabilities of IBM PC servers within the Lotus Notes environment. With a powerful and robust application like Notes, determining the appropriate hardware platform for your Notes server is the first requirement for ensuring a reliable environment. In this document we explain the multiple functions that Notes servers can perform, the impact of each function on the server hardware selection, and provide advice on configuring Notes servers for different requirements.

This redbook was written for IBM customers, business partners, and service professionals who are implementing Lotus Notes on an IBM PC Server platform.

Some knowledge of PC servers, Lotus Notes, and network operating systems is assumed.

How This Redbook Is Organized

This redbook contains 72 pages. It is organized as follows:

- Chapter 1, "Introduction"

  This chapter describes the methods and the test configurations used to produce this redbook.

- Chapter 2, "Notes Design Attributes"

  This chapter discusses features and functions of Lotus Notes that may impact your infrastructure decisions as you proceed with your Notes implementation. Operating systems, transport networks, security issues, and systems management are discussed.

- Chapter 3, "Server Considerations for Notes"

  This chapter presents the current line of IBM PC Servers and offers guidelines for sizing the hardware platforms that you will need to run Notes.

- Chapter 4, "Installing IBM PC Servers"

  This chapter offers hints and tips regarding the installation of OS/2 Warp and Windows NT in preparation for installing Notes.

- Chapter 5, "Server Optimization"

  This chapter discusses ways to optimize the hardware and software in a Notes installation. CPU, memory, and DASD requirements are presented as well as tips for setting operating system parameters.

- Appendix A, "Network Considerations"

  This appendix discusses a few of the more important aspects of designing the network transport and the impact that Notes will have on the network.

- Appendix B, "What's New in Notes R4"

  This appendix highlights the new features and functions in Notes Release 4.1 relative to the performance of the system.

- Appendix C, "Notes and the Internet"

This appendix briefly discusses the Lotus strategy regarding the Internet/Intranet and products such as Domino.

- Appendix D, "Lotus Notes NetBIOS Port Drivers"

This appendix discusses the two Lotus supplied NetBIOS port drivers and the trade-offs associated with using each.

The Team That Wrote This Redbook

This redbook was produced by a team of specialists from IBM, Lotus, Microsoft, IRIS, and FCP Technologies. The primary authors of the book were Nelson Scott and John McNulty of FCP Technologies.

Thanks to the following people for their invaluable contributions to this project:

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Comments Welcome

We want our redbooks to be as helpful as possible. Should you have any comments about this or other redbooks, please send us a note at the following address:

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Your comments are important to us!

Chapter 1. Introduction

The data for this redbook is a compilation of experiences gathered from IBM, Lotus, Microsoft, IRIS, FCP Technologies and other business partners and is meant to reflect how an IS professional, manager, technical engineer or sales engineer may approach server selection and implementation for a Notes network environment.

This redbook it is meant to provide general direction and guidelines for the tasks of server selection and implementation. Sizing figures are based on laboratory tests that were made for specific application sets on the server configurations detailed in this document. These user connection figures are meant to approximate total users typically supportable by these average configurations. As is always the case with any laboratory testing, these results should be used as indicators only; actual performance in real end user installations will vary.

Furthermore, this redbook is *not* intended to represent a fully tuned performance benchmark for the maximum number of users that can be supported on a particular IBM PC Server. IBM PC Server benchmark results based on Lotus' NotesBench are available from IBM at http://www.pc.ibm.com/server.

1.1 How to Use This Integration Guide

The flexibility and power of Lotus Notes have led end users to continually push the envelope in how they use Notes and to find new ways to use Notes technology. For that reason Notes implementations take on many different looks and feels. As you begin to roll out Notes in your organization, it is important to plan how you will be utilizing Notes. Will you be using it as your primary messaging and mail system or be linking it to other services in your enterprise? Will the databases you create in Notes be for publishing information in knowledge bases on your LAN and the Inter/Intranet or will your database applications be integrated into your business processes and have heavy workgroup and workflow performance needs? To start, sketch out the number of users that will be running mail, knowledge bases and workflow applications. Depict where the users are located and what connections they have to the LAN, WAN, Inter/Intranet and how those networks are configured. Documenting these factors and reviewing them as you read through this guide, will assist you in determining what type of server(s) and platform(s) may be appropriate for your environment and provide some ideas on how to create the logical topology for your Notes environment.

1.2 How Was the Data for This Integration Guide Obtained?

The information in this redbook was contributed by many resources including IBM, Lotus, Microsoft, IRIS, and FCP Technologies. Information relating to performance characteristics of IBM PC Servers, was generated by information from IBM and test results of simulated environments using Notes on IBM's PC Server platforms within the lab at FCP Technologies. Each server was configured to resemble typical installations for Notes server environments.

For Notes mail and Notes database application usage, we show the average range of users supported for each server platform in relation to Notes server functions. These statistics are not meant to be absolutes, but guidelines for

selecting hardware for your Notes servers. The guidelines in this redbook should be used as a starting point in determining the hardware that meets the requirements of your unique environment. For example, you may have an office that has a high population of mail users and a small population of heavy workgroup users. To determine the server needs for this office you will need to review the server capabilities and test results and blend the mail and workgroup results to best determine the platform selection.

It is also important to note that some basic hardware and software tuning was performed to improve performance. These suggested changes are documented as part of this book. Ongoing optimization of Lotus Notes on IBM PC Server platforms is being performed at IBM.   Additional information will be made available as appropriate.

1.2.1 Selection of Server Platforms for Our Tests

With Lotus Notes now shipping standard on all IBM PC Servers, the choice of platforms to include in our sizings was not an easy one. For the purposes of this redbook, we chose three average server configurations that would represent typical small, medium or large installations.

We chose:

- IBM PC Server 320

- IBM PC Server 720 - Dual Processor

- IBM PC Server 720 - Quad Processor

Uses for each of these platforms is covered in detail within the document. We have also included descriptive sections on the PC Server 520 and 704. Although similar in design and performance to the 320, the 520 offers much greater disk scalability. The recent addition of the ServeRAID adapter (with UltraSCSI support) to new PC Server 520 models will also increase its I/O flexibility and performance. The PC Server 704 with 4-way Pentium Pro support also provides additional choices at the high end of the performance scale. Initial comparisons between Pentium and Pentium Pro systems in processor-intensive environments show substantial opportunities for high-end performance improvements. Specific information regarding Lotus Notes environments will be made available in the future.

The following sections outline the specific hardware test configurations that were used for performance testing.

1.2.1.1 IBM PC Server 320 Test Configuration

Hardware: IBM PC Server 320 (Pentium/133, 128 MB RAM, IBM PCI SCSI-2 Fast/Wide RAID controller, IBM PCI 10/100 Ethernet controller)

PCI RAID controller configuration: (2 - 2.25 GB SCSI drives mirrored (IBM RAID-1) through the SCSI controller) Drive C: for operating system and other storage, Drive D: for Lotus Notes Server software and databases.

Cache: 512 KB

Operating System: OS/2 Warp Server Advanced and Windows NT 3.51

Lotus Notes Server Software: Version 4.1

1.2.1.2 IBM PC Server 720 Test Configuration (Dual Processor)

Hardware: IBM PC Server 720 (two Pentium/100 processors, 256 MB RAM, IBM Micro Channel SCSI-2 Fast/Wide Raid controller, IBM PCI 10/100 Ethernet controller)

IBM Micro Channel Streaming RAID controller configuration: (6 - 2.25 GB hot-swap SCSI drives configured for RAID-5) Drive C: for operating system and other storage, Drive D: for Lotus Notes Server software and databases.

Cache: 512 KB

Operating System: OS/2 Warp Server Advanced SMP Beta version, and Windows NT 3.51

Lotus Notes Server Software: Version 4.1

1.2.1.3 IBM PC Server 720 Test Configuration (Quad Processor)

Hardware: IBM PC Server 720 (four Pentium/100 processors, 512 MB RAM, IBM Micro Channel SCSI-2 Fast/Wide RAID controller, IBM PCI 10/100 Ethernet controller)

Micro Channel Streaming RAID controller configuration: (10 - 2.25 GB hot-swap SCSI configured for RAID-5) Drive C: for operating system and other storage, Drive D: for Lotus Notes Server software and databases.

Cache: 512 KB

Operating System: OS/2 Warp Server Advanced SMP Beta version, and Windows NT 3.51

Lotus Notes Server Software: Version 4.1

1.2.1.4 RAID Level Selection

In our testing we selected the following levels of RAID:

- **RAID-5** (on the IBM PC Server 720) which spreads both data and data parity information across the disks one block at a time which ensures maximum read performance when accessing large files and provides a high transaction rate.

- **IBM RAID-1** (on the IBM PC Server 320) is an enhanced version of RAID-1 which combines disk mirroring with data striping. RAID-1 stripes data and mirrored data across all disks.

Both of these RAID levels provide excellent performance, data integrity, and disk fault tolerance. Although we could have used RAID-0[1] (which is the fastest level of RAID and is used in many benchmark tests), it does *not* provide for data integrity or any type of fault tolerance. For our testing we did not believe that RAID-0 would represent a typical "real world" Notes environment.

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[1] RAID-0 stripes (or spreads) data across multiple disk drives *without* parity protection in order to maximize DASD performance. RAID-0 is the only level of RAID that does not provide any type of fault tolerance. In other words, a failure in one drive will cause the entire disk subsystem to fail.

1.2.2 Selection of Network Configuration for Our Tests

As with the hardware, from the many possible network topologies supported by Notes we chose the 10 Mbps Ethernet topology for our testing as representing the majority of existing Notes environments. Although more robust topologies such as 100 Mbps Ethernet or FDDI could have been used, monitoring of the servers for each tested environment revealed that the network interface utilization rate was consistently below 30 to 40 percent. Therefore, the requirement for representing prevalent environments was considered more meaningful than attempting to achieve greater results with newer network technologies.

The communication protocol selected was TCP/IP, which is the preferred network protocol for the Notes environment. TCP/IP provides the best performance and most efficient use of the network adapter hardware.

Chapter 2. Notes Design Attributes

Selecting the appropriate server platform for your Notes environment is only one of the required components for ensuring a reliable Notes environment. Additional factors such as operating systems and your existing network can influence the hardware platform selected for your servers. Before implementing Notes, you should take an inventory of your existing environment to allow you to better determine the integration of Notes with your network.

2.1 Operating Systems and Notes

Selection of the OS for your Notes servers will most likely be governed by a few factors: functionality, gateway support, performance, IS Directive, and familiarity. Of all these factors, familiarity is commonly the most decisive factor. It is important to inventory your existing network environment, personnel and their associated skills. You may determine that your enterprise has an established base of knowledge and support for one or more operating systems. This will be helpful as you select your OS, but it is also important to keep in mind the functionality that you desire from your Notes environment and not limit yourself to a single OS.

As an example, one Notes customer, a large communications equipment manufacturer, has a number of needs within their Notes environment. They use Notes to provide support to their customers and field engineers. Notes serves as their main mail system. Notes workflow applications are used to run their 24 hour support help desks, a Notes application with a customized API agent acts as the notification and escalation system when a system goes down, as well as publishing technical and status information for their customers to access via the Internet or by phone. (Notifications are sent by Notesmail, DECmail, numeric pager and fax.) To provide all the functionality needed for this environment a number of operating systems were used (see Table 1).

Table 1. An Example of Notes Functions Using Multiple Operating Systems

Notes Applications and Companion Products	Functioning OS
Mail	Novell NetWare
Help Desk	Microsoft NT
Escalation Application and API	OS/2
E-Mail Gateway	OS/2
Fax Gateway	Windows
Pager Gateway	OS/2
Internet Publication	OS/2
Phone Notes	OS/2

For the purpose of this redbook, we focus our discussions on IBM's OS/2 and Microsoft's Windows NT due to the current popularity of these two operating systems. The Notes R4 Server software supports the full range of major operating systems: Microsoft Windows 95, Windows NT, OS/2, Novell NetWare and UNIX versions including IBM AIX, Sun Solaris, and HP-UX.

2.1.1 Gateway, Companion Product and API Support

At the time of this writing, the majority of Notes gateways, such as the SMTP Gateway and PhoneNotes, as well as Application Programmers Interfaces (API) and companion products, are written to operate on IBM′s OS/2 operating system. This condition is a result of the initial release of Notes only operating on OS/2.

With the recent addition of support for Windows NT within Notes, new gateway and API versions are being designed to run on Windows NT. If gateways or APIs will be essential in your Notes environment, you will need to determine which OS each API or gateway can support. The necessity for functions provided by multiple gateways may drive the requirement for supporting multiple operating systems.

Although some end users may be inclined to wait for the particular gateway or companion product to be released on one operating system as opposed to another, this delay may not be the best approach. The functionality gains attained by combining these technologies is almost exponential. The more experience you gain today the better you will understand the ways to exploit the technology as you expand your enterprise. We have found that the investment in the technology and support pay for themselves quickly.

2.1.2 Performance

Notes′ unique characteristics for sharing information and application processing have introduced new stresses to server platforms. Defining the performance characteristics of a particular OS or hardware platform is complicated by the ability of a given Notes server to perform several functions within the network. However, almost all Notes functions are processor-intensive and benefit significantly from the installation of additional processors. Therefore, when selecting an OS with respect to performance, the support for multiple processors is the foremost requirement.

Both OS/2 for Symmetrical Multiprocessing (SMP), and Microsoft Windows NT are scalable, multitasking operating systems supporting up to 16 and 32 Pentium processors respectively. OS/2 Warp Server Advanced SMP[2] is a more robust operating system than OS/2 SMP, which also provides scalability, multitasking and enhanced disk subsystem performance. All of these operating systems have also been designed to support multivendor hardware systems, including IBM′s PC Server 310, 320, 520, 704, and 720 platforms.

2.1.3 IS Policy and Directives

When selecting the OS for your servers be sure that you have investigated all the internal policies and directives within your organization. Many times a Notes initiative is started within a business division or workgroup that has a specific need for the technology. It is prudent to consult the IS professionals in your organization as you are making your operating system and hardware choices. Many IS groups have set standards and policies for OS platforms that can be implemented within the organization. We have found when implementing Notes environments that adding an IS representative to the team or minimally by keeping them involved in hardware and operating system selections they will provide a continuity with the organizational direction.

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[2] At the time of this writing OS/2 Warp Server Advanced SMP was still in Beta.

2.1.4 Familiarity

When Notes was first released in the early 90s, OS/2 was the only operating system supported for the server. As a result, the majority of Notes servers in today's corporations exist on OS/2 platforms. Due to this large base of installations, support and expertise for the OS/2 operating system is currently predominant in the Notes environment. This factor should be considered when selecting the standard OS for Notes.

With the recent addition of Notes support for Windows NT, corporations are beginning to implement this platform in conjunction with new NT file servers, or in expectation of future migrations. As Windows NT implementations increase in number, support and expertise with this environment can be expected to increase accordingly.

2.2 The Network and Notes

Any solid and consistent Notes environment must have a reliable foundation on which to communicate. Therefore a key piece of your deployment plan is to get an accurate assessment of the network infrastructure. Determining how workgroups and departments are connected will have a major impact on your strategy for server deployment, mail routing, and database replication. For example, you may find that one or more workgroups are dispersed among several geographical regions. Communications for these workgroups could introduce potential problems with your existing WAN infrastructure and may necessitate the installation of multiple servers. As you perform your network inventory, pay careful attention to the following.

2.2.1 WAN Communication between Locations

Notes servers distribute information throughout the network by way of *replication*.[3] For replication to occur between remote locations, the Notes servers can utilize either asynchronous dial-up lines or existing wide area network (WAN) links within the network. Using existing WAN links will reduce the cost of your long-distance carrier service, ensure more reliable connections, and allow for a more efficient scheme when deploying servers in your network.

With the release of Notes Version 4.x, traffic generated when replicating databases has been reduced by the ability to replicate only updated fields within documents versus the entire document as required in Version 3.x. Although the impact to the network has been reduced, mail routing and database replication for a large enterprise could still overburden your WAN network infrastructure.

2.2.2 WAN Bandwidth

Knowing the speed of each WAN connection will help you to schedule mail delivery and database replication. Take a look at the utilization levels on your WAN links. If they are close to capacity, you will probably want to increase the bandwidth to prepare for Notes. You may also consider X.25 connections directly to one or more Notes servers within your enterprise network. This will retain the benefits of WAN connections while eliminating the addition of server-to-server traffic on your local area network (LAN).

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[3] For a detailed explanation of replication refer to the Glossary.

2.2.3 LAN Scalability

Can your network support rapid growth? Historically, the implementation of Lotus Notes has tended to result in a rapid deployment throughout the network. If your network is nearing maximum utilization, you may need to consider increasing network throughput by way of bridging or routing, in the anticipation of growth.

2.2.4 Internet Access

With the recent boom in access to the Internet, Lotus has aggressively embraced this communications medium in a number of ways. In terms of the networking infrastructure many customers are beginning to look at using the Internet as an extension to their corporate regional office backbones providing the ability for Notes Servers within each location to replicate databases and route mail messages replacing point-to-point leased lines. Large and medium-sized corporations with experienced IS departments will realize the most savings. For smaller corporations, direct Internet connectivity many not be a reasonable solution due to the startup cost and experience required for maintenance. Consideration of a Notes Public Network Provider, such as the IBM Global Network, may be more appropriate.

Beyond the networking aspects of the Internet, Lotus is working to advance its overall Internet integration strategy for Notes through the direct incorporation of key Internet and Web standards such as HTTP, HTML, and Java into the Notes architecture. For more information on Lotus′ Internet strategy please visit their Web site at http://www.lotus.com.

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2.3 Protocols

Notes supports networks compatible with the Network Driver Interface Specification (NDIS), and Open Data Link Interface (ODI) standards. This means that Notes is capable of supporting almost any protocol that you may be using within your network. When determining which protocol to use for Notes connectivity, consider the following issues:

- Which protocol is most widely used within your enterprise network?
- Will your Notes servers need to support multiple protocols for the entire user population?
- Which protocols are being utilized on WAN connections?
- What are the protocol′s scalability and limitations?

Use the following lists to determine the network protocol standards with which your network operating system is compliant. If the protocols are NetBIOS-based, the word NetBIOS or NetBEUI appears in parentheses after the name of the protocol. Use that information to determine how many network interface cards you need to install in your servers and workstations.

2.3.1 NDIS Standard Protocols

Which NDIS protocols are you currently using?

- AppleTalk
- Microsoft Windows NT (NetBEUI)
- Microsoft Windows 95 (NetBEUI)
- Banyan VINES with NDIS drivers
- DEC PATHWORKS (NetBIOS)
- Microsoft NetWare Client Services (Windows NT)
- Microsoft NetWare Client Services (Windows 95)
- FTP Software PC/TCP (TCP/IP)
- Novell NetWare SPX (Windows NT)
- Novell NetWare SPX (Windows 95)
- IBM OS/2 LAN Server (NetBIOS)
- TCP/IP

2.3.2 ODI Standard Protocols

Which ODI protocols are you currently using?

- Novell NetBIOS
- Novell NetWare SPX

2.3.3 Proprietary Protocols

Are you using any proprietary protocols?

- Banyan VINES (IP)

2.3.4 Protocol Scalability and Limitations

When planning for server capacity, use the following table as a guide for how many active sessions a server supports with a given protocol. The number of users may exceed the numbers in the table, as Notes reuses sessions that it finds are inactive.

Table 2. Session Limits for Operating Systems and Protocols						
	TCP/IP	**IPX/SPX**	**NetBIOS**	**VINES**	**AppleTalk**	**X.PC**
OS/2	2000+[4]	Limited only by server capacity	120/250[5]	50	50	Up to 64 ports
Windows NT	2000+[4]	Limited only by server capacity	254	Limited only by server capacity	Limited only by server capacity	Up to 64 ports

Results obtained from the tests performed in the labs at FCP Technologies indicated that IPX and TCP/IP performed comparably in relation to support for simultaneous connections, however NetBIOS is limited to 254 due to an internal design of the protocol drivers.

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[4] 2,000 active sessions have been tested. The actual limit is a function of the server capacity.

[5] The Notes *NetBIOS.dll* driver is limited to approximately 120 users. The Notes *IBMEENB.dll* driver supports approximately 250 users. See 5.3.3, "NetBIOS" on page 46 for a discussion of these two Notes port drivers.

2.3.5 Remote Access

With the rapid growth in local area networks, many customers are looking to provide their employees with the capability to remotely access LAN resources. If your environment supports multiple functions on the LAN, including some Notes usage, you may want to consider providing remote access directly into the LAN using an OS/2 or Windows NT product (listed below). If, however, Notes is the *primary* function on your LAN or there are a minimum number of Notes clients with heavy utilization requirements, we recommend that you use a Notes' remote dial-in connection and the Notes XPC protocol. Remote dial-in using XPC to the Notes system provides better performance than a remote LAN service connection.

Both OS/2 and Windows NT have facilities that provide a remote LAN service connection (the ability of a workstation to use dial-in facilities to access LAN resources[6] as if they were physically connected to the LAN).

- OS/2 can utilize OS/2 Warp Server's Remote Access Services or the IBM LAN Distance product.

- Windows NT can utilize Remote Access Services (RAS).

2.4 Security and Notes

Lotus Notes has three primary layers of security for governing access to the server and the associated databases on the server:

1. Authentication
2. Server access control lists (ACLs)
3. Database access control lists (ACLs)

The authentication and validation process occurs whenever a Notes client, workstation or server, attempts to communicate with the Notes server. Requests for communication could be for replication from one server to another, or simply database access. This process verifies that the client has a valid Notes ID and that the requestor is authorized to access the server.

After the client is validated and authenticated, the server then examines the server ACLs to determine if the client has permission to access the server. Each server contains an ACL that defines who can access the server, not access the server, create new databases, create database replicas, and pass through the server. By defining groups within Notes, the ACLs on each server can be managed more efficiently. A good example would be to create a group that contains the names of individuals who no longer have access to the server. Since each user stores their ID file on their local hard drive, this prevents validation and authentication for a user who is no longer with the corporation and may have copied and taken their local Notes ID file.

If the client has been approved for access to the server, each database ACL is then examined to determine what level of access the client has to the individual databases. Database ACLs can limit the extent of access that each client has within the database. The levels of access range from read-only capabilities to complete access or Manager capabilities. Database security can be even more specific by using *field level encryption*. Field level encryption allows a database

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[6] Ethernet or Token-ring

designer to create fields that can be encrypted with special encryption keys. To decrypt the fields, users merge the encryption keys into their ID files. If the users do not have the required encryption key, the encrypted fields appear blank.

2.4.1 Physical Security

Providing for the physical security of servers and databases in the Notes system is just as important as preventing unauthorized access by using features built into the Notes software.

Historically, the majority of Notes servers have been installed using IBM's OS/2 or Microsoft's Windows NT operating systems. Due to the characteristics of these operating systems, if your Notes servers are left in an unsecured location, unauthorized users might circumvent the security features within Notes.[7] This could allow for unauthorized access to databases on the server, use of the operating system to copy or delete Notes files, or physically damage the server hardware itself. We strongly recommend that you locate all Notes servers in a ventilated, secure area, such as a locked room.

In addition to the physical security considerations mentioned above, the IBM PC Server 520 and 720 provide a collection of security features called the LogicLock security system. LogicLock is designed to be hardware-compliant with the C2 security classification. It goes far beyond basic PC security systems in its design to protect data against unauthorized access.

LogicLock security features include:

- Tamper-evident switches
- Optional secure I/O cables
- Privileged-access password
- Optional secure removable media
- Selectable drive startup
- Unattended start mode

2.5 Network/System Management and Notes

The ability to manage both the network and, in particular, the server systems which provide the Notes platforms, needs to be carefully considered during early design phases. The following two applications provide important capabilities that can provide the advanced features necessary to provide the required management of both local and remote nodes.

2.5.1 TME 10 NetFinity

TME 10 NetFinity is shipped standard with every IBM PC Server. NetFinity has the capability to collect information about many aspects of your system, including hardware and software inventory; NetFinity alert logs; CPU, disk, memory, and network utilization monitor data; and system profile data. This wealth of information can be accessed across the standard network connections or "out of band" over serial connections to remote servers that may temporarily have dropped off the network.

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[7] Both OS/2 and Windows NT provide screen savers that can be password protected. Although these are convenient forms of protection, they do consume CPU and memory.

NetFinity provides further integration with Lotus Notes in that all the data that NetFinity collects can be easily imported into a Lotus Notes database so that the information can be viewed and accessed in the familiar Notes format. The actual Notes template files to view all of this information are included with NetFinity, eliminating the need to create new Notes databases for viewing.

2.5.2 NotesView

NotesView is Lotus′ graphical management software that provides administrators control over an enterprise-wide Notes environment. NotesView delivers real-time monitoring of a distributed Notes network by building on the capabilities of SNMP and HP′s OpenView management software. For additional information, please visit the Lotus Web site at http://www.lotus.com/.

Chapter 3. Server Considerations for Notes

Selection of a server platform within the Notes network is not always as easy as selecting a file server for your network. The unique approach of Notes for sharing and distributing information makes it difficult to define the capabilities of a given Notes Server due to the varying server functions it may serve within your enterprise (for example, mail, database, remote, hub, passthru, backup, firewall, or combinations thereof). Defining a server's ability by a single measurement, such as transaction throughput or number of users, provides limited insight into a server's capacity.

3.1 Which Platform Is Right?

As you consider what hardware and software you will need for your Notes network, keep in mind your goals for the full Notes deployment. For example, initially you may decide to dedicate one server to the pilot group. Then as you add workgroups, you might dedicate additional servers. This method might not be efficient if workgroups do not fully utilize their server or workgroups are geographically diverse. A better plan might be to deploy a few high-capacity Notes servers that will serve multiple workgroups.
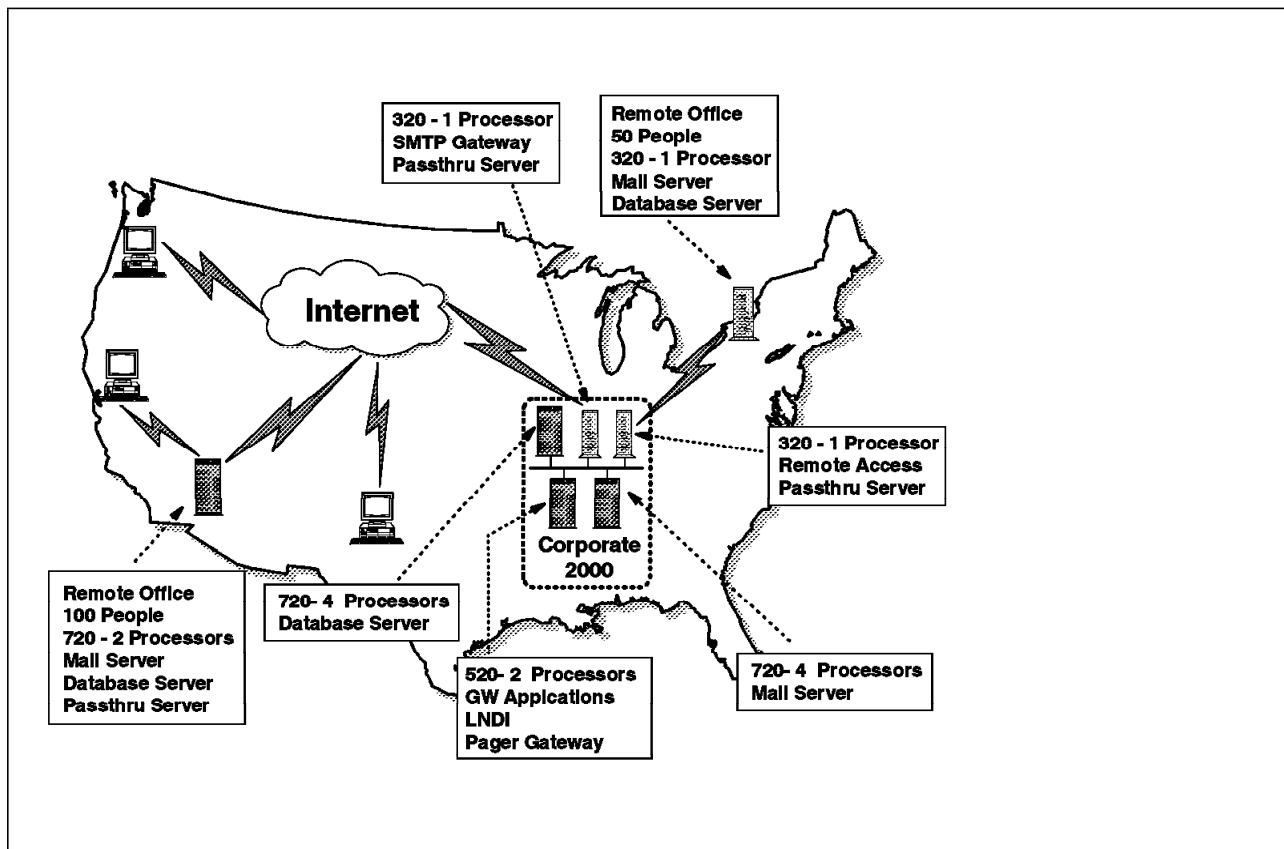

Figure 1. Notes Network Diagram Example Depicting Placement of Servers by Function

Start with a picture of what your entire Notes network environment will look like and then balance the requirements for various server functions and workgroup requirements.

When implementing your pilot, be sure to implement all functional aspects of the full Notes deployment. For example, if you will be using Notes as your mail system, and you need to send mail with additional mail systems, you should investigate and implement the required gateway during the pilot to correct any issues before the production deployment. When selecting hardware for the pilot ensure that it has the capabilities of supporting the production environment. Too often, first time Notes administrators implement server platforms that are incapable of supporting production loads which results in poor performance when the system goes live. Make your system blueprint and stick to it as you develop and roll-out your Notes network.

As you plan for additional servers to support Notes, keep in mind that using servers of the same type and configuration will simplify administrative tasks by establishing a common Notes configuration and setup. Include allocating physical space for servers in planning for your hardware needs, and plan for growth when you allocate space. It is much easier to administer multiple servers if they are physically located close to one another. Also consider the physical security of Notes servers. They should be stored in a locked room with access restricted to authorized administrators.

To assist you in determining which IBM server is best suited for your requirements, we begin by providing specifications on each of the IBM PC Server platforms and then examine each function that a Notes server may carry out. To fully understand the capabilities of a particular hardware platform in the Notes environment, you need to consider each of the functions that the server may support in your network.

The following specifications are intended only to be used as a guideline for the capabilities of each server. For specific information when purchasing, refer to your local IBM reseller, the redbook *IBM PC Server Selection Guide*, publication number SG24-4760, or refer to the IBM Personal Computers home page on the Internet at http://www.pc.ibm.com/servers.

3.2 Model Platforms for Notes Servers

The following sections outline the features of the IBM PC Server product line with focus on those specific models that were tested for this document. Although this information was accurate at the time this writing, server hardware is updated quite frequently to utilize emerging technologies. Please refer to the *IBM PC Server Technical Reference Guide*, publication number S83G-7936, or see the IBM PC Server Web page at http://www.pc.ibm.com/servers for the latest information.

3.2.1 IBM PC Server 310

The IBM PC Server 310 is an economical server that offers everything you need to support multiple users at a very competitive price. The IBM PC Server 310 is a excellent entry-level Notes Mail server, but you will need to upgrade the base memory to at least 32 MB. Typical installations include departmental or small branch office mail servers.

Typical Notes functions are:

- Departmental Mail server
- Small workgroup applications
- Remote server

• Passthru server

Rear Cooling Fan

1.44MB Diskette Drive

Open 3.5" Slim Line Bay

1.08GB Hard-Disk Drive

200 Watt Power Supply

5.25" Half-High Bay

Integrated CD-ROM
for Automated Installation
of Operating Systems
with ServerGuide

5 Bays for Up to
6.7GB Hard-Disk
Storage

5 PCI/ISA or
5 PCI/Micro
Channel Slots
on Riser Card

SVGA Video

Ethernet Adapter

SCSI-2 Fast
Adapter

Mini Tower
Design with
Key Lock Door

75, 100 or 133MHz
Pentium Processor

256KB L2 Cache

6 Gold-Plated
SIMM Sockets for
Up to 192MB Memory
ECC-on-SIMM Optional

Figure 2. Exploded View of the IBM PC Server 310

The PC Server 310 features mini tower packaging with the following benefits:

• 100 MHz or 133 MHz Pentium processor[8]
• Room to grow to 6.7 GB or storage and 192 MB of memory.
• LAN-ready with an Ethernet network adapter
• A generous amount of expansion slots, both ISA and PCI bus architectures to support current and emerging adapter technologies

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[8] 100 MHz and 133 MHz indicates the internal frequency on a Pentium processor.

3.2.2 IBM PC Server 320

Whether your immediate need is for an entry-level Notes database server or moderate Notes Mail server, the IBM PC Server 320 offers outstanding value for your business. Typical installations include departmental mail or database servers, and mail or database servers for smaller branch offices.

The IBM PC Server 320 combines industry standard technologies, configuration flexibility, rugged dependability, ease of installation and system management, plus solid server performance, with symmetric multiprocessing (SMP) capability in a package that offers exceptional value. It is available in four configurations supporting up to 256 MB of ECC memory and 27 GB of internal storage to meet the varied requirements of small to medium-size Notes servers.

Typical Notes functions:

- Departmental mail server
- Small workgroup applications
- Departmental database server
- Remote server
- Passthru server

Rear Cooling Fan

1.44MB Diskette Drive

Open 3.5" Slim Line Bay

1.08GB Hard-Disk Drive

5 PCI/ISA or
5 PCI/Micro
Channel Slots
on Riser Card

SVGA Video

Ethernet Adapter

SCSI-2 Fast

Adapter

200 Watt Power Supply

5.25" Half-High Bay

Integrated CD-ROM
for Automated Installation
of Operating Systems
with ServerGuide

5 Bays for Up to
6.7GB Hard-Disk
Storage

Mini Tower

Design with

Key Lock Door

75, 100 or 133MHz
Pentium Processor

256KB L2 Cache

6 Gold-Plated
SIMM Sockets for
Up to 192MB Memory
ECC-on-SIMM Optional

Figure 3. Exploded View of the IBM PC Server 320

The PC Server 320 features full tower packaging with the following benefits:

- A generous number of adapter slots and device bays to satisfy the storage and functional requirements of an entry enterprise network server or departmental LAN

- Six hot-swap hard drive bays, available optionally or standard on the fault-tolerant array models, to minimize business disruption in the event of a hard drive failure

- Both EISA and PCI bus architectures providing a path to higher throughput along with the capability to exploit both current and emerging PCI adapter technologies

- ECC-on-SIMM (EOS) memory upgradable to 256 MB

The following graph depicts the approximate number of average users obtainable on a typical PC Server 320 based upon tests performed in the lab at FCP Technologies. The PC Server 320 was tested operating on Windows NT and OS/2 Warp Server Advanced, running Notes 4.1. The statistics shown are based upon the presumption that the server is dedicated to each function.

The data is only intended to be used as a guideline; individual results will vary based upon your unique environment. The gray area reflects a maximum user range.

PC Server 320 Sizing Guidelines
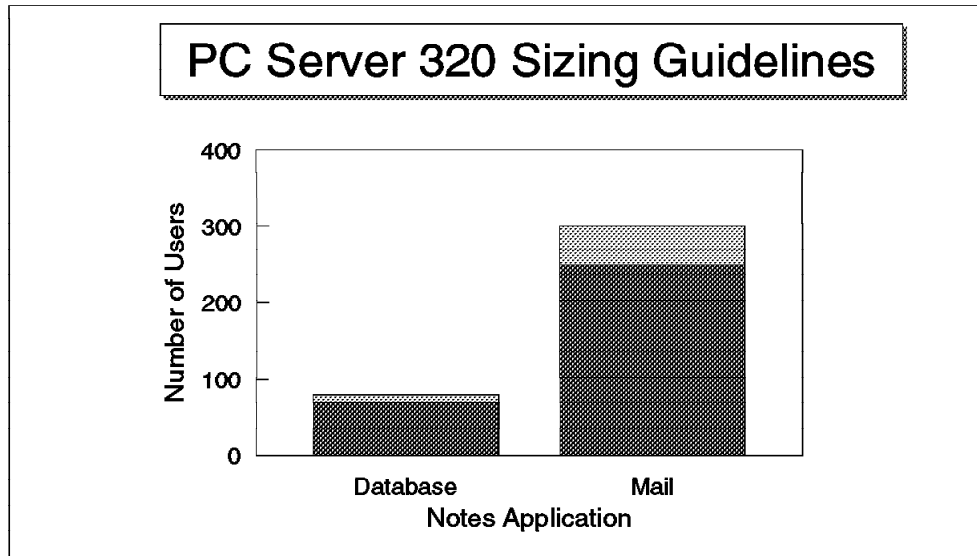
Figure 4. Approximate Number of Average Users for the IBM PC Server 320

Tested configuration:

Hardware: IBM PC Server 320 (133 MHz Pentium, 128 MB RAM, IBM PCI RAID controller, IBM PCI 10/100 Ethernet controller)

PCI RAID controller configuration: (2 - 2.25 GB SCSI drives mirrored through the SCSI controller) Drive C: for operating system and other storage, Drive D: for Lotus Notes Server software and databases.

Cache: 512 KB

Operating System: OS/2 Warp Server Advanced and Windows NT 3.51

Lotus Notes Server Software: Version 4.1

3.2.3 IBM PC Server 520

For environments supporting large Notes applications or databases, the IBM PC Server 520 is designed to support large amounts of internal data storage. Industry-leading expandability is available with 22 device bays supporting up to 49.5 GB of internal storage capacity . This includes 18 hot-swap bays, a 4x SCSI-2 CD-ROM drive, a floppy drive and two open bays. Typical installations include interconnected departmental mail or database servers, and branch office mail or database servers.

The IBM PC Server 520 is available with PCI/EISA architecture to enable businesses that have standardized on these architectures to migrate to the higher-performance, industry standard Peripheral Component Interconnect (PCI) bus, as well as to run their existing applications.

Typical Notes functions:

- Large database server
- Medium-size workgroup applications
- Departmental mail server
- Backup server
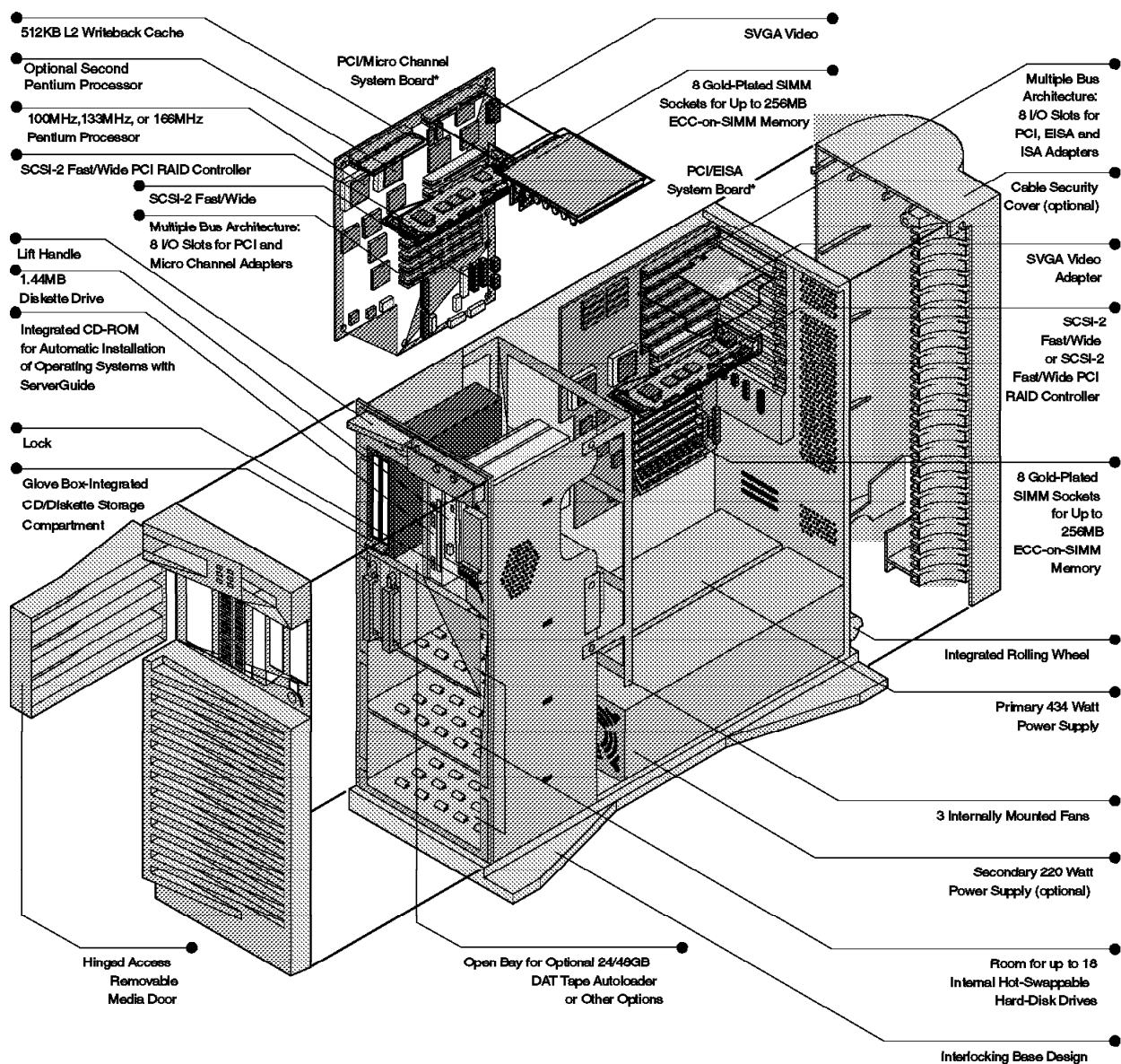
Figure 5. Exploded View of IBM PC Server 520

Highlights of the 520 model include:

- PCI/EISA architecture with 2 PCI, 5 EISA, and 1 shared slot is available.

- 100, 133, and 166 MHz Pentium microprocessor systems with 512 KB write-back cache. SMP processor upgrade option available. The second processor speed must be identical to the primary processor's.

- 166 MHz Pentium models upgradable to 200 MHz when available.

- Advanced architecture featuring a 132 MB per second PCI bus and either a SCSI-2 Fast/Wide PCI Adapter or SCSI-2 Fast/Wide PCI RAID Adapter.

- Large capacity (1.12 GB, 2.25 GB, 4.51 GB), SCSI-2 Fast/Wide high-performance (up to 7200 rpm) hard drives available standard or as options.

- 32 MB of error-checking and correcting (ECC) memory expandable up to 256 MB.

- Full tower packaging that provides 22 device storage bays and eight adapter card slots supported by a 434-watt, worldwide power supply and 220-watt secondary power supply option for full hard drive configurations.

- Internally redundant 780-watt power supply option.

- Quad-speed CD-ROM drive for quick and easy installation of network operating systems and applications on the server.

We did not include the IBM PC Server 520 in the Notes performance testing for this project. This is based solely on the fact that the capabilities of the 320 and 520 architectures are very similar. Scalability and capacity differentiate the products. In addition, the recently announce IBM PC ServeRAID Adapter with support for up to three SCSI-2 or Ultra-SCSI channels provides even greater scalability and opportunity for performance improvements.

When considering server platforms to be used as Notes servers, the IBM PC Server 520 is generally recommended when the processing needs are met and there is an additional need to provide a large disk capacity server for archival, imaging, and centralized database distribution. With the immense internal storage capacity of the PC Server 520, several of these requirements could be fulfilled by one system.

One customer, for example, a large government agency that handles consumer complaints, utilizes Notes and LNDI (Lotus Notes Document Imaging) to handle the complaint process. As the complaint is received it is scanned into the system and stored as part of the case folder. This case folder is then part of the paperless workflow used in processing consumer complaints. The PC Server 520 acts as the main workflow and image storage server for the division calling upon its storage capacities for current as well as archival needs.

3.2.4 IBM PC Server 720

For large Notes Mail or Notes database servers, the PC Server 720 provides flexibility and scalability to meet the requirements of most demanding environments. With the ability to mix and match up to six 100 MHz, 133 MHz or 166 MHz Pentium processors, 64 MB or 128 MB ECC memory expandable to 1.0 GB and 18 hot-swap bays for up to 49.5 GB of internal storage, or a maximum of 229 GB of combined internal/external disk storage, the PC Server 720 can be scaled to meet the future processing demands of large Notes networks or high-demand Notes applications.

To achieve this scalability, the PC Server 720 is designed with a high-speed data bus between the processors and main memory, and a large, internal hard disk capacity. The PC Server 720 provides true symmetric multiprocessing (SMP) in which each processor has its own L2 and L3 caches, and all processors share main memory across a high-throughput multiprocessing bus.

Typical Notes functions:

- Enterprise mail server
- Medium-size to large workgroup applications
- Enterprise database server
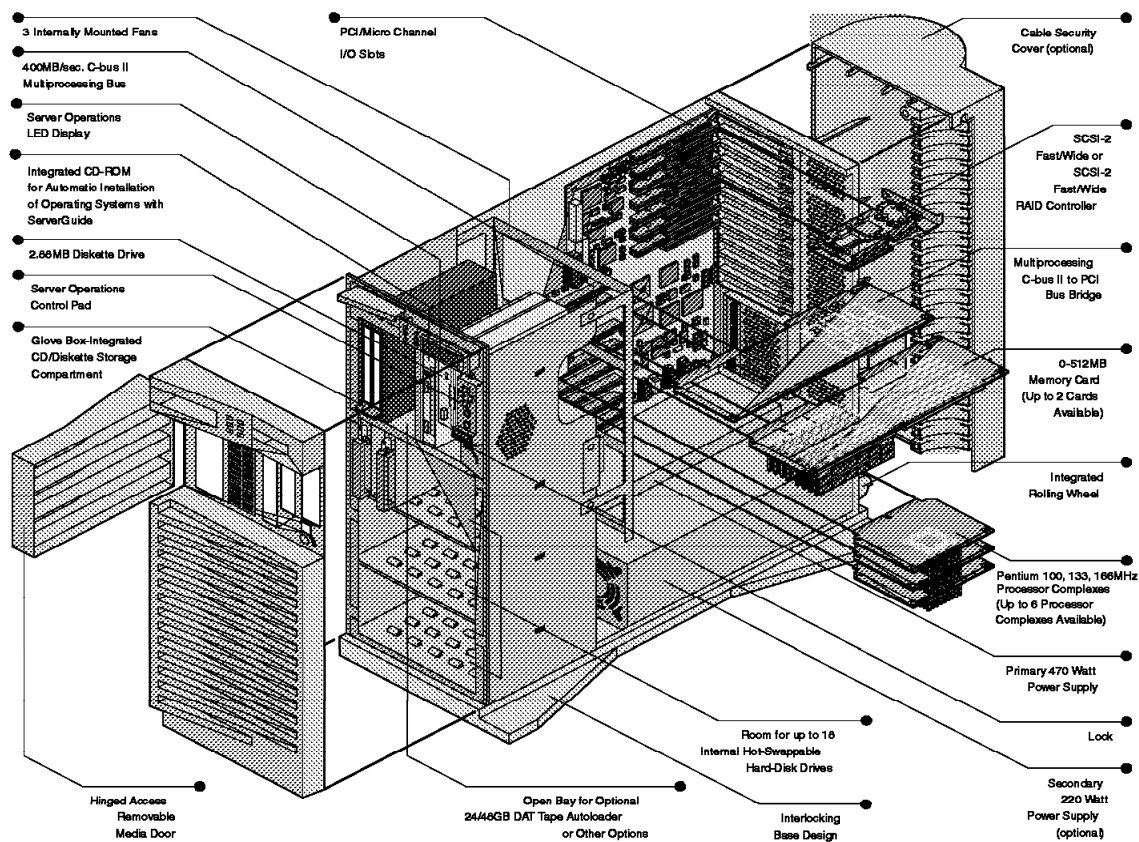
Figure 6. Exploded View of the IBM PC Server 720

The PC Server 720 incorporates a wide range of features that enable it to function as a high-end Lotus Notes mail or database server:

- High transaction throughput with up to six 100 MHz, 133 MHz or 166 MHz Pentium processors.

- 128 MB or 64 MB ECC memory expandable to 1.06 GB.

- 22 total and 18 hot-swap bays supporting up to 40.5 GB of internal hot-swap storage and more than 100 GB of external storage.[9]

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[9] Additional backplanes required when installing more than 6 hot-swap drives.

- High-speed, multiprocessing bus running at 400MB, eliminating data bottlenecks and providing performance scalability as processors are added.

- 7 PCI, and 7 Micro Channel expansion slots let users choose high-performance adapters from a large and expanding range of suppliers.

- Full ECC of both main memory and the C-bus II multiprocessing bus to ensure that valuable data is not corrupted.

- Quad-speed CD-ROM drive for quick and easy installation of network operating systems and applications on the server.

- 470-watt auto-sensing; additional 220 watts, as well as a 780-watt redundant power option.[10]

The following graph depicts the approximate number of average users obtainable on a typical PC Server 720 based upon testing and extrapolations performed in the lab at FCP Technologies and IBM PSP performance labs. The PC Server 720 was tested operating on Windows NT and OS/2 Warp Server Advanced SMP (Beta), running Notes 4.1. The statistics shown are based upon the presumption that the server is dedicated to each function. The data is only intended to be used as a guideline, individual results will vary based upon your unique environment.
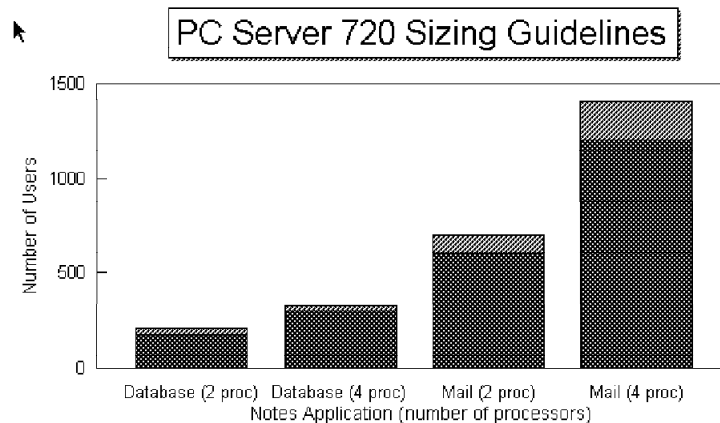
Figure 7. Approximate Number of Average Users for the IBM PC Server 720

Tested configurations:

Hardware: IBM PC Server 720 (two Pentium/100 processors, 256 MB RAM, IBM Micro Channel Streaming RAID controller, IBM PCI 10/100 Ethernet controller)

Micro Channel Streaming RAID controller configuration: (6 - 2.25 GB hot-swap SCSI drives configured for RAID5) Drive C: for operating system and other storage, Drive D: for Lotus Notes Server software and databases.

Cache: 512 KB

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[10] Additional power supplies required when installing more than 6 hot-swap drives.

Operating System: OS/2 Warp Server Advanced SMP Beta[11] version, and Windows NT 3.51

Lotus Notes Server Software: Version 4.1

Hardware: IBM PC Server 720 (four Pentium/100 processors, 512 MB RAM, IBM Micro Channel Streaming RAID controller, IBM PCI 10/100 Ethernet controller)

Micro Channel Streaming RAID controller configuration: (10 - 2.25 GB hot-swap SCSI configured for RAID5) Drive C: for operating system and other storage, Drive D: for Lotus Notes Server software and databases.

Cache: 512 KB

Operating System: OS/2 Warp Server Advanced SMP Beta version, and Windows NT 3.51

Lotus Notes Server Software: Version 4.1

3.2.5 PC Server 704

At the high end, utilizing the power of up to four 166 MHz Pentium Pro processors with 512 KB L2 cache per processor, the PC Server 704 combines cutting-edge industry technology with superior ease of use. The PC Server 704 provides the flexibility and scalability to meet the demanding requirements of a large Notes mail or database server. Typical Notes functions:

- Enterprise mail server
- Enterprise database server
- Medium to large workgroup applications

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[11] At the time of this writing OS/2 Warp Server Advanced SMP was still in Beta test.

Room for Optional
420 Watt Redundant
Power Supply

Two 420 Watt
Power Supplies
with Cooling Fans

1.44MB Diskette Drive

4x SCSI Bootable
CD-ROM Drive

Power, Cooling and
Drive Status Lights

Server Operations
LED Display

64MB or 128MB
Standard ECC Memory
Expandable to 1GB

10 Adapter Slots: 6 PCI
(132MB/sec), 4 EISA

Processor Complex
Card: Up to 2
166MHz* Pentium
Pro Processors
per Card, each with
512KB Dedicated
L2 Cache (2 Cards
per System
Standard)

SCSI
Drive
Status
Lights

100/10Mbps
PCI Ethernet
Adapter

PCI SCSI-2
Fast/Wide
RAID Adapter
(Standard on RAID
Model; Optional on
nonRAID Model)

3 Fans for
Cooling
Redundancy

Access Door

Room for up to 12 Half-High
Internal Hot-Swappable
Hard-Disk Drives

Dual PCI SCSI-2
Fast/Wide
Controllers

Access Door

3 Open Bays for
Optional 5.25"
SCSI Devices

Lock

Figure 8. Exploded View of the IBM PC Server 704

The PC Server 704 has room to grow to support most any high-end Lotus Notes
mail or database server:

- Up to four 166 MHz Pentium Pro processor boards, allow scalability of up to
  four-way SMP, with throughput among the highest in the industry.

- Seventeen storage bays are standard, including 12 half-high hat-swap bays,
  a 4X SCSI CD-ROM drive, and three open 5.25″ bays.

- 10 adapter slots, 6 PCI and 4 EISA.

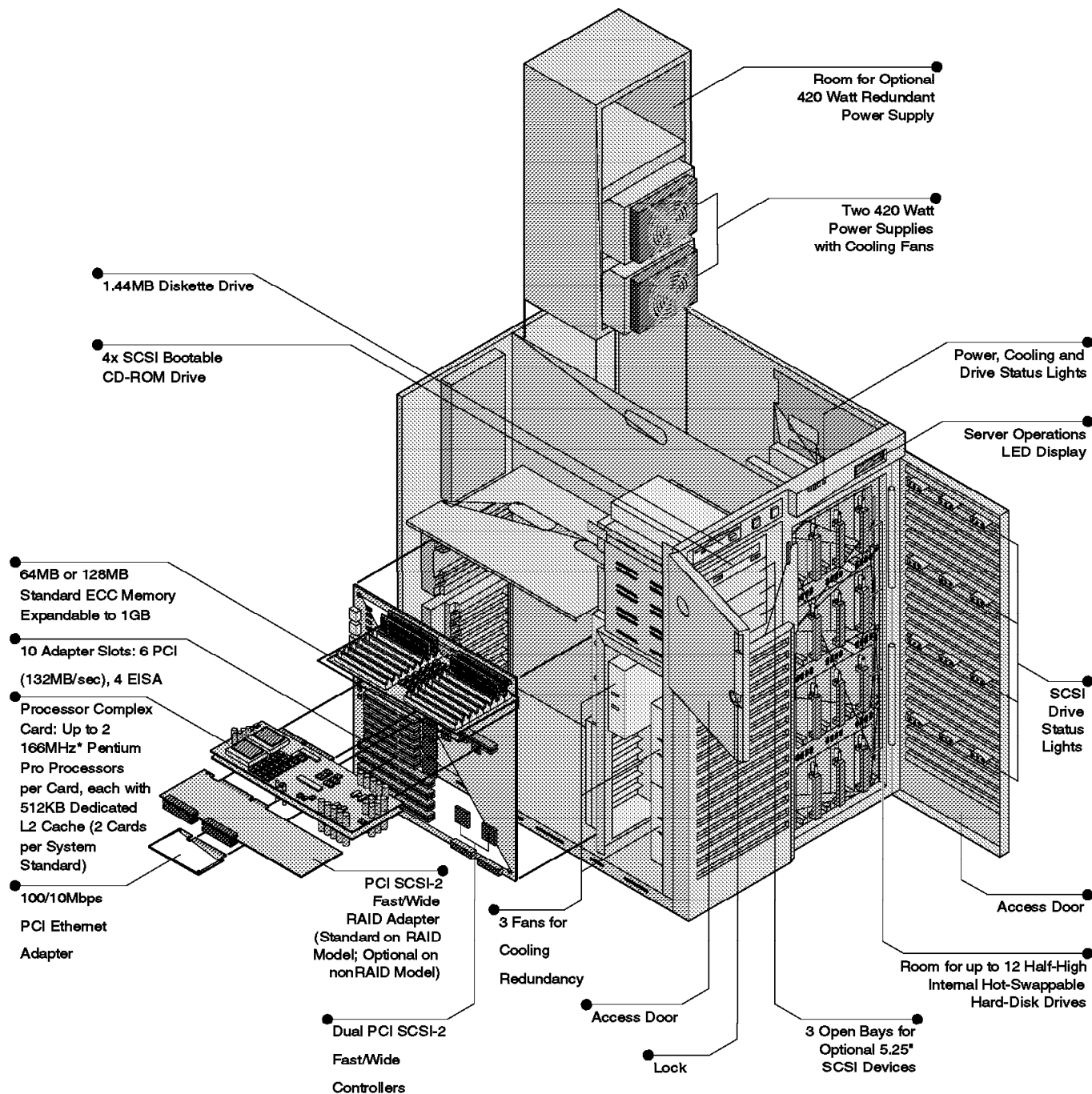- High-performance 2.14 GB hot-swap SCSI-2 Fast/Wide hard disks are either mirrored to the two SCSI-2 Fast/Wide controllers or set up as a RAID disk array.

- 64 MB or 128 MB of ECC memory standard and up to 1.0 GB of ECC RAM expansion capacity

3.3 Notes Servers by Function

When planning your Notes environment, you need to consider the various tasks that each server will perform, and the logical relationships between servers to achieve the most efficient levels of utilization and communication. In this section we discuss the various tasks that each server can perform and the associated requirements, to assist you in selecting the appropriate hardware platform(s) for each server. For connectivity and logical topology issues, please refer to Appendix A, "Network Considerations" on page 51.

Each task performed by Notes stresses the hardware and operating system in different areas and to varying degrees. Dedicating servers to certain tasks within the Notes network will make the selection of your hardware and OS easier by allowing you to more accurately define the requirements of each individual server.

3.3.1 Mail Servers

Mail servers are used in the Notes network to store and route mail messages between users, servers, and Notes applications. Dedicating one or more servers to these responsibilities provides the following:

- Easier administration of mailboxes and users. This provides for improved auditing and simplified installation processes.

- Minimize the processor load on the server by reducing the number of databases that need to be replicated with other servers, and reducing the requirement to index databases on a regular basis.

- Strategic organization of users per mail server will significantly reduce the impact of traffic on your network. Mail traffic delivered to users on the same server will not be routed across the network. This will also allow for immediate mail delivery by eliminating the need to create mail delivery schedules.

- Provide for more specific requirements goals, establishing a better scalable model for expansion as usage and storage needs increase.

Mail Sizing Guidelines

Figure 9. Approximate Number of Average Users for Typical IBM PC Servers As Notes Mail Servers

Figure 9 represents results obtained when dedicating each platform to mail functions operating on OS/2 Warp Server Advanced, OS/2 Warp Server Advanced SMP (Beta), Windows NT, and Notes 4.1. Client connections were simulated for mail usage only.

Server Issues

For mail routing we have found that the first place to look for a potential bottleneck is in the disk subsystem. After reviewing the disk subsystem, if you determine that the disk resources are adequate and the disk subsystem is properly tuned the following is a suggested order to look at other potential bottlenecks: memory, CPU, then network or network adapters.

3.3.2 Database (or Application) Servers

Database servers are used to store Notes application databases, such as discussion, tracking, news, and online documentation databases. Customized applications such as help desk databases, support tracking systems, and so on, should typically be dedicated to specific servers. Notes application databases are becoming very robust and sophisticated systems. Consequently, interaction between numerous databases is quite common. Placement of inter-dependent databases across multiple servers could produce increased stresses on the servers and the network depending on the amount of interaction required by the applications. Dedicating servers to database tasks will provide the following benefits:

- Enable you to group applications by their usage. This will typically reduce replication needs, and simplify administration of both server and database security.

- Allow you to optimize server performance for application database usage without regard to mail usage.

- Provide for more specific requirements goals, establishing a better scalable model for expansion as usage and storage needs increase.

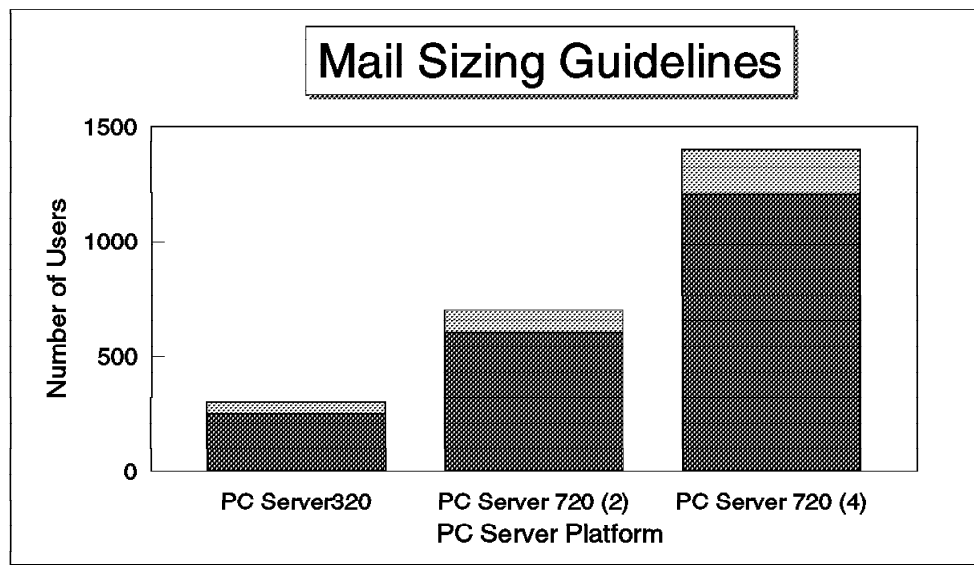## Database Sizing Guidelines
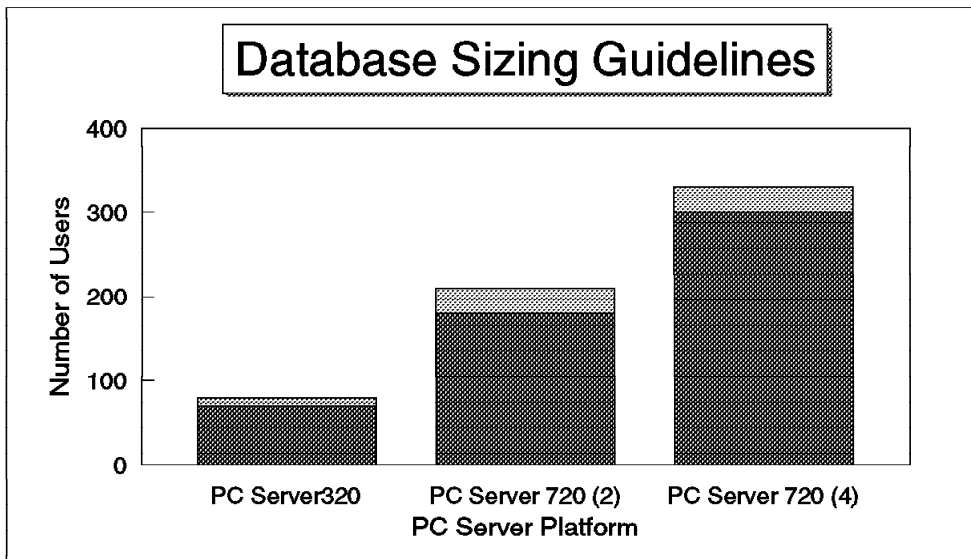
Figure 10. Approximate Number of Average Users on a Typical IBM PC Server As a Database Server

Figure 10 represents results obtained when dedicating each platform to database functions operating on OS/2 Warp Server Advanced SMP (Beta), OS/2 Warp Server Advanced, Windows NT and Notes 4.1. Client connections were simulated for database usage only. These numbers are reflective of a server providing immense and intensive database application services.

Server Issues

Application Server usage has a large impact on the CPU and disk subsystem, more than any other Notes server function. Specifically, replication and indexing are two of the most resource consuming tasks on a Notes server. Both of these tasks are directly associated with application type databases.

3.3.3 Remote Servers

Remote servers are used to provide dial-in access to Notes using a modem. Strategic use of remote servers, could allow you to eliminate the expense and administrative effort of installing and maintaining servers in remote locations.

Users dialing into a remote server have access only to the databases on that server, and not to the databases on other servers in your network. By replicating selected databases to this server you can distribute in-house information with external users while maintaining a secure environment.

There are, however, some limitations to remote servers. Notes Version 4.x can only support a combined total of 64 LAN and COM ports, and Version 3.x supports only 36.[12] Although 64 ports can be defined on a Notes R4 server, at a minimum one port would be required for a LAN connection. These limitations are

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[12] The OS/2 operating system is limited to 16 COM ports.

strictly dependent upon the internal design of Lotus Notes. Therefore, designing remote servers with high-end PC Server 720 platforms will not provide additional remote user access. For remote servers supporting up to the maximum number of 64 connections, the IBM PC Server 320 platform would be an excellent platform. Although the 520 and 720 platforms could also be used, they would not be fully utilized without including additional functional requirements.

You must also keep in mind that each remote user can replicate any databases which reside on the remote server to their local hard drives allowing the user to work offline from the server. This capability typically minimizes the requirement for more than 63 simultaneous remote connections to a Notes remote server.

Server Issues

Utilization of serial ports produces a significant impact on CPU utilization. Due to the slow throughput rates of serial ports, transactions being processed by the CPU are queued for transmission. This queuing process results in prolonged wait states for the CPU at which times no other CPU processes can occur. The use of intelligent multiport communications adapters significantly reduces the impact on the CPU and is therefore highly recommended.

3.3.4 Hub Servers

Hub servers are designed to be used as dedicated servers to route mail and replicate databases to other servers within the network. This typically results in hub servers only being used in larger Notes environments to minimize the performance impact on production servers.

Since the typical use of hub servers within the concept of the Notes topology is only to facilitate communications between other servers, users normally don't have access to these servers which eliminates the requirement for large numbers of simultaneous connections. Therefore, you might assume that a hub server would not necessitate the need for a high-end end server platform to fulfill the requirements. This, however, is typically *not* the case. You must consider the fact that each hub server will be required to support the storage of all common databases within the Notes and be capable of replicating these databases to each additional server in a timely fashion. Each hub server must also be capable of routing mail between servers ensuring that messages are delivered within an acceptable time frame. To fulfill these requirements, each hub server should be designed with extensive CPU and disk subsystem capacities.

IBM's PC Server 520 and 720 platforms would be appropriate platforms for your hub server implementations. Each of these platforms provide the scalability for both CPU and disk subsystems, required for enhancing each hub server as the number of Notes servers, users, and associated databases increases. As two possible examples:

- For medium-sized environments requiring a hub server with communications between 4 to 10 servers a PC Server 520 with 1 processor and several GBs of storage may be appropriate.
- For larger environments supporting 5 to 20 servers a PC Server 720 with 2 or more processors and several GBs of storage may be required.

When determining the requirements for each hub server, you need to consider several factors: the number of server communicating with the hub server, the number of databases to be replicated, the volume of mail being routed, and the available windows of opportunity for replication to occur.

Issues concerning hub servers is discussed more thoroughly in Appendix A, "Network Considerations" on page 51.

Server Issues

Hub servers generally provide database replication and mail routing services to several other servers within the network. They, therefore, produce heavy loads on all components of the hardware. Generally hub servers are designed with high capacity scalable platforms. Other suggestions:

- The system should have a fast disk subsystem for replication and archival.
- Full-text indexing should not be allowed on these systems since index updates degrade performance and users will not be accessing theses servers directly.
- Restrict access to the server for local users so they do not degrade performance.

3.3.5 Passthru Servers

Passthru servers are used to provide a ″stepping-stone″ to allow users to connect to other servers without knowing all the routing steps required to make the connection. Implementing passthru servers will provide your remote Notes users and servers access to servers within your network, by way of dial-in or X.25 connections.

Passthru servers can also be used to provide connectivity between servers or workstations on the LAN that do not share a common protocol. For example, if a workstation is only configured to communicate via IPX and the destination servers only communicate via TCP/IP, a passthru server using both protocols on one or more adapters, could allow communication between these two systems.

Since passthru servers are only employed to provide connections from one Notes host to another, the requirements for the disk subsystem are confined to the support of the OS and the Notes server application. This leaves the primary concerns for passthru server designs with the CPU and network interface. Depending on the combined number of simultaneous connections that your remote server must support, each of the IBM PC Server platforms may be appropriate. For smaller environments requiring 50 to 200 connections the PC Server 320 may be suitable, while environments requiring larger numbers of connections may require a PC Server 520 or 720 for the increased CPU capabilities.

Each passthru server is configured to specify which destination servers the passthru server can access, and which users and servers can use that server for passthru capabilities. This feature allows you to control the maximum number of Notes hosts that can utilize each passthru server at any given time, as well as a secure environment.

Server Issues

Passthru servers are only used to provide access to other servers and Notes services within the network. Therefore the impact to server hardware is confined to the CPU and the network interface in that respective order. Selection of the appropriate hardware platform is dependent only on the number of sessions that need to gain access through the server.

3.3.6 Back-up Servers

Backup servers are used to store copies, or replicas, of your business-critical databases. Using backup servers will allow your users to continue using their databases when the primary server is down. From the users point of view, only a simple point-and-click process is required at the workstation to begin using the backup server.

The use of backup servers should never replace your normal network backup procedures. Since backup servers only contain replicas of the production documents, it is possible for a damaged database to be replicated to the backup server. If this were to occur, neither the production nor the backup database is usable. In order to recover from this type of scenario, a restore must be made from a backup prior to the occurrence of corruption.

The primary requirement for a backup server is disk capacity. Both the PC Server 520 and 720 platforms provide this capability with additional scalability for the processors.

3.4 Examples of Notes Server Selections

Having examined each of the IBM PC server platforms and the different functions within Notes, the next step is to define the positioning of each platform with respect to Notes server capabilities. Although each PC server platform has unique capabilities making them more appropriate for certain Notes functions, no two environments are the same. Therefore, the recommendations in this redbook are only recommendations.

Selecting the appropriate platform for a Notes server is a complicated but important requirement to ensure a reliable and acceptable network. The complexity of designing a Notes server is due to the multiple functions that each server can support to provide services for the network. To assist you with this process, we discuss some real world scenarios requiring multiple Notes functions and provide recommendations on how each of the IBM server platforms has been or can be employed for each of these client cases.

Large Bank

One customer, a large bank located on the east coast, is implementing Notes. The main uses for Notes at the bank is the replacement of their mainframe mail system that services the 3000+ users at the bank, a customer service application, and the publication of corporate knowledge bases that include HR and policy and procedure. The employees are located in a scattered campus. The majority of the employees are located in three main buildings that are networked and connected to each other via a 100 Mbps FDDI backbone. The other employees are located in multiple branch offices scattered around the region.

The servers in this configuration are shown in Table 3.

Table 3 (Page 1 of 2). A Large Bank's Notes Servers by Function				
Qty	Server	Functions	Users per Server	Location
2	PC Server 720 - Quad	• Mail • Knowledge Base Publication	1200-1300	Corporate IS

Qty	Server	Functions	Users per Server	Location
		Table 3 (Page 2 of 2). A Large Bank's Notes Servers by Function		
1	PC Server 320	• HUB	NA	Corporate IS
1	PC Server 520	• Customer Service Application	40-50	Customer Relations
1	PC Server 320	• Training • Application Dev.	20-30	Corporate IS

Satellite Communications Manufacturer

A large communications equipment manufacturer has a number of needs within their Notes environment. They use Notes to provide support to their customers and field engineers. Notes serves as their main mail system. Notes workflow applications are used to run their 24hr support help desks; a Notes' application with a customized API agent acts as the notification and escalation system (notifications are sent by Notesmail, DECmail, numeric pager and fax) when a system goes down, as well as publishing technical and status information for their customers to access via the Internet or by phone. To provide all the functionality needed for this environment a number of operating systems were used. These are shown in Table 4.

Qty	Server	Functions	Users per Server	Location
		Table 4. A Sample Manufacturing Company's Notes Servers		
3	PC Server 720 - Quad	• Mail • Knowledge Base Publication	1200-1300	Corporate IS
1	PC Server 720 - Dual	• Help Desk Workflow Application	100-120	Corporate IS
1	PC Server 320	• Help Desk Escalation Application	Interacts Only with the Help Desk Server	Corporate IS
1	PC Server 520 - Dual	• E-mail Gateway • Pager Gateway • Phone Notes	Interacts as a service	Corporate IS
1	PC Server 320	• Fax Gateway	Interacts as a service	Corporate IS

Worldwide Professional Services Company

A worldwide professional services company based in the United States is implementing Notes for mail, expense management, time management, and pre-sales proposal development and tracking. The organization is located in 60 cities around the globe including many emerging economies. The focus for this company is to link their 1000 consultants around the world so they can communicate effectively and share the institutional knowledge developed as the company has grown. Their servers are shown in Table 5 on page 32.

Table 5. A Sample Services Company's Notes Servers

Qty	Server	Functions	Users per Server	Location
1	PC Server 720 - Dual	• Mail • Knowledge Base Publication • Workflow Applications	200-300	Corporate IS
1	PC Server 520 - Dual	• Knowledge Bases • Collaborative Databases • Mail Routing • Internet	All remote offices and field consultants replicate	Corporate IS
4	PC Server 320	• Mail • Knowledge Base Publication • Workflow Applications	30-40	Major International Locations

To facilitate mail routing and database replication between each of the major cities within their Notes network, they have opted to utilize both the Internet and an international X.25 network. For connections to each of these communication services, two additional Notes servers will be installed within the Washington, DC office. For X.25 service, a single server will be installed with Notes Connect for X.25 supported by an adapter from Eicon, Inc. Use of the Internet will be confined to the transport of mail for several locations by the installation of an additional server within their home office using the Notes SMTP Messaging agent. These servers are shown in Table 6.

Table 6. Communications Servers

Qty	Server	Functions	Users per Server	Location
1	PC Server 720 - Dual	• Notes Connect X.25	100-200	Corporate IS
1	PC Server 320 - Single	• Notes SMTP Messaging Agent	All Internet mail users	Corporate IS

Government Customer Services Advocate

Another customer, a large government agency that handles consumer complaints, utilizes Notes and LN:DI (Lotus Notes Document Imaging) to handle the complaint process and the workflow for managing the case from report to close. As the complaint is received it is scanned into the system and stored as part of the case folder. This case folder is then part of the paperless workflow used in processing consumer complaints. The PC Server 520 acts as the main workflow and image storage server for the division calling upon its storage capacities for current as well as archival needs. These servers are shown in Table 7.

Table 7 (Page 1 of 2). A Sample Government Installation

Qty	Server	Functions	Users per Server	Location
1	PC Server 520	• Mail • Knowledge Base Publication • Workflow Applications	30-60	Complaint Division

Table 7 (Page 2 of 2). A Sample Government Installation				
Qty	Server	Functions	Users per Server	Location
1	PC Server 320	• Fax Server	40-50	Corporate IS
1	PC Server 320	• Internet	20-40	Corporate IS

Systems Integration Company

A mid to large-size systems integration company with offices throughout the Northeast Region utilizes Notes for sales activities, scheduling and tracking of professional services, publication of institutional knowledge, and publication to the Internet. Each office operates fairly independently but shares technical resources and sales responsibilities. The servers in place at this company are shown in Table 8.

Table 8. A Sample Services Company				
Qty	Server	Functions	Users per Server	Location
5	PC Server 720 - Dual	• Mail • Knowledge Base Publication • Workflow Applications	100-200	• MD • VA • PA • NJ • MA
1	PC Server 520 - Dual	• Knowledge Bases • Collaborative DB • Mail Routing • Internet	External connect to Notes Net & the Internet	Corporate IS
1	PC Server 320	• Fax Gateway • Phone Notes • Pager Gateway	20-40	Corporate IS

Large Chamber of Commerce

A very large chamber of commerce recently used Notes to develop a comprehensive management system for their operations including memberships, events, knowledge bases for telemarketing and research, internal messaging, workflows, and connection to the Internet. This configuration is shown in Table 9.

Table 9. A Sample Local Government's Notes Servers				
Qty	Server	Functions	Users per Server	Location
1	PC Server 720 - Dual	• Mail • Knowledge Base Publication • Workflow Applications	100-120	Corporate IS
1	PC Server 320	• Mailing Lists	20-30	Corporate IS
1	PC Server 320	• Remote Access • Internet	20-30	Corporate IS
1	PC Server 320	• Fax Gateway	Runs as a service	Corporate IS

Experience with Notes has shown that often its usage grows well beyond the initial plans and expectations of the design team. Because of this, it is important to select server hardware platforms which allow for easy expansion and migration as your requirements increase.

Chapter 4. Installing IBM PC Servers

In order to provide assistance during server installation, IBM provides its ServerGuide product standard with every server. ServerGuide provides for semi-automated installation of OS/2, NetWare, Windows NT and SCO UNIX as well as a wealth of additional information and utilities to assist in the initial installation tasks.

However, many customers may still choose to install the operating system of the choice with standard product diskettes and CDs. The following section provides some important hints and tips encountered during the setup of the servers tested during the development of this document. As is often case, some of the procedures detailed below may change as improvements are made to device drivers and new releases of hardware and software are available. Always check the IBM PC Server home page for the latest device drivers and support diskettes and consult the appropriate README or other information files provided for the operating system being installed.

4.1 IBM OS/2 Warp

Before installing OS/2 on your Notes server, verify that you have obtained the latest patches from IBM. The following are the patches required for running Lotus Notes on the various versions of Warp at the time of this writing:

- OS/2 Warp and OS/2 Warp Connect

  - Fixpack #17 - Cumulative set of fixes for Warp and Warp Connect.

- OS/2 Warp Server Advanced SMP

  - Still in Beta. Check the IBM Web site at http://www.software.ibm.com for up-to-date information.

- OS/2 Warp Server Advanced

  - Fixpack #17[13]

  - CSD WR08210 - Allows Notes to report appropriate error messages when the system has exhausted all available resources.

4.1.1 Installing with IBM PCI RAID Controllers

> **Note**
>
> This procedure is necessary for versions of Warp that are current at the time of this publication. However, this procedure may not be necessary in future versions of Warp and Warp Server as the base device driver support for these adapters may be added. Make sure to review all readme files and the installation documentation for your version of Warp before performing this procedure.

Installing OS/2 Warp on the IBM PC Server with the IBM PCI RAID Controller requires that the installation disk be modified from its default configuration. The

---

[13] Check for the availability of Fixpack 19 or higher on the IBM PSP Web Page. This level contains enhancements to OS/2 Warp Server Advanced memory management.

most current configuration should be on the IBM PCI RAID Controller diskette, which ships with the board. The procedure is as follows:

1. Make backup copies of the Install disk and disk 1 of the OS/2 software.

2. Boot the server with the IBM PCI RAID Controller diskette.

3. Select **Start OPTION diskette**.

4. Choose to modify the install diskettes.

Once Disk 1 has been modified, OS/2 Warp can be installed.

4.1.2 Installing LAN Adapter and Protocol Support

With the release of OS/2 Warp Connect, network adapter drivers and protocol support are now included with the base package in the form of Multiprotocol Transport Support (MPTS). This addition to the OS/2 operating system provides numerous network adapter drivers, as well as TCP/IP, NetBIOS, and IPX/SPX protocol support.

Installation and configuration of your network adapter and the required protocols is accomplished through the menu driven MPTS application. The following are some issues for installation:

1. When installing OS/2 Warp the first time, you will need to select the CUSTOM installation if you require the full suite of TCP/IP applications.

2. To install the IBM 10/100 Ethernet Adapter you will need to use the driver supplied on the IBM 100/10 PCI Ethernet Adapter Configuration and Drivers diskette. This diskette is provided with the board.

4.2 Microsoft NT 3.5.1

Before installing Microsoft NT 3.51 on your server, verify that you have obtained the latest patches from Microsoft. The following Servicepak is recommended for improved performance running Lotus Notes on Windows NT 3.51 at the time of this writing:

- ServicePack#4

4.2.1 Installing NT on the IBM PC Server 720 with the IBM Streaming RAID Adapter

Installing NT on this platform requires that the latest BIOS rev, Streaming RAID controller driver, and required Microsoft Service Packs be used. The diskettes for the latest BIOS revisions and the Streaming RAID controller can be obtained from www.pc.ibm.com. The NT Service Pack can be obtained from Microsoft's Web site.

1. Ensure the server is at BIOS rev level 7. The BIOS diskette is bootable; follow the instructions on the screen if an upgrade is necessary.

2. Boot the server with the SCSI-2 Fast/Wide Streaming RAID Adapter/A.

3. Choose Advanced functions from the main menu.

4. Format every drive installed in the system.

5. Define a 300-500 MB logical drive. Do not initialize the drives.

6. Expand NTKRNLMP.EX_ from the NT Service Pack 3 (or Service Pack 4), and copy it over NTKRNLMP.EXE that is on the install disk 1 of NT.

7. Boot the server with a DOS disk and create an active partition.

8. Boot with the NT install disk and press F5 when NT is detecting your hardware. The screen should be black. This will interrupt the detection process and allow you to choose a specific platform.

9. Choose **Other** when asked for a hardware platform and insert the disk labeled PC Server 720 System Device Drivers.

10. When prompted for a hardware controller, skip detection and specify **Other**. Insert the Streaming RAID Adapter diskette and continue with the install.

11. Install service pack 3 (or 4) before running Disk Administrator to partition and format the remaining disk space.

12. Drives added after the installation must be formatted with the RAID diskettes before being added to an array.

4.2.2 Installing LAN Adapters and Protocol Support

The IBM 100/10 PCI Ethernet adapter is not recognized by Windows NT's detection process when the adapter is installed. If installing the adapter after the installation of Windows NT, you need to use the NETWORKS option within the CONTROL panel to add the adapter to your configuration.

The IBM 100/10 PCI Ethernet Adapter must be added using the supplied diskette.

For IBM's PC Server 320, installation of the 100/10 PCI Ethernet Adapter after the complete installation of Windows NT 3.51 could possibly cause the EISA configuration to be modified reflecting an incorrect count for total memory. The possible symptoms of this modification are:

1. Windows NT hangs when the driver is installed from the accompanying diskette.

2. Windows NT displays an error screen upon re-boot after the driver has successfully installed.

To correct this situation, rerun the EISA configuration utility and set the memory to the correct installed amount.

Chapter 5. Server Optimization

This chapter provides hints and tips for optimizing both the hardware and software for your Notes installation.

5.1 Hardware Optimization

With the release of Notes R4, hardware configurations have become the most significant influencing factor to server performance.[14] The largest contributors to the performance of Notes servers is the CPU, memory, and disk subsystem. Increasing or decreasing the amount or speed of each of these items will directly impact the server's ability to support sessions or effortlessly complete Notes related tasks.

5.1.1 CPU Requirements

CPU requirements in a Notes server can be simply stated as, the faster the better. With the release of Notes R4, multiple processors can now be used to enable interaction across and between global and local memory spaces of each process. The ability to utilize the memory caches and processing power of multiple CPUs results in better performance and increased session capabilities. However, the capacity of a Notes server does not scale linearly with the addition of processors. Installing four processors in your server will not provide four times the performance of a server with a single processor.

It should be emphasized that although Notes is certainly processor-intensive, not all environments will require a large multiprocessor solution. Performance benchmarks performed by the IBM Personal Software Products group clearly show uniprocessor solutions supporting 1000 average users in some configurations under OS/2 Warp Server Advanced.

5.1.2 Memory Requirements

Memory in a Notes server performs an important role for both the OS/2 and Windows NT operating systems. Each of these operating systems incorporate a feature called *virtual memory*, which utilizes space on the disk subsystem when the installed physical RAM is not large enough to support the requirements of the operating system or the Notes server application. The use of the disk subsystem for virtual memory is beneficial in that it allows the operating system to dynamically respond to the requirements of the Notes server. However, accessing the disk subsystem for virtual memory is dramatically slower than the use of physical RAM and reduces the overall performance of the system. Ensuring that your Notes servers have efficient amounts of installed RAM is crucial to acquiring optimal performance.

The following table depicts the minimum and optimal amounts of RAM that should be installed for each of the IBM PC Server platforms.[15]

---

[14] Refer to Appendix B - What's New in Lotus Release 4

[15] Typically OS/2 does not require as much memory (approximately 75%) as Microsoft Windows NT.

Table 10. Notes Memory Requirements				
Platform	**OS/2**		**Windows NT**	
	Minimum	**Recommend**	**Minimum**	**Recommend**
IBM PS Server 320	32 MB	96 MB	48 MB	128 MB
IBM PC Server 520 - 2 processors	32 MB	192 MB	48 MB	256 MB
IBM PC Server 720 - 2 processors	32 MB[16]	192 MB	48 MB[17]	256 MB
IBM PC Server 720 - 4 processors	32 MB[16]	384 MB	48 MB[17]	512 MB
IBM PC Server 704 - 2 processors	32 MB[16]	384 MB	48 MB[17]	512 MB

5.1.3 DASD Requirements

The most common factor influencing the design of the disk subsystem of any server is the need to achieve the largest amount of available space while maintaining fault tolerance. Common solutions in todays industries are to utilize RAID technology, mirroring, duplexing, or a combination thereof. Although, usable disk space is a valid requirement when designing any server, Notes is so disk I/O-intensive, that you should consider performance as the primary concern for your disk subsystem architecture.

Table 11. Notes DASD Requirements				
Platform	**OS/2**		**Windows NT**	
	Minimum	**Recommend**	**Minimum**	**Recommend**
IBM PS Server 320	300 MB	2-6 GB[18]	300 MB	2-6 GB[18]
IBM PC Server 520 - 2 processors	300 MB	8-10 GB[18]	300 MB	8-10 GB[18]
IBM PC Server 720 - 2 processors	300 MB	10-12 GB[18]	300 MB	10-12 GB[18]
IBM PC Server 720 - 4 processors	300 MB	14-16 GB[18]	300 MB	14-16 GB[18]
IBM PC Server 704 - 2 processors	300 MB	14-16 GB[18]	300 MB	14-16 GB[18]

By using IBM's RAID controllers both performance and maximum availability can be achieved. Implementing RAID-5 with multiple small drives (2 GB or smaller) will provide you with the best throughput while requiring only one drive to be reserved for fault tolerance. When RAID technology with multiple small drives is used for the Notes volume, the Notes databases are automatically spread across multiple drives producing a balanced I/O throughput across the drives. For large servers, supporting several hundred or more users, two or more RAID controllers may be beneficial.

With a RAID-5 configuration the data is striped across multiple drives with one drive reserved, called the *parity drive*, for fault tolerance. For example, if you were to use 5 2 GB drives and configure them for RAID-5, you would have 8 GB of usable space and one 2 GB reserved for parity. The mathematical calculation required to create the parity drive does increase the overhead associated with

---

[16] The OS/2 minimum required RAM for Notes is 32 MB. However, 64 MB of RAM is the standard RAM configuration for the IBM PC Servers 704 and 720.

[17] The Windows NT minimum required RAM for Notes is 48 MB. However, 64 MB of RAM is the standard RAM configuration for the IBM PC Servers 704 and 720.

[18] RAID technology should be used for fault tolerance.

each disk write operation, but it also provides for an automatic recovery process if one of the drives were to fail.

RAID-0 would have provided the best performance because it eliminates the need to create a parity disk and any mirroring. RAID-0 (which is used in many Notes benchmarks) provides better performance and maximizes available space because it has no parity drive and does not perform the calculations required for a parity drive. However, the disadvantage to configuring your disk subsystem for RAID-0 is that you remove the fault tolerance. In other words, a failure in one drive will cause the entire disk subsystem to fail.[19]

5.2 Operating System Optimization

This section presents ways to optimize the operating systems that provide the base for Notes implementations. It also states recommendations for optimal performance of the Notes environment.

5.2.1 OS/2

When selecting OS/2 as the operating system for your Notes servers, there are three primary versions that should be considered: OS/2 Warp Connect, OS/2 SMP, and OS/2 Warp Server Advanced. OS/2 Warp Connect should be sufficient for small Notes servers. OS/2 SMP is required to utilize multiple processors, and OS/2 Warp Server Advanced is required for large Notes uniprocessor servers. As a rule of thumb, OS/2 Warp Server Advanced is *recommended* for supporting more than 100 active users and *required* for more than 250 active users on a uniprocessor. OS/2 Warp Server Advanced includes a special, optimized file system called HPFS386. This optimized file system provides the additional disk cache capacity needed to support a high-capacity Notes server.

Virtual memory

When OS/2 Warp is first installed, the default swap file is set to 2 MB which is too small for typical Notes servers with 64 MB or more of RAM. If the swap file is left at this default setting, the file will dynamically increase as more virtual memory is needed. The problem with leaving the swap file at the 2 MB default size occurs when the file grows over non contiguous areas of the hard drive. This will degrade the performance of the server by interrupting data transfer when the drive heads move to each location. It is recommended that the default swap file size be increased and monitored on a regular basis to establish the correct sizing. Modify the SWAPPATH line in the CONFIG.SYS file, start at 20 MB or more and monitor it on a regular basis.

For example:

```
SWAPPATH=drive:\directory 2048 20480 or greater
```

Redirecting the swap file to the most used partition in the least used drive is also recommended. By putting the swap file in a different location than the OS/2 system files or on another drive, OS/2 will be able to more easily locate and access it, thus improving its performance. Where you should put the swapper depends on the physical makeup of your drives. Putting it on a separate partition on the same physical drive will hurt performance by causing excessive head

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[19] RAID-0 is typically used for recoverable or non-mission critical data, not your Notes database.

movement between the two disk partitions. One recommendation might be to put OS/2 on a small (150-300 MB), separate, very fast disk, and install the Notes program and data files on a second drive.

File Systems

When configuring smaller sized Notes servers, the FAT file system should be used for the best performance. This recommendation is based upon a characteristic of HPFS which limits the disk cache to a maximum size of 2 MB. The FAT file system allows for a disk cache size of up to about 14 MB, and is a 32-bit bit file system while HPFS is only 16-bit.

For larger sized Notes servers, the HPFS386[20] file system in OS/2 Warp Server Advanced and OS/2 Warp Server Advanced SMP (in Beta test at the time of this writing) should be used to allow large cache sizes up to 512 MB or more. HPFS386 is a full 32-bit file system and supports more concurrent open files, file shares, and file locks, all of which are requirements of Notes server. Quite often Notes servers are installed with two partitions, the C: partition as FAT, and the D: partition as HPFS. This allows the system to be booted with a DOS formatted diskette for maintenance purposes.

For more specific and up-to-date information concerning OS/2 and Notes refer to *Lotus Notes OS/2 Server Performance, Positioning, and Tuning* located at http://www.austin.ibm.com/pspinfo. Potentially some performance improvement can also be achieved by modifying the THRESHOLD parameter in the DISKCACHE statement. The following is an example of the DISKCACHE statement (DISKCACHE is applicable to the FAT file system only):

```
DISKCACHE=8000,LW,8,AC:C
```

In this example the size of the cache is 8 MB (8000 x 1024 bytes), with lazy write,[21] and has a threshold of 4 KB (8 x 512 bytes).[22]

Note: If you are using FAT-formatted drives only on the system, you can comment out the HPFS.IFS line altogether to gain more memory for the system.

If you are using OS/2 Warp Server Advanced, in most cases, set the *useallmem* parameter to YES in the HPFS386.INI file. This parameter specifies whether the 386 HPFS should use memory above the 16 MB boundary (provided this system is configured with more than 16 MB). The *useallmem* parameter should be set to YES if all of your adapters[23] can access memory above the 16 MB boundary.

For OS/2 Warp Server Advanced, a general rule of thumb for RAM allocation is to first take care of your Notes and Warp working set needs. The system should not be doing any sustained paging. Then ensure that the NSF_BUFFER_POOL_SIZE requirements are adequate (see Chapter 5, "Server

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[20] The HPFS386 file system should not be confused with HPFS which is a standard file system available with OS/2. HPFS386 is available only with the advanced version of the OS/2 Servers.

[21] The contents of the cache are written to disk during disk idle time.

[22] The threshold size represents the maximum number of disk sectors that will be placed in cache on a disk operation. For example, if a disk read was for 1 KB, the data would be placed in the cache. If a disk read was more than 4 KB the cache would not be used.

[23] Some adapters cannot do direct memory access (DMA) to memory above the 16 MB boundary. If you have a LAN or disk adapter that cannot do DMA to memory above the 16 MB boundary, the 386 HPFS must use only memory below 16 MB so that the adapter can put data into the file system buffers.

Optimization" on page 39). Finally the memory still available should be used by HPFS386 cache.

Device Drivers

As a general rule of thumb, do not install unneeded OS/2 features or device support (such as Multimedia support, DOS/Windows support and so on) on your Notes server. If you install OS/2 Connect or OS/2 Warp Server and select the default options you may be installing and loading some unneeded device drivers. If this is the case, you can later comment out any device drivers in the CONFIG.SYS file that are not being used by the system. This will free up some memory and leave OS/2 with fewer overall items to manage in memory. The following device drivers are not normally used when running the Notes server for OS/2 (assuming no DOS programs are running on the machine at the same time):

For example:

```
REM DEVICE=C:\OS2\MSDOS\VCDROM.SYS
REM DEVICE=C:\OS2\MSDOS\VWIN.SYS
REM DEVICE=C:\OS2\MSDOS\VCOM.SYS
REM DEVICE=C:\OS2\MSDOS\VPCMCIA.SYS
REM DEVICE=C:\OS2\MSDOS\VMOUSE.SYS
```

The VCDROM.SYS, VWIN.SYS, VPCMCIA.SYS and VMOUSE.SYS drivers are for CD-ROM, Win-OS/2, COM port, PCMCIA card, and mouse support under DOS sessions in OS/2, respectively.

5.2.2 Windows NT

Windows NT 3.51 is the version supported by the Notes Server application.

File Systems

When configuring file systems for Notes servers on Windows NT, we recommend that you use NTFS. This file system is a full 32-bit system which can allocate as much as 50% of the system's RAM to a disk cache and creates a log area for each volume on the partition. If your server should crash, this log area can be used to clean up problems with the volumes almost instantaneously.

NTFS also provides the ability to select individual file directories for automatic compression, although this feature is not recommended for Notes databases or directories containing Notes databases.

Virtual Memory

The allocation of real memory to the disk cache can be indirectly controlled by specifying how much memory to give to the server process. This is accomplished by:

- Opening the **Control Panel**
- Opening the **Network icon**
- Select **Server** in Installed Network Software

You can specify how much memory is reserved for the operating system indirectly by specifying how much memory (relatively) to give to server processes. You have four choices:

1. Minimize Memory Used: This choice will minimize the memory used for disk cache and maximize the memory available for the operating system. However, on Notes servers, the resulting performance would not be desirable. This choice should only be used for NT workstations.

2. Balance: This choice will attempt to balance the use of real memory between the operating system and the disk cache. Typically a good choice for non-dedicated servers also used as a workstation.

3. Maximize Throughput for File Sharing: This choice yields the best performance when the system is used as a file server but necessitates a significant amount of memory swapping unless you have enough physical memory to ensure adequate resources for both the operating system and disk cache.

4. Maximize Throughput for Network Applications: This choice is the recommended setting for NT servers running Notes. Another feature of the virtual memory system in Windows NT is the ability to create multiple paging files. One paging file can be created on each physical disk and is beneficial if your server contains multiple disk drives. This feature allows multiple virtual memory pages to be swapped to and from the drives simultaneously, reducing the amount of time required for memory swapping.

Foreground/Background Responsiveness

By default, the Foreground/Background Responsiveness is set to Best Foreground Application Response Time when Windows NT is installed. By leaving this parameter at its default setting, Windows NT will give priority to which ever application is currently active in the foreground. However, it is more than likely that other windows will be in the foreground with the Notes server task in the background (for instance, when the administrative client is being utilized). By selecting Foreground and Background Applications Equally Responsive, Windows NT will not give priority to any one task. This will allow the Notes server to have the same priority as any other process on the machine. To change this setting:

1. Open **Control Panels** and select the System control panel.

2. Click the **Tasking** button.

3. Select **Foreground and Background Applications Equally Responsive**.

Note: If your Windows NT server is dedicated as a Notes server, leaving this parameter at its default setting will provide an increase in performance if the Notes server is continually the foreground application.

5.3 Protocol Optimization

Optimization of protocols within the Notes environment really has very little to do with the Notes Server application. Instead, the issues we discuss here are common guidelines that should be used for any network environment regardless of Notes.[24]

5.3.1 TCP/IP

Using the TCP/IP protocol in a Notes environment has historically proven to provide the best performance and efficient use of network adapter hardware. This fact can be attributed directly to the nature of how TCP/IP is routed and transmitted on the network. The use of TCP/IP on a LAN is highly recommended, especially when implementing a geographically disperse network using WAN links. More often than not, TCP/IP is the protocol used by routers for communication across WAN links. By implementing your Notes environment with the TCP/IP protocol on the LAN, the overhead associated with each router examining and forwarding packets is reduced.

With respect to Notes, a common problem with Notes servers is when the packet buffer size is increased by the administrator for performance or by the installation of a new client/server application. For proper operation within Notes, the NOTES TCP BUFFER PACKET SIZE parameter within the NOTES.INI file must match for all servers and clients on the LAN.

5.3.2 IPX/SPX

Using the IPX/SPX protocol in local area networks has also proven to produce very high performance results for Notes environments. However, when communicating across wide area links, the performance is severely degraded due to packet segmentation and server-to-server SPX traffic.

There are two types of NetWare services supported by Notes, Bindery Service for NetWare 3.x servers and NetWare Directory Services (NDS) for NetWare 4.x servers. The default service support when installed on an OS/2 server is NDS. In a mixed NetWare 3.x and 4.x environment, the Notes server will first perform a Directory Services request. If no 4.x server responds, it will then attempt a Get Nearest Server (GNS) request. Only NetWare 4.x servers will respond to the initial Directory Services request. Therefore, if the desire is to have the Notes server connect to a 3.x server the following parameter is required in the NET.CFG file:

```
DIRECTORY SERVICES OFF
```

For Windows NT 3.51, Directory Services is not supported by the Windows NT Microsoft NetWare Client. To utilize NetWare 4.x Directory Services, you will need to disable the Microsoft NetWare Client and install the Novell NetWare Client. Furthermore, if the Microsoft NetWare Client is being used on the Notes NT server, both the NwLink IPX/SPX and Gateway Services for NetWare options need to be installed. Both of these options are located on the Windows NT CD-ROM.

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[24] For more information on each protocol, refer to the *Notes R4 Network Configuration Guide*.

5.3.3 NetBIOS

Use of the NetBIOS protocol for Notes servers is hampered by a relatively low limit on the number of active users which can be supported through the Notes NetBIOS port drivers. Both OS/2 and NT-based servers can accommodate at most about 250 active sessions simultaneously. (Please see Appendix D, "Lotus Notes NetBIOS Port Drivers" on page 59 for further discussion of this limitation.)

For this reason, using this as the only protocol on a robust Notes server would result in the server being under utilized. The NetBIOS limitations would be reached long before the server would otherwise reach capacity.

Having said that, NetBIOS is still a very important protocol and many installations will require it to be supported on the server, although usually in conjunction with TCP/IP or sometimes even IPX/SPX.

In an OS/2 environment, if you do require NetBIOS, Notes supplies two port drivers which can be used. These are named NetBIOS.dll and IBMEENB.dll. You can select one or the other, but not both. From a Notes application standpoint, the two drivers are equivalent.

The NetBIOS.dll driver uses an interface supplied by the OS/2 LAN Requester and therefore requires the LAN Requester to be loaded in order to use it. This driver also limits the number of users it can support to approximately 120.

If you require more NetBIOS users, you can use the IBMEENB.dll driver. This driver will support approximately 250 users by spreading the network load across multiple LAN adapters. However, setup of the IBMEENB.dll driver is not as easy because it requires that the resources in the notes.ini, protocol.ini, and ibmlan.ini files be coordinated. The Warp Server Tuning Assistant can provide help with this task.

If NetBIOS is required in your Notes environment, we recommend that the NetBIOS.dll driver be used if possible. If this driver does not allow enough users for your environment, then consider the IBMEENB.dll driver as a way to get some more notes NetBIOS client connectivity, although be prepared for some additional time and effort to get it configured.

5.4 Lotus Notes Optimization

The Notes server is controlled by the values stored in the NOTES.INI file. Several variables can be modified to enhance the performance of your server.

Before making any of the suggested modifications below, be sure to make a backup copy of your existing NOTES.INI in case any of the changes that you make are not accepted by the system.

5.4.1 Memory Buffers

The capacity of a Notes server is heavily influenced by the amount of memory that is available for the NSF Buffer Pool. This pool of memory is used to buffer I/O transfers between Notes and the disk subsystem for information about views that are in use, the clients who are using the views, and temporary document storage. The NSF Buffer Pool is divided among all active users that are accessing a particular database view, therefore, it is one of the largest pools of memory on the server. Initially we recommend that you accept the default value

established by the Notes server because this value is determined automatically by the server based on the amount of memory available in the server.

Periodic monitoring of this memory pool will allow you to determine if the NSF Buffer Pool default size needs to be increased.[25] This is accomplished by comparing the *Database.BufferPool.Used* parameter against the *Database.BufferPool.Maximum* parameter. If the amount used is close to or the same as the maximum setting, the memory pool should be increased. Figure 11 shows an example of to monitor these parameters using the *show* command.

```
>SHOW STAT DATABASE

Database.BufferControlPool.Peak = 654060
Database.BufferControlPool.Used = 155664
Database.BufferPool.Maximum = 124729242
Database.BufferPool.Peek = 23270400
Database.BufferPool.PerCentReadsInBuffer = 99
Database.BufferPool.Reads = 39267
Database.BufferPool.Used = 23142178
Database.BufferPool.Writes = 24024
Database.NIFPool.Peak = 1438932
Database.NIFPool.Used = 589692
Database.NSFPool.Peak = 1111902
Database.NSFPool.Used = 228619
```

Figure 11. Monitoring the NSF Buffer Pool Statistics

To increase the default size of the NSF Buffer Pool, the following value must be changed within the NOTES.INI file:

NSF_BUFFER_POOL_SIZE = XXXXX

Unlike memory tweaks in the OS/2 CONFIG.SYS, where memory is expressed in KB, the NOTES.INI memory variables are specified in bytes. To increase the NSF Buffer Pool to 8 MB you would enter:

NSF_BUFFER_POOL_SIZE = 8388608

since 8 x 1024 x 1024 = 8388608. Notes assumes that the amount of memory which you allocate with the NSF_Buffer_Pool_Size variables will be available in physical memory (RAM). If there is not sufficient RAM available for the system to allocate this value, then it will begin to disk swap or page (if the platform supports these functions) to compensate for this memory and the performance of the server will degrade dramatically.

It is not recommended that you change the values of the NSF_Buffer_Pool_Size variables from their defaults unless your Notes server does a lot of indexing-related I/O and definitely has enough physical RAM to accommodate the values that you choose.

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[25] 6 MB is the largest ″default value″ to which the NSF_Buffer_Pool_Size can be set. The maximum size of the NSF_Buffer_Pool_Size is 128MB. If your server has a large amount of memory available, edit the NOTES.INI file to change the NSF_Buffer_Pool_Size.

5.4.2 Server Tasks

Minimizing the number of server tasks that are run on the server, the frequency in which they run, and the time in which they run will allow you to increase the performance of the server. The Notes server tasks to be automatically launched by the server are set in the NOTES.INI variables:

```
ServerTasks=Replica,Router,Update,Stats,AMgr,Adminp
ServerTasksAt1=Catalog,Design
ServerTasksAt2=UpdAll,Object Collect mailobj.nsf
ServerTasksAt22=Statlog
```

Each of these variables control the schedules for automatic server and database maintenance tasks. The time is entered in 24-hour format, where 0 is 12:00AM and 23 is 11:00 PM. In the example above, Catalog and Design tasks would initiate at 1:00 AM, and the Statlog task would initiate at 10:00 PM.

Following are some suggestions on how to increase performance related to Notes server tasks:

- Remove the Stats server task (installed by default). This task is installed only for backward compatibility with Notes Release 2.x servers which had been set up for statistics collecting and can be removed (although it takes up very little resources). This is the server task which produces the messages: Stats agent started and Stats agent shutdown on the server console once each hour.

- Both the Replicator and/or Router tasks can be removed if they are not being used on the server, as each of these tasks take up a fair amount of server resources when loaded. For example, if you only have one Notes server in your organization which is used for both applications and mail routing, you may not need the Replicator task as you don't have any other servers to replicate from (and because clients will be replicating from the Notes server, not vice versa). Another example might be if you have a hub replication server which never routes mail. In this case, you can remove the Router task. Be careful with this example because, although the server might not be used for routing mail between users, you may have some mail-enabled Notes database applications, in which case you will need the Router task and should not remove it.

- Daily server tasks should be run when other server tasks are not running and at times when few or no users are using the Notes server such as before users begin using the server in the morning, during lunch time or after normal working hours. This allows the maximum amount of server resources to be available for each server task which is currently executing and for user sessions. Examples of such server tasks are Design, Catalog, Statlog, and customized Notes API programs that only need to be run once a day.

5.4.3 Database Indexing

Maximize disk space used for database view indexes and minimize the effort required to update view indexes by the Indexer server task. In general, the fewer view indexes that the Indexer server task must update, the fewer server resources will be used by this task. You can use the NOTES.INI variable Default_Index_Lifetime_Days to minimize the amount of effort required by the Indexer task when updating view indexes. The Default_Index_Lifetime_Days variable controls how long a view index is kept in a database before it is deleted due to non-use.

For example:

```
Default_Index_Lifetime_Days=
```

The default value for this variable is 45 days (unless a database designer has specified a different lifetime in the Design - View - Attributes Index Options dialog box). Setting this number to a lower value will reduce the number of view indexes on a server and therefore reduce the amount of time and effort that the Indexer server task must spend in updating view indexes.

Disable the updating of full-text indexes on a server if you do not have any full-text indexed databases on your server (and do not intend to). The NOTES.INI variable Update_No_Fulltext can be used to disable all full-text index updating on the server. You may want to use this variable to disable the updating of full-text indexes if, for example, you do not want users to create full-text indexes on their mail files on a mail server in order to save disk space on that server (the space which would be used for the full-text indexes) and to save the Indexer task the time and resources of updating these full-text indexes.

For example:

```
Update_No_Fulltext=<0 or 1>
```

Setting this value to 0 causes full-text indexes to be updated each time the Updall server task is executed and setting the value to 1 disables all full-text indexing.

5.4.4 Minimize the Notes Log File

Keep the Notes log file (LOG.NSF) as small as possible and minimize the amount of database activity that is logged. Minimizing the activity of the Notes log will help to increase server performance by minimizing the updates to the log file.

In general, you should only log Notes server activities when you are keeping regular statistics on certain activities, trying to diagnose a problem, or track the use of a specific resource. The following NOTES.INI variables below all apply to logging Notes server activities and can be disabled if the results of their logging are not being used.

For example:

```
Log=logfilename, log_option, not_used, days, size
Log_AgentManager=<0 or 1>
Log_MailRouting=<0, 10, 20, 30, or 40>
Log_Replication=<0 or 1>
Log_Sessions=<0 or 1>
Log_Tasks=<Yes or No>
Log_View_Events=<0 or 1>
PhoneLog=<0, 1 or 2>
```

For specific information on each of these variables refer to Appendix A in the *Notes R4 Administrators Guide.*

5.5 Administration Guidelines for Better Server Performance

When designing your Notes environment, there are some general guidelines that you should keep in mind for optimizing the performance of each server and the entire network.

5.5.1 Dedicating Servers

As we have discussed earlier, Notes is a robust application capable of performing many functions on a single server. For example, remote or small offices may utilize an IBM PC Server 320 platform to support both mail and database applications. Although this may be more practical, running multiple functions on a single platform reduces the server's response time as the number of users increases. By limiting each server to an individual function, the response times will be increased.

This issue becomes most apparent with database application servers. The most CPU intensive tasks incurring performance degradation are: rebuilding views, background macros, full text indexing, non-indexed searches, and database compacting. All of these tasks are directly related to database applications. By consolidating database applications to individual servers, most of these tasks can be assigned to occur outside normal production hours thereby eliminating any impact to other functions within the Notes network such as mail routing and replication.

In addition to dedicating each server to a specific Notes function, avoid using a Notes server as a file server within the network. This will only result in a degradation of performance for either the Notes server or the file server.

5.5.2 Hardware Designs

Ensuring that each server is configured appropriately for the function(s) that it will support is the first step to ensuring optimal server performance. Each function with the Notes server application tests different areas of the server hardware. For example, mail routing and replication are very I/O intensive tasks. Therefore, mail routing servers and hub servers should be designed with fast disk subsystems and network adapters, while passthru servers should be designed with fast CPUs and network adapters.

5.5.3 Server Reboot Intervals

Experience with Notes 3.x has shown that any given server should be rebooted every 7 to 14 days. Our experience with Notes R4 indicates that reboot, although still required, should be performed every 30 days. Typically when a Notes server is not systematically rebooted, the performance of the server will degrade and possibly lock up. This issue appears to be related to the interaction between the operating system and Notes. Restarting the server also purges all the deletion stubs for databases that always remain open, such as the Server Log, Public Name and Address Book, and the Statistics Reporting database.

Appendix A. Network Considerations

As part of your deployment strategy, you need to make decisions about arranging servers and workstations to achieve the most efficient use of your network for communications. The topology of your Notes network refers both to the physical connections between servers and workstations and the logical method your Notes servers communicate via replication.

A.1 Types of Server Topologies

Notes servers communicate with other servers by way of replication and mail routing. The possibilities for communication from server-to-server is extensive, depending on the number of servers, their locations, and how often each server needs to be updated. The most common way to minimize the impact on the network and simplify administration is to create specific replication topologies. Creating a replication topology consists of designing a systematic process in which replication between servers occurs. Quite often, Notes networks are installed without considering what impact replications will have on the network and the productivity of the Notes clients. Commonly this results in disorganized server replications which will eventually degrade the performance of the entire network if not corrected as the Notes environment grows.

When designing your replication topology, there are two goals that should be achieved:

1. Minimize the number of replications that occur between servers, yet ensure that each server maintains current information.

2. Confine major updates between servers to your non-production hours.

The following examples depict recommended configurations provided by Lotus:

A.1.1 Hub-and-Spoke

With the hub-and-spoke configuration, a single server, known as the hub, is configured to control all replications with secondary, or spoke servers, and additional hub servers. This topology is common in large Notes networks as it minimizes replication times and controls the process by which mail is routed.

Since each server represented as a spoke only replicates with the central hub server, the most current information is consistently stored in a central location. This allows a controlled schedule to be implemented whereby the hub server ensures that each spoke server is consistently updated with a single replication. Administration is simplified, since the hub server controls the schedule for updating each spoke center and this topology provides an adaptable environment for growth and change.
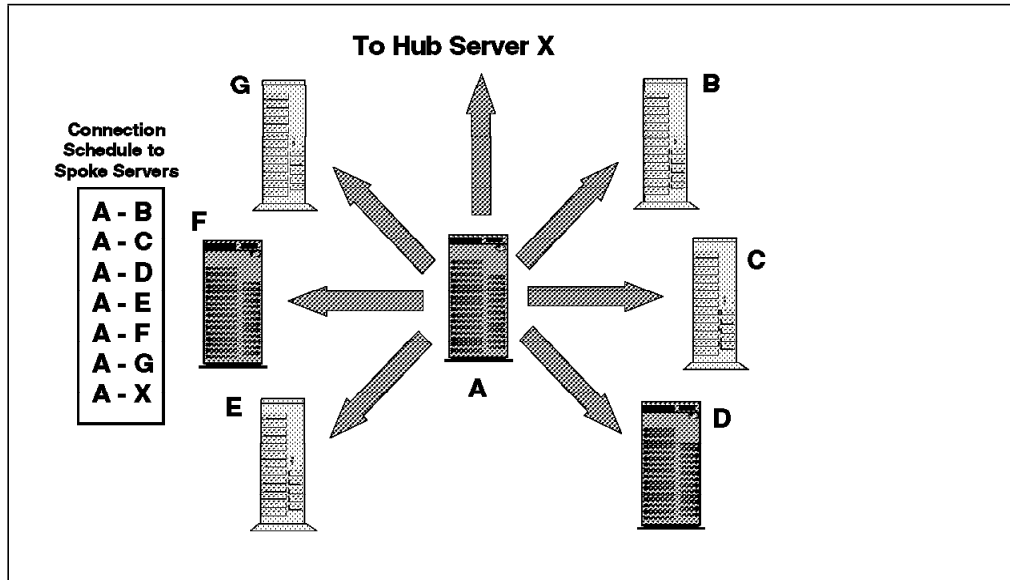
Figure 12. Hub and Spoke Topology

For mail routing, the hub server is used to control the delivery of in-bound and out-bound mail to other Notes domains. In addition to controlling the delivery of mail, the hub server provides a central location for tracking mail routing failures.

A.1.2 Hub Server in a Single LAN Environment

In a single LAN environment, a smaller hub server connects directly to spoke servers and other hub servers across the local network. The spoke servers then provide replication and mail services to the Notes clients. Here again, each server represented as a spoke needs only perform a single replication with the central hub server to ensure that the most current information is consistently available.
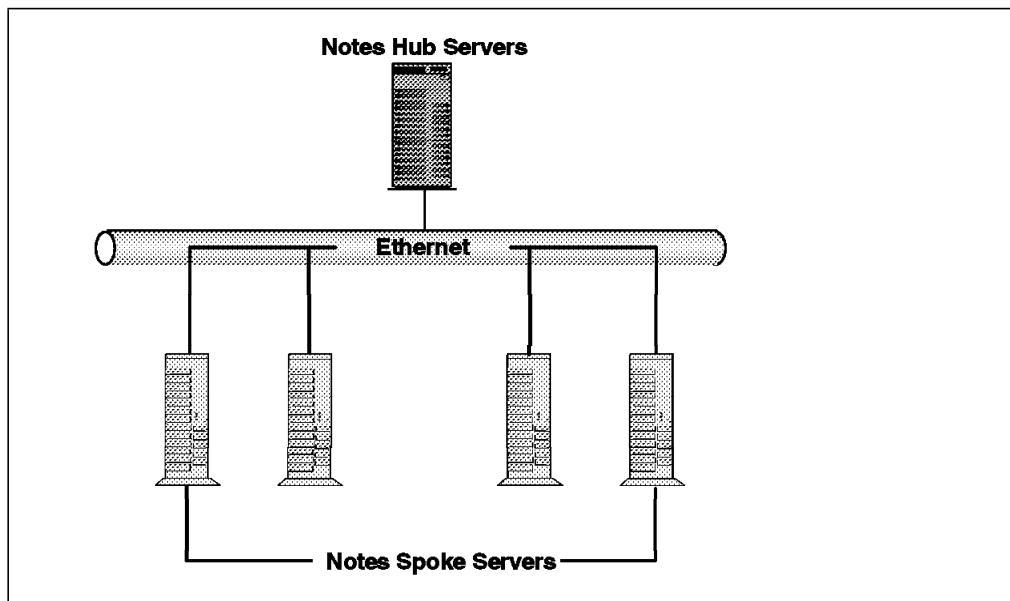
Figure 13. Hub and Spoke Topology in a Single LAN Environment

A.1.3 Hub Server in a Dual-Protocol Environment

A hub server can also be used to connect Notes servers on different protocols or topologies. Mail is routed and databases are replicated between the originating Notes server to the hub, then from the hub to the destination server on the other network. The hub server in this scenario supports both protocols and replicated copies of every common database between the different networks.
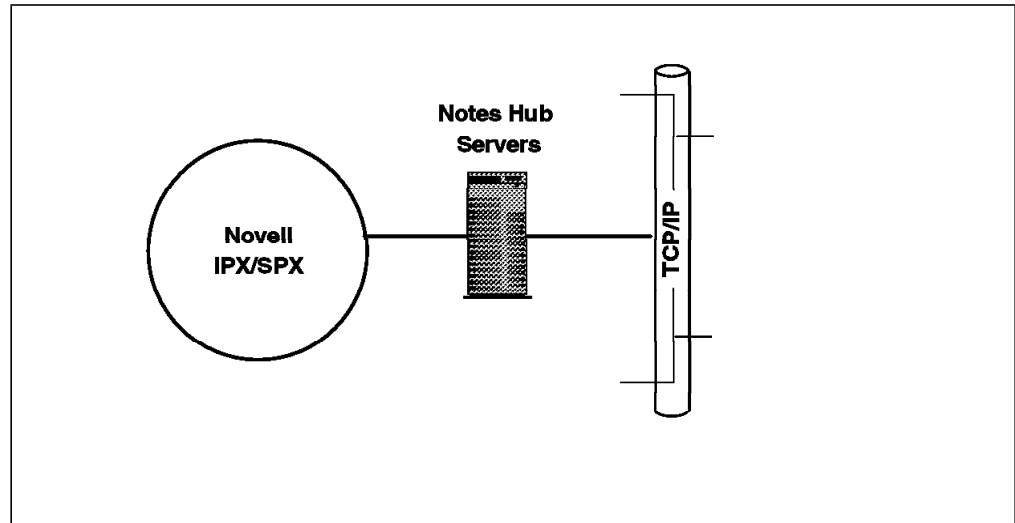
Figure 14. Hub Server in a Dual-Protocol Environment

A.1.4 Hub Server in a Remote Environment

In a remote environment, a hub server could be used to connect field office LANs and a remote hub server to the corporate network through dial-up or X.25 lines.
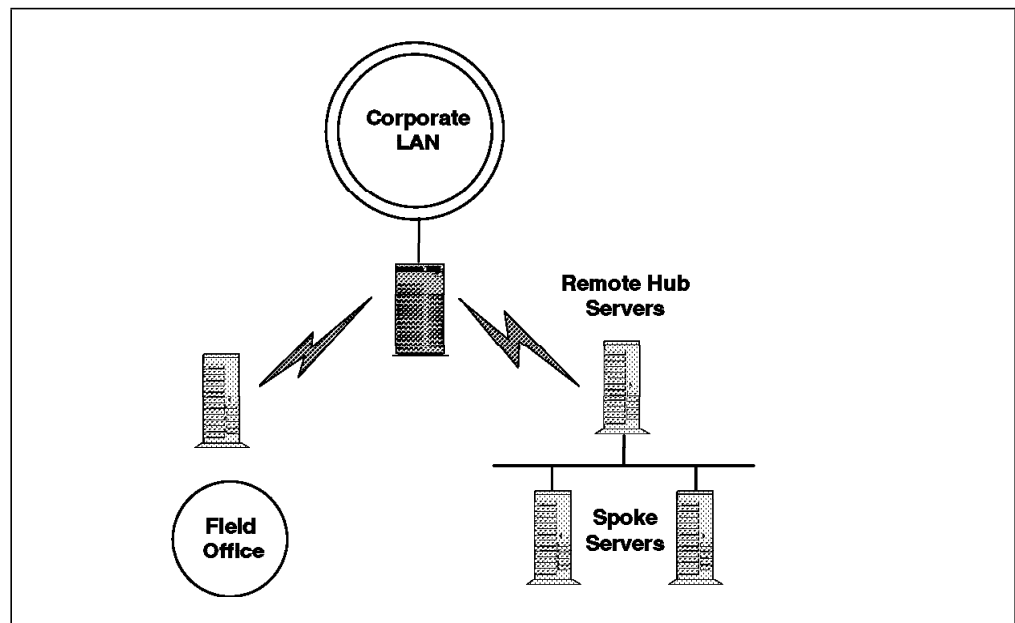
Figure 15. Hub Server in Remote Environment

Appendix B. What′s New in Notes R4

With the release of Notes Version 4.1, Lotus has incorporated many changes to increase performance, simplify administration, enhance security, and enhance troubleshooting to list only a few. For now we limit our discussion to the increases in performance that Notes R4 provides over R3.

B.1 Server Connections

Notes 3.x has an internally coded limitation of 120 concurrent connections per server. Beyond 120, connections are recycled to allow additional users to access the server. This means as user 121 connects to the server, the least used active connection is temporarily suspended until it is required to become active again. Because of this architectural design in Notes 3.x, experience has shown that the capacity of any given Notes server is limited to around 100 to 140 users. Although this limit varies somewhat with different operating systems and hardware platforms, the fundamental capacity of each server is primarily determined by the Notes application itself.

Just as Notes 3.x, Notes R4 also has an internally coded limitation, but the numbers are so large as to not be an issue. Therefore limitations to the maximum number of connections for Notes 4.x is more dependent upon the configuration of each Notes server. Testing within the labs at FCP Technologies and IBM′s PC Server Performance Lab have shown that the PC Server 720 can support well over a 1,000 users with out Notes design characteristics ever becoming a factor.

B.2 Replication and Indexing

Replication and indexing are two of the many tasks that each Notes server performs. These two tasks are significant when considering performance capabilities as they produce the most significant loads on Notes servers. Notes R4 reduces these stresses placed on a server through the following enhancements:

- With Notes R4 it is now possible to configure multiple replications to occur with several servers simultaneously. By executing multiple simultaneous replications, the amount of overall time required for a replication cycle is significantly reduced and thereby minimizes the probability of impact to production hours.

- Replication now occurs at the field level. This eliminates the requirement to replicate a complete document when only a single field has been modified.

- Notes R4 now allows individual directories to be selected for each replication task. This eliminates the requirement for each server to replicate all databases in common.

- Time limits can now be defined, specifying times after which replication ends.

- Multiple indexers can now be configured allowing multiple full-text and view indexers to be executed simultaneous during non-production hours.

Each of the enhanced characteristics within Notes R4 are dependent upon the operating system and hardware platform of each Notes server. Therefore, selection of these components for Notes R4 is much more important than for Notes 3.x for optimum performance.

Appendix C. Notes and the Internet

Lotus′ Internet strategy has rapidly evolved during the past year, beginning with the initial shipment of InterNotes Web Publisher in May 1995, with subsequent versions shipped in November 1995 and March 1996. In May, Lotus began Beta shipments of Domino, and in July ships a final product via the Web, to be used with Notes 4.x Servers.

Domino transforms Notes into the industry′s only interactive Web application server allowing any Web client to participate in Notes applications securely. Bridging the open networking environment of Internet standards and protocols with the powerful application development facilities of Notes, Domino provides businesses and organizations with the ability to rapidly develop a broad range of business applications for the Internet and Intranet. For organizations only interested in building Intranets with TCP/IP, HTTP, HTML and other emerging standards, the Domino II product line will bring the best elements of Notes to the Web. All these products are part of the same architectural family and can easily be upgraded and reconfigured to meet business objectives.

Lotus will soon ship Notes Release 4.5, incorporating the Domino server technology with the new Notes Release 4.5 client, featuring integrated calendaring and scheduling, direct Web access, and support for Java applets and Internet plug-ins.

Lotus′s strategy is to offer a complete, yet modular, set of products for Internet and Intranet users. For those desiring the market leading client/server messaging solution, Notes Mail offers unmatched price and performance. For users who want a rapid application development and deployment environment for groupware solutions with enterprise integration, broad connectivity and platform support, Lotus continues to offer and enhance Notes.

For more information on Lotus and the Internet, access the Lotus Web site at the following URL: http://www.lotus.com.

Appendix D. Lotus Notes NetBIOS Port Drivers

As discussed in 5.3.3, "NetBIOS" on page 46, there are two Notes supplied NetBIOS port drivers available for the OS/2 Notes server. These are called NetBIOS.dll and IBMEENB.dll. These port drivers use resources from the underlying NetBIOS protocol stacks provided by the OS/2 LAN Requester and the OS/2 Multi-Protocol Transport Services (MPTS) respectively.

We recommend that you use the NetBIOS.dll, if possible, because of its ease of configuration and its efficient use of resources.

The NetBIOS.dll driver is limited to a system total of approximately 100-125 clients. Those familiar with OS/2 LAN Server might ask themselves ″Why is Notes limited to only 125 NetBIOS clients? OS/2 Warp Server can support up to 1000 NetBIOS clients.″[26] The reason for this limitation is in the design of the port driver, not a limitation of the NetBIOS protocol itself. The port driver uses 16-bit OS/2 system semaphores, two per client, and there is a system limit of 256 16-bit system semaphores in OS/2.

Now that we have explained the capacity limitation, let′s discuss the two NetBIOS implementations available for OS/2-based Notes servers. In the OS/2 environment, there are two NetBIOS APIs, the *submit interface* and the *NB30 interface*. The submit interface is supplied by the OS/2 LAN Requester and the Notes driver *NetBIOS.dll* gets its network resources through this interface. That is the reason for the requirement that the OS/2 LAN Requester must be active in order to use this driver.

The NB30 (NetBIOS 3.0) is supplied by Multi-Protocol Transport Services (MPTS) and it is this interface that is used by the *IBMEENB.dll* driver.

Since it uses the resources available to the OS/2 LAN Requester, the NetBIOS.dll driver is dependent on the resources allocated to the requester that are allocated in the IBMLAN.INI file. In other words, the network resources (sessions, commands, and names) that both the Notes port driver and the OS/2 LAN Requester use come out of the same pool. In effect, the Notes port driver and OS/2 LAN Requester must share these resources. Consequently, when you configure IBM LAN Requester, you should make sure that you configure sufficient resources for OS/2 LAN Requester AND the Notes port driver. You will probably need to increase the number of Sessions, Commands (NCBs) and Names from their default values in order to provide sufficient quantities for both components.

Also, the startup sequence of OS/2 LAN Requester and Notes is also important when using the NetBIOS.dll driver. Since the Notes driver is dependent on the LAN Requester, You must start the LAN Requester before starting Notes.

As stated earlier, the IBMEENB.dll driver makes calls to the standard NetBIOS 3.0 (NB30) interface instead of using the NetBIOS Submit interface. This means you do NOT need to install or run the LAN Requester. However, this driver is more difficult to configure and does not allocate resources as efficiently as the NetBIOS.dll driver. This is explained below:

---

[26] Using four LAN adapter cards.

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1. Notes has several processes which perform communications. They are the database server, database client, replicator, background replicator on the client, and the periodic macro agent. Each of these uses the port driver to handle the lower level tasks associated with the configured protocol.

2. When the process is being initialized, it makes a call through the port driver to NetBIOS asking for NetBIOS resources to be allocated to the process. The number of resources can be explicitly specified or it can be left to default.

3. In the case of NetBIOS using the IBMEENB.dll driver, Notes uses the default value of 15 sessions per process for all cases except for the database server. This means that 15 sessions are allocated whether they are needed or not. This results in an inefficient use of NetBIOS sessions, which are a limited commodity anyway.

4. The Database server process on the Notes server is the one exception - it uses the value specified on the port line in NOTES.INI. For example, if the port line was

```
LAN0=IBMEENB,0,50,2000,,12288
```

then the database server process gets 50 sessions. This value can be changed if required.

As an example, let's say that you performed the following sequence on your Notes server:

1. Start the replication process

2. Start the Notes client interface

3. Access a database on another server

4. Start a background replication

5. Start a timed macro to access another server

In order to perform the preceding sequence of events, you will need 50+15+15+15+15+15 = 125 sessions! These sessions must be available or the process will fail at initialization time. (For the IBMEENB.dll driver using the NB30 interface, the maximum number of sessions is defined in the Netbeui section in the PROTOCOL.INI file.)

Contrast this resource allocation with the NetBIOS.dll driver. In this case, the OS/2 LAN Requester allocates all the resources specified in IBMLAN.INI when the requester service starts. Notes and any other application which use that NetBIOS interface will share those resources with the LAN requester. So with our earlier example, Notes would only need X+1+1+1+1+1 = X+5 sessions, where 'X' equals the number of currently attached Notes users. As you can see this is much more resource efficient.

Appendix E. Special Notices

This publication is intended to help IS professionals perform server selection and implementation for a Notes network environment. The information in this publication is not intended as the specification of any programming interfaces that are provided by Lotus Notes or OS/2 Warp. See the PUBLICATIONS section of the IBM Programming Announcements for more information about what publications are considered to be product documentation.

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Appendix F. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

F.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see "How To Get ITSO Redbooks" on page 65.

- *IBM PC Server Selection Guide*, SG24-4760
- *IBM PC Server and Novell NetWare Integration Guide*, SG24-4576
- *IBM PC Server and OS/2 LAN Server Integration Guide*, SG24-4577
- *IBM PC Server and Windows NT Integration Guide*, SG24-4578

A complete list of International Technical Support Organization publications, known as redbooks, with a brief description of each, may be found in:

International Technical Support Organization Bibliography of Redbooks, GG24-3070.

F.2 Other Publications

These publications are also relevant as further information sources:

- *IBM PC Server 310 System Library,* S52H-3697
- *IBM PC Server 320 System Library for Non-Array Models,* S19H-1175
- *IBM PC Server 320 System Library for Array Models,* S19H-1196
- *IBM PC Server 320 PCI/Micro Channel System Library,* S30H-1778
- *IBM PC Server 520 System Library,* S52H-3695
- *PC Server 704 System Library*, S78H-5300
- *PC Server 720 System Library*, S30H-1782
- *IBM PC Server Technical Reference Guide*, S83G-7936

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This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

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We accept American Express, Diners, Eurocard, Master Card, and Visa. Payment by credit card not available in all countries. Signature mandatory for credit card payment.

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Glossary

Concurrent Active Users. Number of users who, at a given time, are attached to the server and interactively accessing databases. For the Notes 3.x architecture, it is important to understand the difference between active concurrent users and total users.

Domains. A logical group of Notes servers that share a common name and address book.

Duplexing. A mirroring technique where each partition is on a disk attached to a different controller. This is intended to protect against controller failures in addition to media failures. Duplexing has additional performance advantages to mirroring in that read and write transactions can be performed by both disk controllers simultaneously.

Indexing. Full text indexes of databases are created to allow users to execute text search queries on the information contained within the database. Notes stores index files for each database in a directory named filename.FT where filename is the file name of the indexed database, excluding the .NSF extension.

I/O. Input/Output. Refers to data transfer for one sub-system to another.

Maximum Connections. Notes 3.x has an internally ″coded″ limitation of 120 concurrent connections. Beyond 120, connections are recycled, which means as user 121 connects to the server, the least recently active connection is temporarily suspended until it becomes active again. Then another connection will be suspended so it can again become active.

Notes 4.x also has an internally coded. limitation, but the numbers are so large as to not be an issue. Limitations to the maximum number of connections for Notes 4.x is dependent upon the configuration of the hardware and OS.

Mirroring. Duplication of a single physical partition on two separate drives connected to a single disk controller.

Notes Server. An application server/hardware system dedicated to running the Server portion of Lotus Notes.

NSF. Notes Storage Facility.

Partition. A section of a physical disk that would normally appear in the system as a logical volume.

RAID5. RAID is a specification for a Redundant Array of Inexpensive Disks. RAID uses intelligent adapters and multiple disk drives to maximize data transfer rates. RAID 5 is a technique of striping data across drives with error correction codes stored on a reserved parity disk. This implementation allows a drive array to be recovered if one of the drives in the array fails.

RAID0. RAID 0 indicates a disk array that implements data striping across multiple drives without any drive redundancy. It offers no fault tolerance and is less reliable than a single drive implementation due to the failure of a single drive resulting in the loss of data on all drives. Its only advantage is speed.

Replication. A server task that allows 2 copies, called replicas, of a database to exchange updates and synchronize data. During replication, two replicas exchange modifications, additions, and deletions. Replication between two replicas can be configured to occur in one or both directions and can also allow only certain portions of each replica to be replicated. Notes R4 replicates only modified fields, not entire documents within a database.

SMP 1.1 Specification. (Intel Pentium Only) This is a specification for implementing symmetrical multiprocessing with Pentium processors. It is significantly less expensive than true SMP (see below); However, it is limited in that only two processors are supported and both share the same cache. Adding a second processor might add up to 40% to overall system throughput (independent of Notes).

SMP 1.4 Specification. True, fully symmetrical multiprocessing. Each CPU has its own dedicated cache, multiple CPUs are supported and performance scalability on a well architected system is significantly better. Two CPUs might give 1.75 to 1.80 overall performance; 3 CPUs might provide 2.5 - 2.6 and so on.

Total Users. The total number of users who have access to the databases on a given server. These users may or may not be attached to the server at a given time.

Volume. A logical drive.

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Processing Options

Runtime values:

Document fileid .... SG244857 SCRIPT
Document type .... USERDOC
Document style .... REDBOOK
Profile EDFPRF30
Service Level 0029
SCRIPT/VS Release 4.0.0
Date 96.08.05
Time 14:18:51
Device 3820A
Number of Passes 4
Index .... YES
SYSVAR D .... YES
SYSVAR G .... INLINE

Formatting values used:

Annotation .... NO
Cross reference listing .... YES
Cross reference head prefix only .... NO
Dialog .... LABEL
Duplex .... YES
DVCF conditions file .... (none)
DVCF value 1 .... (none)
DVCF value 2 .... (none)
DVCF value 3 .... (none)
DVCF value 4 .... (none)
DVCF value 5 .... (none)
DVCF value 6 .... (none)
DVCF value 7 .... (none)
DVCF value 8 .... (none)
DVCF value 9 .... (none)
Explode .... NO
Figure list on new page .... YES
Figure/table number separation .... YES
Folio-by-chapter .... NO
Head 0 body text .... Part
Head 1 body text .... Chapter
Head 1 appendix text .... Appendix
Hyphenation .... NO
Justification .... NO
Language .... ENGL
Layout .... OFF
Leader dots .... YES
Master index .... (none)
Partial TOC (maximum level) 4
Partial TOC (new page after) .... INLINE
Print example id's .... NO
Print cross reference page numbers .... YES
Process value .... (none)
Punctuation move characters ....,
Read cross-reference file .... (none)
Running heading/footing rule .... NONE
Show index entries .... NO
Table of Contents (maximum level) 3
Table list on new page .... YES
Title page (draft) alignment .... RIGHT
Write cross-reference file .... (none)

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