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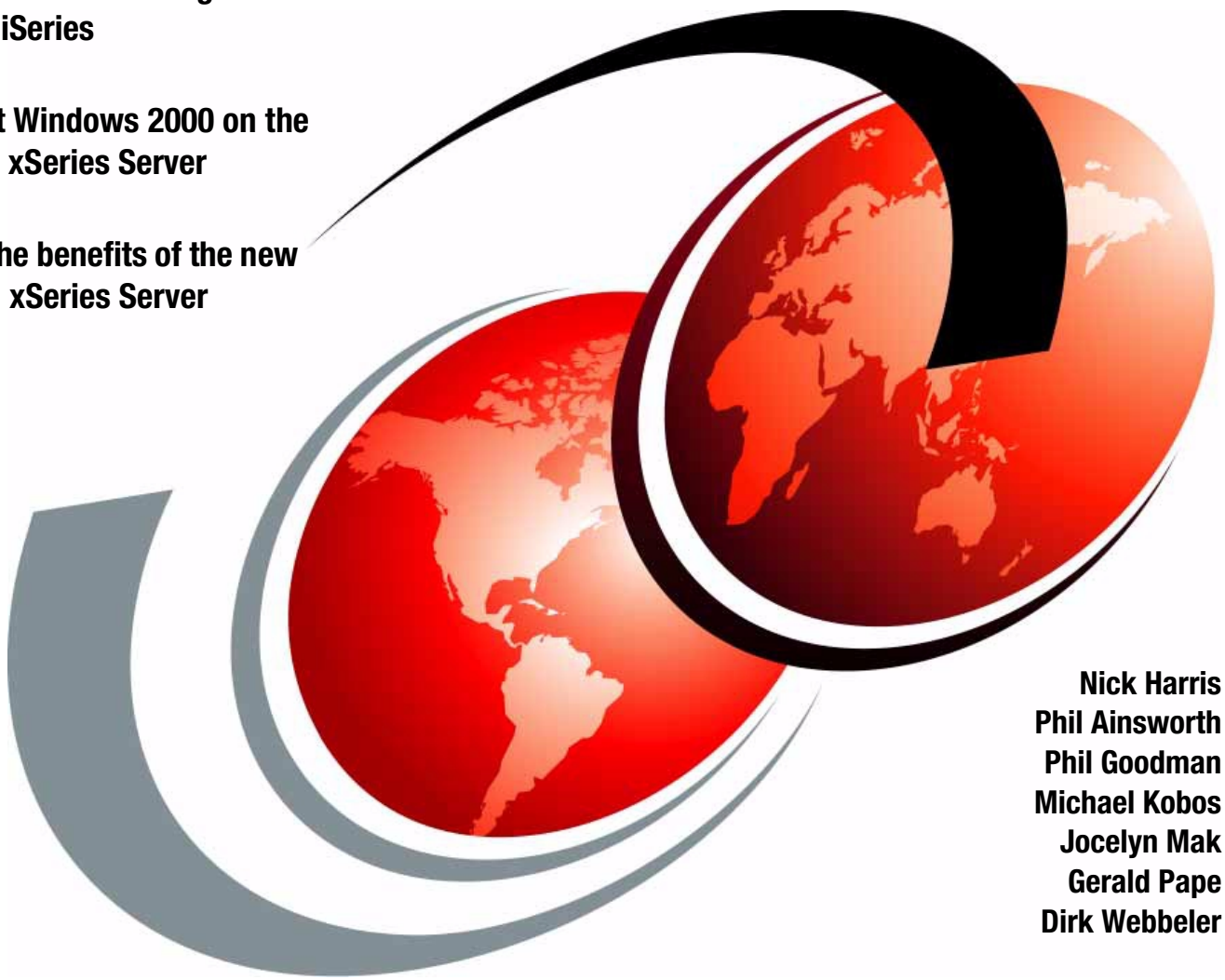
Consolidating Windows 2000 Servers in iSeries

An Implementation Guide for the IBM Integrated xSeries Server for iSeries

- Understand the new integrated PC server for iSeries
- Implement Windows 2000 on the Integrated xSeries Server
- Discover the benefits of the new Integrated xSeries Server



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Consolidating Windows 2000 Servers in iSeries: An Implementation Guide for the IBM Integrated xSeries Server for iSeries

December 2000

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix F, “Special notices” on page 469.

First Edition (December 2000)

This edition applies to OS/400 Version 4, Release 5 for the iSeries server.

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Preface

Gain detailed insights and explanations on the support provided by the OS/400 Integration for Windows 2000 Server software. This IBM Redbook is ideal for IBM customers, Business Partners, service providers, and personnel who need an in-depth understanding of how to implement Windows 2000 running on the IBM Integrated xSeries Server for iSeries (IXS).

This redbook highlights the benefits of running the Windows 2000 server on the Integrated xSeries Server for iSeries, rather than on a separate PC server. Plus, it enables you with the knowledge you need to plan, install, and manage the Integrated xSeries Server when it is installed in your IBM @server iSeries server.

Note

At the time this redbook was published, the Integrated xSeries Server option was not available on the Operations Navigator and OS/400 displays. As the figures in this redbook show, you may need to select Integrated Netfinity Server to indicate the Integrated xSeries Server option.

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization Rochester Center.

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Chapter 1. Overview

This chapter presents an overview of the Windows 2000 server running on the Integrated xSeries Server for iSeries server. It also describes the benefits you can achieve by setting up this environment.

IBM has combined the iSeries and xSeries servers into one integrated package capable of running OS/400 and Windows 2000 server. This provides additional benefits over and above those provided by each system operating independently. In 1998, with the delivery of OS/400 Version 4 Release 2, IBM extended its range of AS/400 support to include Windows NT Server 4.0. Now, with Version 4 Release 5, IBM has announced new Integrated xSeries Server hardware for the Windows server. IBM also added considerable new functions to the implementation of Windows server running in the OS/400 environment. The new functions that are made available in Version 4 Release 5 include:

- Support for the Windows 2000 server
- Save and restore individual Windows files through the QNTC file system
- The Windows system and installation image drives are now network server storage (NWSSTG) spaces
- OS/400 Integration for Windows Server is now a licensed program (5769-WSV)
- The Windows NT and 2000 servers now use the standard Microsoft-provided Hardware Abstract Layer (HAL)

The Intel processor-based adapter has been available from IBM on the AS/400, AS/400e, and iSeries server since Version 3 Release 1. The hardware was initially known as the *File Server IOP* (FSIOP), and then the *Integrated PC Server* (IPCS). In Version 4 Release 4, the server hardware was again renamed to the *Integrated Netfinity Server (INS).* Integrated xSeries Server (IXS) is now the generic name that applies to *all current* models of the iSeries server features, which are the two 700 MHz adapters. For release and product support information for all models of the Integrated xSeries Server for iSeries, refer to Appendix E, “Integrated xSeries and Netfinity Server support” on page 465.

This document uses the above terminology extensively. On existing AS/400e models, the terminology remains as *Integrated Netfinity Server* and applies to both 200 MHz and 333 MHz processors. The new Models 270 and 8xx are iSeries servers and have the Integrated xSeries Server for iSeries installed. These are the 700 MHz processors. You can have an Integrated Netfinity Server attached to an iSeries server, but it is located in a migration tower or SPD-based expansion unit. Only the 700 MHz processors can be installed in the new 270 and 8xx models.

You can find additional information regarding this product on the Web site at:
`http://www.as400.ibm.com/windowsintegration`

1.1 Windows 2000 server on the Integrated xSeries Server for iSeries

A standard PC-based server has an Intel processor, memory, hard disk, tape unit, LAN adapter, and CD-ROM drive. The Integrated xSeries Server for iSeries also has an Intel processor, memory, and one or more LAN cards. However, these are

packaged-on adapters that fit inside the iSeries server frame. The Integrated xSeries Server can be thought of as a PC that has been transplanted into the frame of the iSeries server. Device drivers are provided to enable the iSeries server to share its hard disks, tape unit, and CD-ROM drive with the Integrated xSeries Server. See Figure 1.

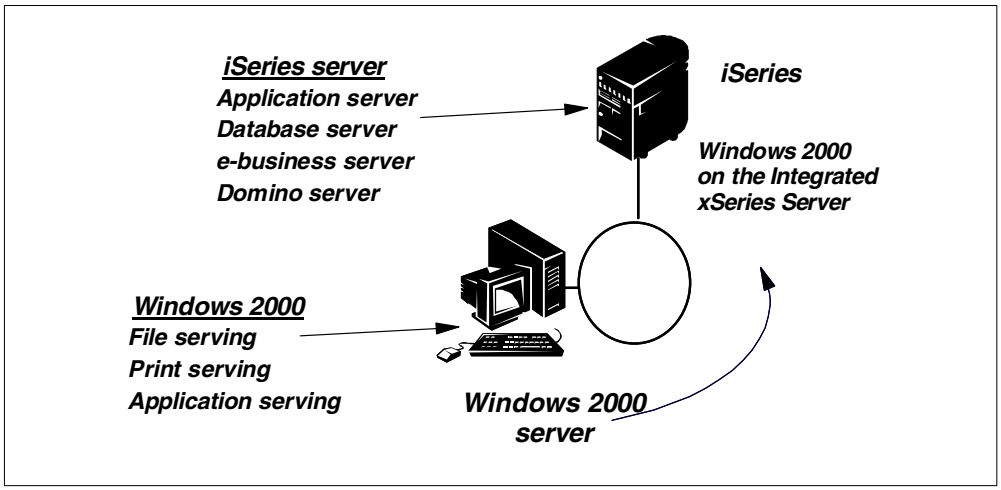

Figure 1. iSeries and Windows 2000 server: A single integrated package

The 200, 333, and 700 MHz Integrated xSeries Servers and Integrated Netfinity Servers are fundamentally different from previous server adapters because they have the facility to attach a monitor, keyboard, and mouse.

Note

The 200 MHz Integrated Netfinity Server does not support the Windows 2000 server.

The monitor, keyboard, and mouse are connected directly to the Integrated xSeries Server to provide a dedicated Windows 2000 server console for installation and operation. For this reason, the Windows 2000 server requires the Pentium III 700 MHz, or the Pentium II 333 MHz versions of the Integrated xSeries or Netfinity server hardware, and is not supported on the earlier 486 and Pentium models. Parallel and serial ports are available on the 200 MHz and 333 MHz Integrated Netfinity Server for the direct attachment of devices, such as a modem or printer. Because the new 700 MHz Integrated xSeries Server does not have parallel and serial ports, it has two Universal Serial Bus (USB) ports for this purpose.

The newest Integrated xSeries Server has an Intel 700 MHz Pentium III processor with up to 4 GB of on-board memory. This new server supports up to three LAN adapters, each up to 100 Mbps (token-ring or Ethernet).

The monitor, keyboard, and mouse connect directly to the Integrated xSeries Server; the keyboard and mouse use a Y-cable to plug into a single port on the adapter. Mouse, keyboard, and monitor extension cables are also available.

The Integrated xSeries Server runs the Windows NT Server 4.0, Windows NT Server 4.0, Terminal Server Edition, and Windows 2000 server (including

Terminal Services). These are the standard CD-ROM versions available from a Microsoft re-seller. There is no special version of the Windows 2000 server software required to run on the Integrated xSeries Server for iSeries. IBM provides software that enables integration between the Windows server and the iSeries server as a licensed program (5769-WSV). This licensed program includes hardware device drivers and the software that provides the integrated functions.

All iSeries and AS/400e RISC models are capable of running Windows server on the Integrated Netfinity Server and Integrated xSeries Server for iSeries, However, the new 700 MHz Integrated xSeries Server is only supported on the iSeries 270 and 8xx models. Up to 16 Integrated xSeries Servers can be installed in a single iSeries or AS/400e server, depending on the model.

IBM has designed new Windows 2000 server-compatible device drivers that enable the Windows 2000 server to share the iSeries server's disk storage, tape unit, and CD-ROM drive. Refer to Chapter 10, "Integrated xSeries Server hardware and software" on page 255, for more information on the Integrated xSeries and Integrated Netfinity Server hardware and software.

The ability to run Windows 2000 server on the Integrated xSeries Server extends the integration value of the iSeries server to the LAN. This provides customers with the ability to combine an iSeries server with Windows 2000 server for file, print, and application serving. IBM continues to invest in and position the iSeries server as an enterprise and general business commercial application server to run customers' main business applications. However, IBM does not intend to implement Windows 2000 server natively on the iSeries server.

The Integrated xSeries Server is suited to iSeries customers who choose Windows 2000 server as their network operating system and want to integrate it with the iSeries environment. Although the Windows 2000 server on the Integrated xSeries Server does not provide the scalability of some PC servers in the marketplace, customers can reduce the complexity and cost of managing their PC networks by taking advantage of this tightly integrated environment, rather than trying to work with two separate platforms.

Customers who want to use the file, print, and application serving capabilities of Windows 2000 server can do so without the need to purchase, install, and maintain a separate PC server. The iSeries server with an Integrated xSeries Server becomes a single consolidated platform that provides a lower total cost of ownership compared with two separate platforms, in addition to improved manageability and choice of applications.

Any application that runs on a PC-based Windows 2000 server, except those requiring hardware not available on the Integrated xSeries Server, should run without restriction. The Integrated xSeries Server has passed the Microsoft hardware compatibility tests for the Integrated Netfinity Server. See Microsoft's hardware compatibility list on the Web site at `http://www.microsoft.com/hwtest/hcl` for details. Select the category **misc**, and then select company **IBM**.

A standard CD-ROM version of the Windows 2000 server, purchased from a Microsoft re-seller, is installed directly from the iSeries server CD-ROM drive using an automated, iSeries-based procedure.

The Windows 2000 server, running on the Integrated xSeries Server, has access to iSeries disks, tape units, and the CD-ROM drive. iSeries disk resources are allocated to the Windows 2000 server with a maximum of 64,000 MB for each iSeries NWSSTG space linked to a Windows 2000 server. The Windows 2000 server automatically takes advantage of the RAID-5 and mirroring capabilities on the iSeries server (if configured).

With V4R5, support for file-level backup and restore of Windows files from OS/400 is provided through the QNTC file system using CL commands. In addition, OS/400 backup commands can be used for disaster recovery backup and restore.

The LAN adapters attached to the Integrated xSeries Server on the new 270 and 8xx models can only be used for access to the Windows 2000 server. The host LAN functionality, where you can also gain access to iSeries applications through a LAN adapter under the control of the Integrated Netfinity Server, is not supported on these iSeries models.

An internal LAN, which is really a bus connection between the Windows 2000 server and the iSeries server, provides a reliable, secure connection that is protected from external network disruptions. This connection is used for a variety of system functions including installation and user administration. It can also be used by iSeries and Windows 2000 server user applications to communicate with each other using TCP/IP.

Using the administration functions of the integration software, customers can reduce the overhead of maintaining one set of user profiles for the iSeries and another for the Windows 2000 server. An OS/400 operator can create or delete both an OS/400 user and a Windows 2000 server user in a single operation. Users can change their password on the iSeries server and have the change automatically propagated to the Windows 2000 server.

1.2 The midrange server marketplace

In the commercial marketplace, companies normally run their commercial and business applications on a midrange server, such as the iSeries server. When using the iSeries server for these applications, it is common for companies to install PC-based servers alongside the iSeries server for PC file and print serving. OS/400 is optimized for multi-user application and database services. Network operating systems, such as Microsoft Windows 2000 server and Novell NetWare, are optimized for PC file and print services.

Today, many companies are considering the Windows 2000 server as their network operating system for sharing files, printers, and personal productivity applications. The Windows 2000 server also provides the ability to run server-based applications natively, such as Microsoft Exchange.

The iSeries server has always excelled in the commercial midrange marketplace by focusing on the value of integration for database, security, and application services, and more recently, e-business and native Domino. The integrated architecture of the iSeries server reduces complexity in customers' installations, lowering their total cost of ownership. iSeries customers want to extend that same integrated model to include their PC servers. The Integrated xSeries Server achieves this goal by combining iSeries server and PC server hardware inside

the same physical package. In addition, the iSeries server and Windows 2000 server share resources such as disk, tape, and CD-ROM devices, and employ combined operations and systems administration.

By packaging the Integrated xSeries Server inside the iSeries hardware platform, there are benefits to be gained from sharing hardware resources and combining management and operations. There are tasks and costs involved in installing, managing, and maintaining separate PC-based servers that can be reduced with this integrated solution. Hardware support for the Integrated xSeries Server is covered by one company, and maintenance charges for the Integrated xSeries Server are included in the iSeries support agreement.

The Windows 2000 server running on the Integrated xSeries Server addresses the following three markets in particular:

- **Distributed branch offices**: The Windows 2000 server on the Integrated xSeries Server is ideally suited for customers with distributed branch offices where centralized management is required. For example, an OS/400 operator can remotely start, stop, and allocate additional disk resources to a Windows 2000 server running on the Integrated xSeries Server. The Tivoli IT Director management product can be used to enhance the remote management of the Windows 2000 server. IT Director provides the ability to take control of the Windows 2000 server console remotely, distribute software to the server, and perform hardware and software administration tasks. This remote management function is also supported with the two administrator Terminal Services Clients in the Windows 2000 server.
- **Server consolidation**: Because the iSeries server is capable of managing multiple Integrated xSeries Servers, it is possible to consolidate a number of PC servers into a single system. Depending on the iSeries model, up to 16 Integrated xSeries Servers, each running its own copy of the Windows 2000 server, can be installed in a single iSeries server.
- **Application server for network computers**: The Windows 2000 server on the Integrated xSeries Server also supports Microsoft Windows 2000 Server Terminal Services and the Citrix MetaFrame product that provide multi-user support for applications running on the Windows 2000 server. This enables network stations to use Windows-based personal productivity applications running under the Windows 2000 server on the Integrated xSeries Server.

1.3 Installation

The Windows 2000 server is installed on the Integrated xSeries Server using an OS/400 command that runs an automated installation program. See Figure 2 on page 6. You insert the Windows 2000 server CD-ROM into the iSeries CD-ROM drive, enter information into the command prompts, and press Enter.

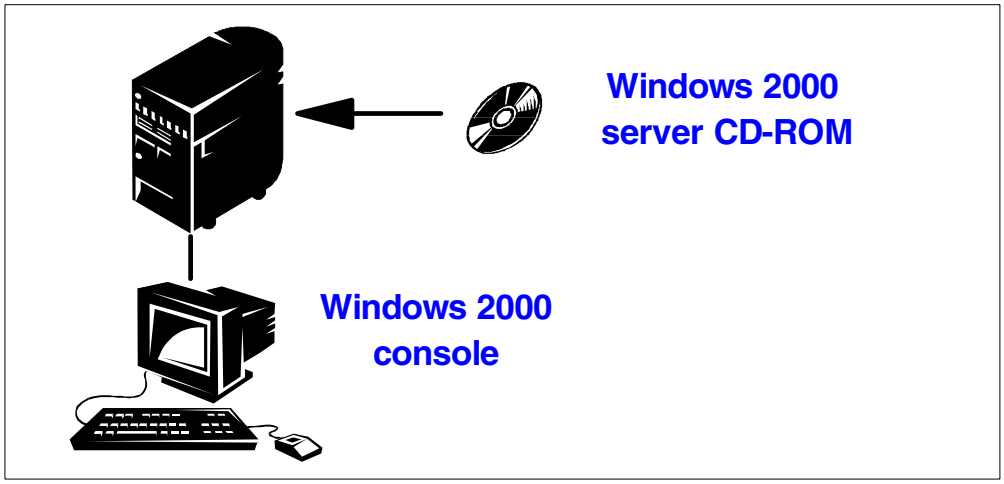

Figure 2. Windows 2000 server installation

The operation of the Windows 2000 server on the Integrated xSeries Server is divided between the server console and the Windows 2000 console. The installation and disk configuration are performed from an OS/400 display. Messages from the Integrated xSeries Server can be collected in OS/400 message queues and job logs. On the other hand, Windows 2000 server operations are performed directly on the Windows 2000 server console that is connected to the Integrated xSeries Server. This preserves the Windows 2000 server graphical interface for most operations, including the installation of Windows 2000 server applications.

Refer to Chapter 3, “Installing the Windows 2000 server” on page 37, for more information on installing Windows 2000 server on the Integrated xSeries Server.

1.4 Shared devices

One benefit of running the Windows 2000 server on the iSeries server is the ability to take advantage of iSeries disk storage reliability and management flexibility. This is particularly useful when providing operational support for remote installations, where adding disk storage to a PC-based server often requires significant downtime. When you use iSeries disk drives, Windows 2000 server files are automatically protected using the iSeries RAID-5 and mirroring technology (provided these functions have been enabled on the iSeries server). There is no benefit to be gained by configuring RAID-5 or mirroring on the Windows 2000 server.

The integration support enables the Windows 2000 server backup applications to use the iSeries tape drive for backup and restore. The iSeries tape drive is varied off and then allocated to the Windows 2000 server. The tape drive is available for use by the Windows 2000 backup and restore utilities. Then, the tape drive is reallocated to the iSeries server for normal tape operations after the Windows 2000 server backup or restore operation has completed. You can also save the Windows 2000 server files directly from the iSeries server to a tape drive at a file level using the new file-level backup capability or at a storage space level for disaster recovery purposes.

The iSeries CD-ROM drive can be dynamically allocated to a Windows 2000 server. The CD-ROM drive can be used concurrently by the iSeries server and by the Windows 2000 server without specifically allocating the drive to either operating server. See Figure 3 for an example of how this concept works.

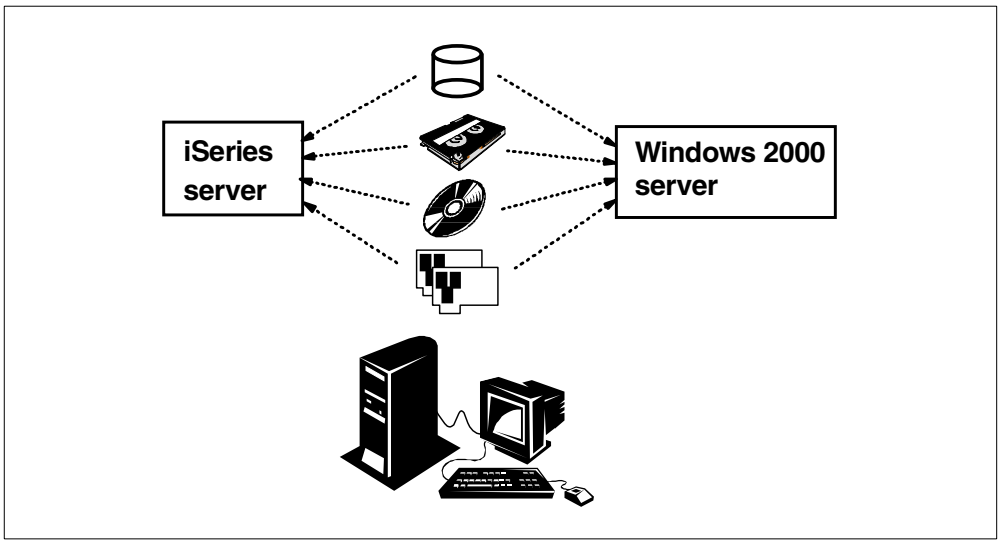

Figure 3. iSeries server and Windows 2000 server device sharing

1.5 Disk administration

iSeries disk storage is allocated to the Windows 2000 server by creating an object called a *network server storage space* (also referred to as a “NWSSTG space” or simply “storage space”), which resides in the system auxiliary storage pool (ASP) or a user ASP. Each storage space can be from 1 MB to 64,000 MB in size.

The task of assigning new disks to a Windows 2000 server can be performed at a central iSeries server, using native OS/400 commands. Telnet or SNA pass-through allows you to shut down the Windows 2000 server from a remote location. After shutdown, a storage space can be linked to the server. After the Windows 2000 server is brought up again, the remote operator can use, for example, Windows 2000 Server Terminal Services configured in administrator mode to take over the Windows 2000 server console and format the disk. This entire process can be completed from a central location, or directly at the iSeries server and Windows 2000 server consoles.

Windows 2000 server disk images can be saved on a central iSeries server and then transmitted as a save file, or sent on tape to a remote site. This allows the addition or replacement of a complete disk image on a remote server without any hardware changes. For example, this technique could be used when a company needs to periodically distribute a catalogue of parts or sales information to its remote branches. An example of disk administration is shown in Figure 4 on page 8.

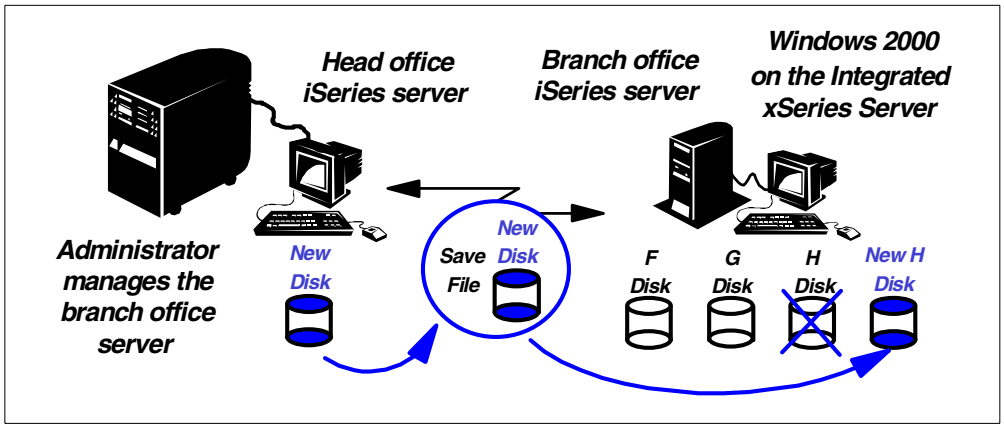

Figure 4. Disk administration scenario

Refer to Chapter 5, “Disk storage administration” on page 87, for more information on disk administration.

1.6 User administration

The user integration function enables the enrollment of OS/400 users and groups in a Windows 2000 server domain or on an individual server. This function also allows the synchronization of user passwords from OS/400 to the Windows 2000 domain or server. This feature can significantly reduce the overhead required to administer two separate operating systems.

For example, when an OS/400 group profile is enrolled in the Windows 2000 domain or on an individual server, you can optionally enroll user profiles in the group and the group itself. A predefined account template on the Windows 2000 server is used to set up the appropriate Windows 2000 group memberships and user preferences. As new users are added to the group profile in OS/400, they are automatically propagated to the Windows 2000 domain or server.

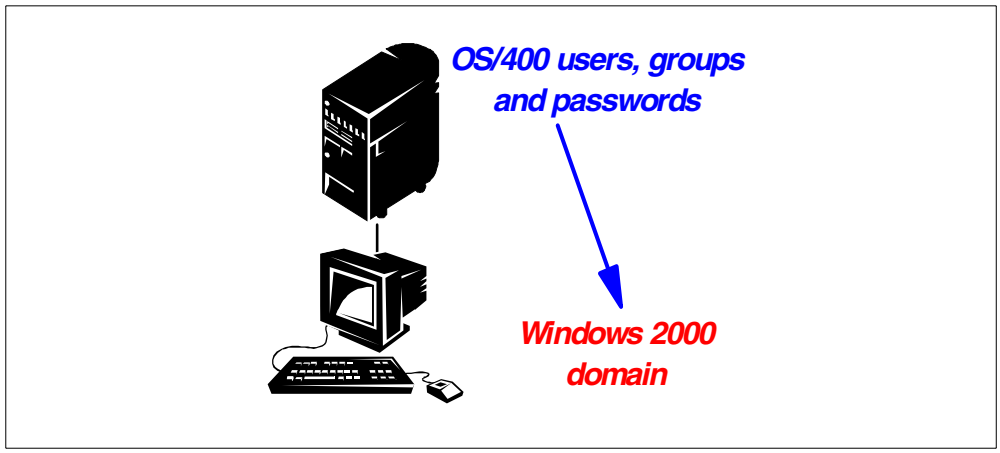

Figure 5. User enrollment and password synchronization

When OS/400 users enrolled in the Windows 2000 domain change their passwords, the changes are automatically propagated to the Windows 2000

domain. As shown in Figure 5, notice that password synchronization is from OS/400 to Windows 2000 only.

Refer to Chapter 6, “User administration” on page 121, for more information on user administration.

1.7 Backup and restore

Windows 2000 files can be backed up from either OS/400 or Windows 2000. See Figure 6. From OS/400, you can save a complete storage space for disaster recovery purposes or perform a file-level backup from the Windows 2000 server or OS/400.

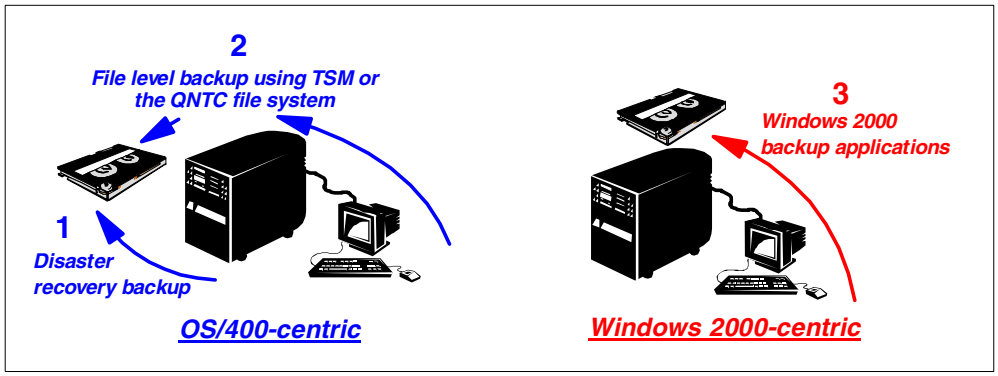

Figure 6. Backup and restore options

The ability to save and restore individual Windows files from OS/400 using CL commands is new with V4R5. This capability is called *OS/400 file-level backup.* It uses the QNTC file system to gain access to directory shares on a Windows server running on the Integrated Netfinity Server.

You can view the backup and restore of Windows files from two perspectives: OS/400-centric or Windows-centric. Currently, the following four methods can be used to back up and restore files on a Windows 2000 (or Windows NT 4.0) server running on the Integrated xSeries Server:

- From the OS/400 side, you can use the following three methods:
  - Disaster recovery backup is the term that is used when backing up Windows files at a storage space level.
  - OS/400 file-level backup can be used to back up individual Windows files using the QNTC file system.
  - Tivoli Storage Manager (TSM) can also be used to back up individual Windows files.
- From the Windows side, you can back up files using Windows backup applications to either an iSeries or PC tape drive.

Most iSeries tape drives can be used by Windows backup applications to provide fast and reliable saves of Windows files.

Refer to Chapter 7, “Backup and restore” on page 151, for more information on backup and restore.

1.8 Multi-user Windows environment

Many companies that want to consolidate their Windows 2000 servers on the iSeries server also want to replace their PC workstations with network computers to reduce costs and simplify their operational environment.

The iSeries server is an ideal platform to fulfill the role of a host server for IBM Network Stations. The iSeries can act as a boot manager and as a server for Domino, Internet, and legacy applications.

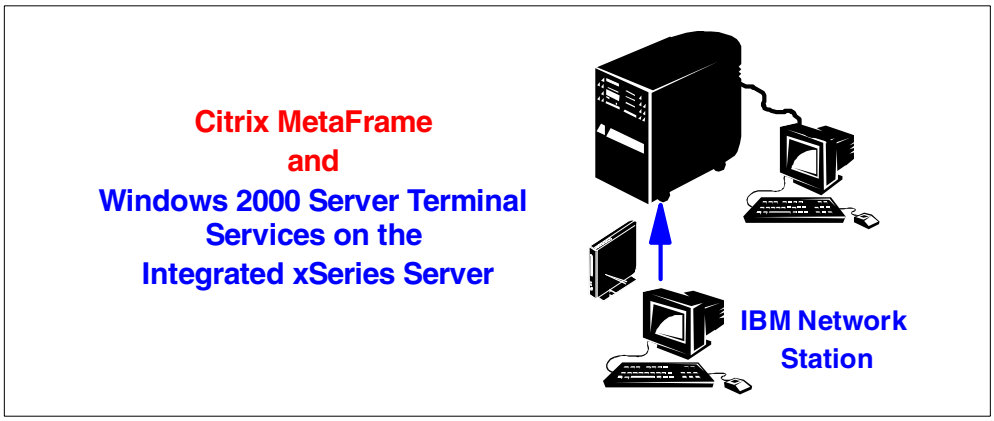

Figure 7. Multi-user Windows environment on the Integrated xSeries Server

As shown in Figure 7, a Windows 2000 server can be added to this environment to provide IBM Network Stations access to Windows-based personal productivity applications, such as Lotus 1-2-3 and Microsoft Word. Windows 2000 Server Terminal Services provides the Remote Desktop Protocol (RDP) protocol, which is used to connect Windows clients to Terminal Services on the Windows 2000 server. Citrix MetaFrame provides the ICA protocol, which is used to connect IBM Network Stations or other devices using ICA to Terminal Services.

When using Windows 2000 Server Terminal Services and Citrix MetaFrame on the Integrated xSeries Server, it is estimated that approximately 50 IBM Network Station users can be connected to the Pentium III 700 MHz processor version. However, the number of users that can be adequately supported in any particular environment varies widely, depending on user workload and network throughput.

Another possibility is to use the NetVista Windows-based terminal to connect directly to a Windows 2000 server without using Citrix MetaFrame. This could be a cost-effective and easy way to change to a thin client network architecture if the network has no more than 30 to 50 clients.

Refer to Chapter 12, “Windows 2000 server Terminal Services” on page 275, for more information about Windows Terminal Services.

1.9 PC server consolidation

Currently, many companies deploy multiple PC-based Windows 2000 servers, each dedicated and tuned to an individual application. These applications commonly include file and printer sharing, database serving, Internet and intranet serving, remote access capability, fax, groupware, e-mail, firewall, and so on.

Although the single-server-per-application concept has availability advantages (for example, a fax server failure does not affect the Internet server), it also introduces significant space, maintenance, and systems management considerations.

These issues often translate into additional costs to the organization. Therefore, a server that can consolidate multiple application servers onto a single physical platform should have inherent advantages over the discrete server model. A consolidated platform can provide multiple separate Intel-based servers and be housed and managed in a single physical package. The iSeries server performs this consolidation function by hosting multiple Integrated xSeries Servers, each running its own copy of the Windows 2000 server.

The iSeries server accommodates up to 16 Integrated xSeries Servers, depending on the model. Each Integrated xSeries Server runs independently, but is controlled by the iSeries server for the purposes of disk storage management, backup and restore, and user administration. An example of server consolidation is shown in Figure 8.

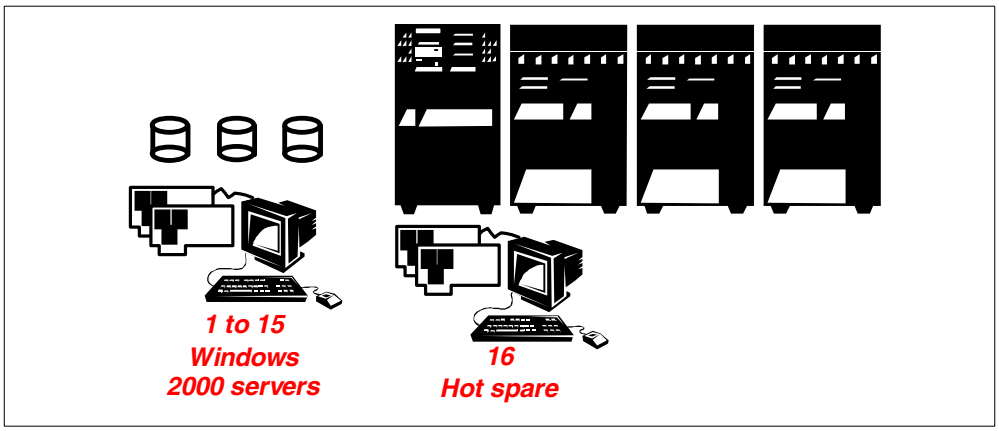

Figure 8. Server consolidation

In addition to physical space savings, the iSeries server as a consolidated Windows 2000 server platform provides these enhanced features:

- Unique high availability characteristics improves Windows 2000 reliability.
- Centralized reset and IPL of individual servers removes the requirement for physical access to the PC reset switch.
- Sharing of disk, tape, and CD-ROM devices between servers optimizes hardware investment.
- Single OS/400 console for centralized administration and error monitoring improves operator productivity and convenience.
- Internal links between OS/400 and Windows 2000 servers allows for management of the integrated servers to continue during times of network disruption.

Refer to Chapter 16, “PC server migration and consolidation” on page 377, for more information about PC server consolidation.

1.10 Remote management of the Windows 2000 servers

For many iSeries customers, a typical scenario has an iSeries server divided between the head office location and distributed branch offices, sometimes in a single region, but often worldwide. In this distributed computing model, operators at the head office are often responsible for administering computing services in the branches. Typically, the branches have few operational skills. Figure 9 shows an example of remote management.

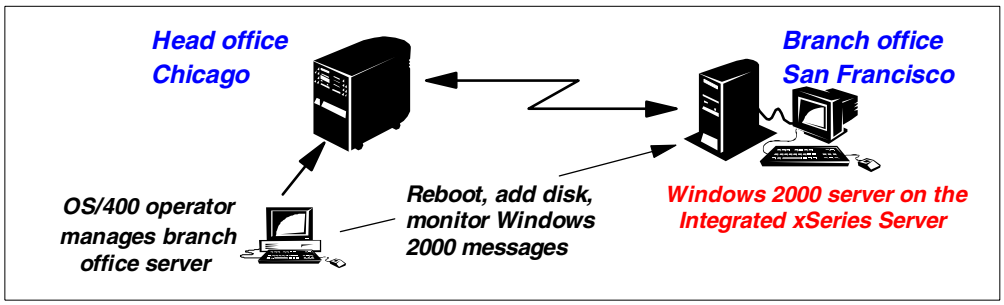

Figure 9. Remote management of branch office servers

Distributed iSeries servers in a network running Windows 2000 server on the Integrated xSeries Server can be easily managed from a central location.

Using remote communications (such as Telnet or SNA pass-through), a central administrator can sign on to a remote iSeries server and perform tasks such as bringing the Windows 2000 server up or down, adding new disk volumes, and managing users. These tasks are difficult, if not impossible, to perform on a remote PC server. You can also save a Windows 2000 server disk image on one iSeries server, transmit it across the network, and restore it for use by a Windows 2000 server on another server. With Windows 2000, there are now two ways to take over remote control of a Windows 2000 server. One way is integrated in Windows 2000. You can set up Windows 2000 Server Terminal Services for use by administrators only. This allows you to access the Windows 2000 server console from a remote Windows client to perform any operation that you can do on the console locally. The second method is to use a product like Tivoli IT Director, which also enables you to take over the Windows 2000 console remotely.

Refer to Chapter 15, “Managing Windows 2000 servers remotely” on page 369, for more information on remote management of the Windows 2000 servers.

1.11 iSeries and Windows application integration

Many companies that have a mixed iSeries and Windows 2000 server environment want to exchange data between the two operating systems, or have a Windows 2000 server application access the OS/400 database directly.

Database integration and other integrated applications are ideally suited to the Integrated xSeries Server environment because of the internal bus-level communication link between the iSeries server and Windows 2000 server. This *internal* LAN connection between the two operating systems provides a secure, reliable conduit between the iSeries server and Windows 2000 server. It is not

dependent on token-ring or Ethernet connections to the external LAN. This link emulates a token-ring LAN and is designed to run the TCP/IP protocol (only) between the Windows 2000 server and the iSeries server. Although the internal LAN is used for some integration functions, such as user administration, there is relatively little traffic using this connection. Therefore, you can expect consistent performance across this link.

For example, IBM MQSeries could be used to write a communications application that enables the iSeries server and Windows 2000 to exchange transactions across the internal LAN. Figure 10 shows an example of iSeries and Windows 2000 application integration.

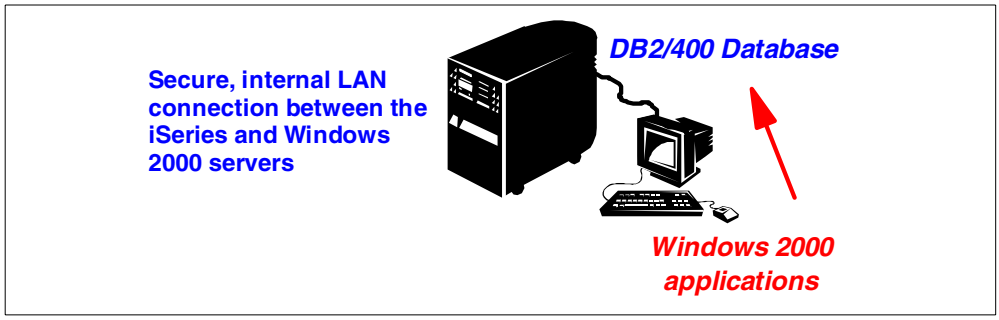

Figure 10. iSeries and Windows 2000 application integration

Modification to the OS/400 Client Access ODBC driver allows it to be used by a Windows 2000 server service. This implementation allows the internal LAN to act as a conduit for Windows 2000 client applications that need to access the OS/400 database using ODBC. This provides additional flexibility in application design.

In addition, there are other ways to interchange data in this environment. An example includes IBM DataPropagator, which can be used to replicate data between databases on the iSeries and Windows 2000 server.

1.12 Benefits of running the Windows 2000 server on the iSeries server

You may ask yourself why you should install the Windows 2000 server on the Integrated xSeries Server for iSeries, rather than on a PC. This section describes some of the benefits of running the Windows 2000 server on an Integrated xSeries Server, versus running it on a separate PC.

1.12.1 Reduced user administration

OS/400 users can be enrolled on a Windows 2000 domain and then be maintained automatically by the integration software. This reduces Windows 2000 server administration. For example, you can enroll an OS/400 group profile in a Windows 2000 domain. Then, every time a new user is added to this group profile on the OS/400 system, the new user is automatically propagated to the Windows 2000 domain.

When enrolled users change their OS/400 passwords, the new passwords are automatically updated on the Windows 2000 server. This can eliminate one of the biggest problems of maintaining user profiles in two separate operating environments—password synchronization. With this feature, users do not need to

change multiple passwords, and Windows 2000 administrators do not have to waste time continually resetting user accounts.

1.12.2 Higher availability

Running the Windows 2000 server on the Integrated xSeries Server enables you to take advantage of the following high availability features of this environment:

- **Integrated hardware and software package**

  All hardware and drivers used to run Windows 2000 on the Integrated xSeries Server are supplied as a package by IBM. Therefore, the possibility of a conflict between a hardware component and an incompatible driver is unlikely.

- **Hot spare hardware backup**

  An additional Integrated xSeries Server adapter card can be installed as a spare. In the unlikely event of a hardware failure on the primary Integrated xSeries Server, you can quickly bring up the Windows 2000 server on the spare adapter.

- **Save and restore Windows 2000 system drive**

  Because Windows 2000 runs as a *guest* operating system on the iSeries server, you can backup the complete Windows 2000 system drive to tape or disk. In case an error prevents the server from starting, you can quickly restore a good copy of the system drive and bring the server up again.

- **Highly reliable, high performance disk storage**

  iSeries disk drives have a reputation for being highly reliable and providing high performance. With the Integrated xSeries Server, these attributes are automatically available to the Windows 2000 environment.

- **RAID-5 and mirroring support**

  IBM implementation of RAID-5 and mirroring on the iSeries server is implicitly available to Windows 2000 running on the Integrated xSeries Server. There is no need to configure these functions within Windows 2000.

- **Fast, reliable tape backup**

  Tape drives available on the iSeries server are generally superior in reliability and speed to those available for personal computers. A Windows 2000 server running on the Integrated xSeries Server can use the iSeries tape drive for backup and restore operations.

- **File-level backup from OS/400**

  A backup of Windows 2000 server at a file level can now be incorporated into your OS/400 backup strategy using the new OS/400 file-level backup capability.

- **Enhanced monitoring of the Windows 2000 Event Log**

  The Windows 2000 Event Log can be mirrored to a message queue on the iSeries that allows an OS/400 operator to manage the iSeries server and monitor the Windows 2000 server running on the Integrated xSeries Server.

- **Monitor the Windows 2000 server**

  You can monitor Windows 2000 server vital statistics such as CPU utilization, paging file quota, registry quota, number of logged on users, and disk usage percentage from OS/400 Operations Navigator.

1.12.3 Comprehensive remote management

The Integrated xSeries Server for iSeries addresses the challenges of distributed environments by providing a combined server for both OS/400 and Windows 2000 applications, while improving central control of remote operations. This is because most of the administration of a Windows 2000 server running on the Integrated xSeries Server can be performed remotely.

Through the iSeries server, an administrator at the head office has access to a variety of systems management tools to simplify the administration of the remote office environment. For example, an OS/400 operator at the central site can sign on to a remote iSeries server, shut down and restart a Windows 2000 server, perform backups, and add disk space to the server from an OS/400 display session. After signing on, the central site operator can perform remote analysis of Windows 2000 server errors by using the ability of the iSeries server to mirror the Windows 2000 Event Log.

In addition, the operator can use a tool, such as Windows 2000 Terminal Services or Tivoli IT Director, to take control of the remote Windows 2000 server console to perform the administrative tasks that require console access.

1.12.4 Better application integration

The internal LAN between the iSeries server and the Windows 2000 server can provide more secure and reliable communication between the iSeries server and the Windows 2000 server. This, in turn, can provide a platform for the improved integration of the iSeries and Windows 2000 applications.

The ODBC driver available with OS/400 Client Access Express can be used to provide improved access to the DB2/400 database from ODBC applications running on Windows clients.

1.12.5 Price competitive

When you take in account hardware, software, administration, maintenance, and environmental costs, implementing the Windows 2000 server on an existing iSeries server is attractive in terms of cost. Because you can also run other applications natively on the iSeries, implementing the Windows 2000 server on the Integrated xSeries Server is a cost-effective option for many existing iSeries customers. It is also cost effective for companies that are looking for a single platform that can satisfy both their application and file serving needs.

1.12.6 Reduced space requirements

Up to 16 Integrated xSeries Servers, each running its own copy of the Windows 2000 server, can be installed within the frame of the iSeries server. Consolidated Windows 2000 servers on the iSeries server have a smaller footprint than an iSeries server with additional PC servers.

Chapter 2. Installation planning

The key to a successful installation of the Windows 2000 server on the Integrated xSeries Server is in the planning. This chapter highlights the major planning considerations for both the iSeries server and Windows 2000 server. It also provides an installation worksheet, which we *strongly* recommend you complete before attempting the installation.

This chapter and Chapter 3, "Installing the Windows 2000 server" on page 37, cover the installation of a new Windows 2000 server on the supported Integrated xSeries Server hardware. If you want to upgrade an Integrated xSeries Server running Windows NT to Windows 2000, refer to *Networking Operating Systems, Windows Server on AS/400*, which is available from the iSeries 400 Information Center via CD-ROM or the Web at:

`http://publib.boulder.ibm.com/pubs/html/as400/v4r5/ic2924/info/index.htm`

Click **Network Operating Systems** and then **Windows server on AS/400**.

Note

The installation of the Windows 2000 Advanced Server and Datacenter Server on the Integrated xSeries Server or the Integrated Netfinity Server is not supported at this time.

2.1 Skill requirements

To install the Windows 2000 server on the Integrated xSeries Server, you must have the following skills:

- **iSeries server experience:**
  - *The iSeries server and OS/400*

    Basic operational skills are required to set up and manage the OS/400 side of the integration with the Windows 2000 server. These include a knowledge of how to create user profiles, enter CL commands, display messages, and locate job logs.
  - *Configuring TCP/IP*

    The iSeries server communicates with the Windows 2000 server running on the Integrated xSeries Server across an internal (also described as *virtual*) LAN using TCP/IP. If the external host LAN is supported in your environment, you may also want to share the Integrated xSeries Server LAN adapters with the iSeries server. This enables communications from the external LAN through to the iSeries server using TCP/IP. In both cases, the installation process for the Windows 2000 server on the Integrated xSeries Server configures the necessary TCP/IP communications for you. However, you should understand how the TCP/IP configuration process works on the iSeries server.

- **Windows 2000 server experience:**
  - *Configuring the server role*

    When you install Windows 2000 server, you choose whether the server becomes a member of a workgroup or domain. If you want the server to be a domain controller, it must be manually promoted. Also, additional components need to be installed such as Active Directory. If you do not already have a Windows 2000-compatible Domain Name System (DNS) on the network, you will be required to install this service on the new server. The Windows 2000 server provides a wizard to help you perform the promotion process, but we recommend that you familiarize yourself with the concepts of Active Directory and DNS before attempting to use it. The following Microsoft Web site provides a lot of useful documentation to help you begin: `http://www.microsoft.com/windows2000/library/`

  - *Configuring network connections*

    When the iSeries server performs the unattended installation of Windows 2000 server on the Integrated xSeries Server, it installs the basic LAN connections for you and configures the TCP/IP protocol. If you need to add additional protocols, or if you have a requirement to change any TCP/IP settings after installation, you need to understand how to configure network connections under the Windows 2000 server.

  - *Administering users*

    A major benefit of running the Windows 2000 server on an Integrated xSeries Server is that your user and group administration can be managed centrally on the iSeries. OS/400 users can be enrolled automatically on the Windows 2000 server rather than having to add them as new users at the Windows 2000 server console. We require that you have knowledge of Windows 2000 user and group administration so you can create the necessary Windows 2000 user templates, which are referenced when enrolling OS/400 users to the Windows 2000 server environment.

2.2 iSeries planning

Before you install the Windows 2000 server on the Integrated xSeries Server, you should consider the following iSeries server-specific issues:

Disk storage requirements

To install the Windows 2000 server on the Integrated xSeries Server, you need to consider the following disk storage requirements:

- *OS/400 licensed program*

  The OS/400 Integration for Windows Server licensed program (5769-WSV) provides the necessary software and device drivers that enable Windows 2000 server to run on an Integrated xSeries Server. The base licensed program and option 2 (OS/400 Integration for Windows 2000) use approximately 50 MB of disk storage when installed on the iSeries server.

- *Windows 2000 server storage spaces*

  When the Windows 2000 server is installed on the Integrated xSeries Server, the iSeries server creates two network storage (NWSSTG) spaces that represent the server's C: and D: drives. The C: drive contains the Windows 2000 boot and system files. The D: drive contains the installation source code

for the Windows 2000 server and the OS/400 integration software. You choose the size of these drives at the time of installation. Refer to 2.4, “Windows 2000 disk storage considerations” on page 26, for more information on estimating disk storage requirements for your server.

TCP/IP Connectivity Utilities for OS/400

The TCP/IP Connectivity Utilities for OS/400 licensed program (5769-TC1), which is supplied free of charge with OS/400, is *not* a requirement for installing the Windows 2000 server on an Integrated xSeries Server. OS/400 (5769-SS1) contains all the necessary TCP/IP communications support. However, we recommend that you install TCP/IP Connectivity Utilities for OS/400 so that you can use the Telnet and FTP applications.

Sharing LAN adapters

The Pentium II 333 MHz PCI Integrated Netfinity Server allows you to have up to two LAN adapters that are under the control of the Integrated xSeries Server. You can use these LAN adapters to communicate from the external LAN through to the iSeries server. This function is often referred to as the *external host LAN*.

We recommend that you use a separate LAN adapter on another input/output processor (IOP) for your iSeries or OS/400 host LAN communications so that there is no disruption to host access when you shut down or restart the Windows server.

Note

The new iSeries server 270 and 8xx models *do not* support the external host LAN function. This restriction extends to the Pentium II 333 MHz Integrated xSeries Server when it is installed in a 50xx Migration Tower or an SPD attached expansion tower. Notice, however, that the external host LAN may still work in these environments.

If you intend to use the external host LAN, and your Integrated xSeries Server hardware configuration supports it, we recommend that you supply the information required to set up your LAN adapters after you run the Install Windows Server (INSWNTSVR) command on the iSeries server or AS/400e server. By doing this, the OS/400 line descriptions and TCP/IP interfaces are created for you automatically, rather than you manually creating them later.

Internal LAN addresses

The internal (virtual) LAN is a component of the Integrated xSeries Server that enables the Windows 2000 server to communicate with the iSeries internally over the system bus using TCP/IP. The internal LAN is fully described in Chapter 11, “OS/400 components of the Windows 2000 server” on page 263.

The internal LAN uses Class C restricted Internet addresses for private domains. Therefore, the addresses are not propagated through Internet gateways or routers. These addresses are of the form 192.168.xxx.yyy, where *xxx* is the hardware resource number of the Integrated xSeries Server. You need to check whether your intranet uses IP addresses in this range already. If so, the IP addresses that are automatically configured for the internal LAN may conflict with the addresses on the external LAN, with potentially serious consequences. You

need to ensure that the TCP/IP subnet that is configured for the internal LAN does not overlap with any external subnets.

If necessary, you can override the default assignment of IP addresses for both the iSeries server and the Windows 2000 server ends of the internal LAN by specifying addresses for the Internal LAN port parameters of the Install Windows Server (INSWNTSVR) command. If you discover that you have an address conflict after installing the Windows 2000 server, or you want to change the IP addresses for the internal LAN for any other reason, you can do this by following the procedure that is explained in 11.3.1.2, “IP address conflicts” on page 272.

AS/400 NetServer
The OS/400 integration software running on the Windows 2000 server may need updating occasionally with a service pack. Service packs are distributed by IBM as program temporary fixes (PTFs) for the OS/400. They are made available to the Windows 2000 server by using an AS/400 NetServer file share. You should ensure that AS/400 NetServer is configured before you start installing Windows 2000 on the Integrated xSeries Server. For more information on AS/400 NetServer, including detailed instructions on how to set it up, see Chapter 14, “AS/400 NetServer” on page 345.

Installation source directory
You can install the Windows 2000 server on the Integrated xSeries Server from either the Microsoft-supplied CD-ROM or an image of it located somewhere in the OS/400 Integrated File System (IFS). The latter choice may be useful if you intend to create multiple Windows 2000 servers on a single iSeries server, or if you need to send an image of the installation CD-ROM to a remote location. For details on how to copy an image of the installation CD-ROM to the IFS, see 3.2, “Completing the pre-installation tasks” on page 37.

We recommend that you install the Windows 2000 server from the CD-ROM, unless you have a good reason to copy the image to the IFS.

Machine pool size
Each Integrated xSeries Server that is installed in the iSeries server requires additional memory to be allocated to the machine pool. The amount of additional memory needed depends on the model type of the Integrated xSeries Server and the number of network adapters it has under its control, as shown in Table 1.

Table 1. Machine pool requirements

Integrated xSeries Server or Integrated Netfinity Server	Minimum memory required	Additional memory required for network adapter card
6617	5400 KB	1800 KB for each 2838, 2723, or 2724 network adapter card that you install with the Integrated Netfinity Server.
2850	1800 KB	1800 KB for each 2838, 2723, or 2724 network adapter card that you install with the Integrated Netfinity Server.

Integrated xSeries Server or Integrated Netfinity Server	Minimum memory required	Additional memory required for network adapter card
2790/2890	856 KB	You do not need to consider network adapter cards that you install with this model Integrated xSeries Server because they cannot serve as shared external host LAN adapters for the iSeries server.

If the machine pool is not large enough, the network server may not become active.

We recommend that you change the performance adjustment system value (QPFRADJ) to automatically adjust the size of the machine pool, and then change it back (if necessary) after you have installed the server and made it active.

Program temporary fixes (PTFs)
Before you attempt to install Windows 2000 on the Integrated xSeries Server, you should ensure that your iSeries server has been loaded with any PTFs that may be required.

The list of available PTFs can be found on the OS/400 Windows Integration Web site at: `http://www.as400.ibm.com/windowsintegration/`

Select **Service Information**, and then select **OS/400 PTF Descriptions**.

Information on the latest PTF that provides the service pack for the integration software can also be found at this Web site.

Select **Service Information** and then **Service Packs**.

We *strongly* recommend that you order the PTF for the latest service pack on CD-ROM well in advance of your installation date. Most problems that arise after installation are due to the fact that service packs have not been applied to the Windows 2000 side.

OS/400 authorities
Verify that you have access to a user profile with the necessary authority to perform the installation. To install Windows 2000 server on an Integrated xSeries Server, you must have *IOSYSCFG, *ALLOBJ, and *JOBCTL special authorities.

A user profile with *SECADM special authority is required to set up AS/400 NetServer.

Integrated xSeries Server resource names
If you have *multiple* Integrated xSeries Servers of the same type installed in your iSeries server, you may not be able to match a physical adapter with the resources listed in the Display Communication Resources display. You need to identify the physical Integrated xSeries Server that you intend to use by its resource name, so that this can be specified on the Install Windows Server (INSWNTSVR) command at the time of installation.

To find out which Integrated xSeries Server is associated with each resource name, follow these steps:

1. If you are not already at the Display Communication Resources screen, type:

   ```
   DSPHDWRSC *CMN
   ```

   Then, press Enter.

2. Type 7 in the Opt field to the left of the resource name for a File Server IOA or File Server IOP, and then press Enter. The Display Resource Detail display appears.
3. Make note of the card position under the Physical location section.
4. Look at the labels on the physical slots in your iSeries server. One slot should be labeled with the same number or combination of letters and numbers shown in the Card position field. This slot contains the Integrated xSeries Server to which the resource name refers.

AS/400 NetServer

It is possible to configure AS/400 NetServer from as an OS/400 user session to enable integration service packs to be downloaded to the Windows 2000 server. However, you can also use the Operations Navigator component of OS/400 Client Access Express to perform this task. In fact, Operations Navigator is essential if you want to unleash the full capabilities of AS/400 NetServer. You only need to install OS/400 Client Access Express for Windows on one PC in the network to configure AS/400 NetServer, and it does not require a license.

We recommend that initially you only set up AS/400 NetServer to enable you to apply service packs to the Windows 2000 server. You are instructed when to do this as you work through Chapter 3, “Installing the Windows 2000 server” on page 37. Later, you may want to take advantage of the full capabilities of AS/400 NetServer. In this case, refer to Chapter 14, “AS/400 NetServer” on page 345, for a description of how to perform the complete setup.

The functions of Operations Navigator have been significantly expanded with OS/400 Client Access Express for Windows V4R5M0. Specifically, a new plug-in has been provided that enables you to perform simple administrative tasks on your OS/400 integrated Windows servers once they are installed. An example is shown in Figure 11, where Operations Navigator is being used to start Windows 2000 server running on an Integrated xSeries Server.

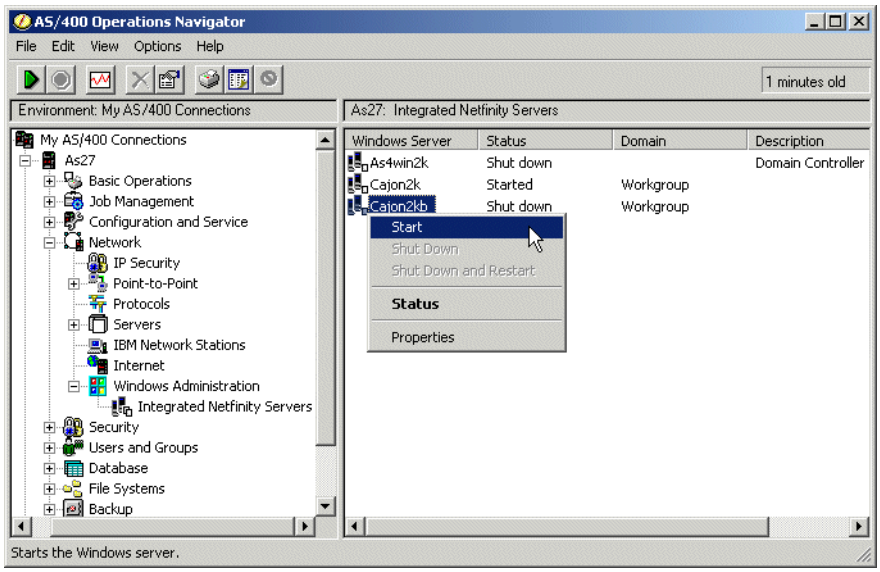

Figure 11. Starting a Windows 2000 server using Operations Navigator

For more detailed information on using Operations Navigator with your integrated Windows 2000 server, refer to Chapter 4, “General administration” on page 57.

Daylight saving

The integration software uses OS/400 offset from Greenwich Mean Time (QUTCOFFSET system value) and its time setting (QTIME system value) to calculate the correct time for the Windows 2000 server. Because OS/400 does not automatically adjust QTIME for daylight saving, you need to manually adjust QTIME when daylight saving starts and ends. Notice that, for the integrated Windows 2000 server to report the correct time, you also need to adjust the QUTCOFFSET system value. QUTCOFFSET works differently than the time zone setting under Windows, which you do *not* need to adjust when daylight saving starts and ends. Add one hour to QUTCOFFSET when daylight saving starts, and subtract one hour when it ends.

If daylight saving is observed in your location, check the Windows Server *Automatically adjust clock for daylight saving changes* setting. Otherwise the integrated Windows 2000 server will report the time incorrectly.

Notice that the Windows 2000 server uses the default dates for your time zone to identify the start and end of daylight saving. If, for some reason, the actual dates on which daylight saving starts and ends are different than the defaults, you can use QUTCOFFSET to adjust for this situation. For example, if daylight saving starts earlier than the default date, adjust QTIME, but not QUTCOFFSET. When the default daylight saving start date is reached, simply add one hour to QUTCOFFSET to correct the Windows 2000 time.

If daylight saving is not observed in your location, the Windows Server *Automatically adjust clock for daylight saving changes* setting should be grayed out. If it is not, make sure it is deselected. Otherwise, the integrated Windows 2000 server will report the time incorrectly.

Notice that the Windows server does not need to be in the same time zone as the iSeries server for the integration software to correctly calculate the Windows time setting.

Logical Partitioning (LPAR)
If you use logical partitions on your iSeries server, install the OS/400 Integration for Windows Server (5769-WSV) base licensed program and option 2 on each logical partition that will have an integrated Windows 2000 server installed. There is no requirement to install the licensed program on every logical partition.

If you are going to use the iSeries tape and CD-ROM drives from Windows 2000 running on the Integrated xSeries Server, these devices must be assigned to the same logical partition as the Integrated xSeries Server. Typically, when you implement logical partitioning, there are multiple CD-ROM and tape drives on your iSeries server because partitions are, in effect, separate iSeries servers running on the same machine.

2.3 Windows 2000 server planning

Before you install the Windows 2000 server on the Integrated xSeries Server, you should consider the following Windows 2000 server-specific issues.

Disk storage requirements
Planning the disk storage size requirements for your user applications and files is the same for a Windows 2000 server running on the Integrated xSeries Server as it is for a Windows 2000 server running on a stand-alone PC server.

It is important that you accurately estimate the disk storage requirements for your Windows 2000 system drive before you start the installation. If you underestimate the disk storage you need, the installation may fail, and you may have to start again from scratch (the beginning). Refer to 2.4, “Windows 2000 disk storage considerations” on page 26, for advice on estimating your disk storage requirements.

Server role
There are two server roles to choose from when installing and configuring a Windows 2000 server. These roles are:

- **Domain controller**: A domain controller is primarily responsible for authenticating users who log on to the Windows domain. A domain can have multiple domain controllers, and any one of them can be used to administer changes to the domain as each holds a current copy of the Active Directory, which stores the domain information.
- **Server:** A server can belong to a domain or workgroup. It usually performs file and print sharing, or another function such as Dynamic Host Configuration Protocol (DHCP). When you install the Windows 2000 server on the Integrated xSeries Server, you must install it as a server, not as a domain controller. You also need to decide whether to add the server to an existing domain or to a workgroup. If it is the first Windows server on your network, or you are creating a new domain, you must add the server to a workgroup. Once the installation is complete, you can promote the server, making it a domain controller in an existing domain or in a new one.

Deciding which type of server to install on the Integrated xSeries Server requires *very* careful planning, especially if you already have an existing domain containing one or more Windows NT 4.0 or Windows 2000 servers. You should consult your Microsoft documentation for guidance on this matter. A lot of useful material on this subject can also be found on the Microsoft Windows 2000 Technical Library Web site at: `http://www.microsoft.com/windows2000/library/`

Memory sizing
Use the same guidelines for sizing memory on an Integrated xSeries Server that is running the Windows 2000 server as you would for sizing a PC server of the same specification.

A minimum of 128 MB of memory is required on the Integrated xSeries Server to run the Windows 2000 server. However, if you plan to run any resource-intensive applications on your server, such as Terminal Services, we recommend that you have at least 512 MB available. You should consult your Microsoft documentation for more detailed guidelines on memory requirements.

Windows 2000 server console
A PC monitor, keyboard, and mouse need to be attached to the Integrated xSeries Server to provide the Windows 2000 server console. IBM does not supply this equipment, but extension cables for the monitor, keyboard, and mouse are supplied. We recommend that you obtain an SVGA monitor that is capable of at least 800 x 600 resolution.

For more information on how to attach these devices to the Integrated xSeries Server, refer to Chapter 10, “Integrated xSeries Server hardware and software” on page 255.

Service Packs
You should obtain the latest supported Windows 2000 server service pack from Microsoft well in advance of the installation date. Information on the latest supported Microsoft service pack can be found on the Web at:
`http://www.as400.ibm.com/windowsintegration`

Select **Service Information** and then **Microsoft Service Packs**.

Diskette drive
The Integrated xSeries Server does not have a diskette drive. Installation of the Windows 2000 server on the Integrated xSeries Server does not require one.

If you need a diskette drive to install other software on the Windows 2000 server, we recommend that you use a drive that has been shared by another Windows workstation on the network. Alternatively, you could obtain a diskette drive that can be connected to either the parallel port or the Universal Serial Bus (USB) ports of the Integrated xSeries Server, depending on the model. For more information on what ports are available on each model of the Integrated xSeries Server, refer to Chapter 10, “Integrated xSeries Server hardware and software” on page 255.

CD-ROM drive
By default, the Windows 2000 server uses the first available drive letter after the last assigned drive letter for the CD-ROM drive. This means that each time you add a new drive by creating a new NWSSTG space on the iSeries server and linking it to the Windows 2000 server, the CD-ROM is re-assigned to another

drive letter. To avoid this situation, we suggest that you decide on a specific drive letter for the CD-ROM drive. Once the Windows 2000 server installation is complete, assign that letter to the CD-ROM drive. We recommend that you assign the letter X: to the CD-ROM drive.

Administrator password
When you complete the final steps of the Windows 2000 server installation, you must decide on a password for the server's Administrator account. Choose a password that is easy to remember, yet impossible for someone to guess. If you need to write it down, make sure it is stored in a secure place.

If you intend to install a Windows 2000 server in an existing Windows domain, you need to learn the current Domain Administrator's password to complete the installation.

IP forwarding function
If you have a Model 2850 or 6617 Integrated Netfinity Server and you plan to use external host LAN support, you *must not* enable the IP forwarding function within the Windows 2000 server. If you ignore this restriction, you could cause a TCP/IP packet storm that could disrupt your entire network. If you need to enable the IP forwarding function within the Windows 2000 server, you should use a LAN adapter attached to a separate IOP for OS/400 communication support, rather than enabling the external host LAN capability.

Be aware that this restriction only applies to IP forwarding on the Windows 2000 server. It does not apply to IP forwarding configured under OS/400.

Customized installation
It is possible to customize the installation of the Windows 2000 server by modifying the Windows 2000 server unattended installation script file (unattend.txt) during the installation process. However, support for customization is limited to system drives that have been formatted as File Allocation Table (FAT), and therefore, are 2047 MB or less in size. We do not recommend it, but if you want to take advantage of this capability, refer to *Networking Operating Systems, Windows Server on AS/400*, which is available through the iSeries 400 Information Center via CD-ROM or the Web at:
`http://publib.boulder.ibm.com/pubs/html/as400/v4r5/ic2924/info/index.htm`

Look under **Network Operating Systems** and then **Windows server on AS/400**.

2.4 Windows 2000 disk storage considerations

The installation of the Windows 2000 server on the Integrated xSeries Server creates two NWSSTG spaces representing the server's C: and D: drives. The C: drive contains the DOS boot and Windows 2000 server system files. The D: drive holds an image of the Windows 2000 server installation source files, plus other files supplied by IBM as part of the OS/400 Integration for Windows Server (5769-WSV) code. It is important that you accurately estimate the amount of disk storage needed for these storage spaces before you begin the installation.

If you are not already familiar with the basic concepts behind iSeries and Windows 2000 server disk storage management, refer to Chapter 5, "Disk storage administration" on page 87.

For more information about how the Integrated xSeries Server uses disk storage and for a description of the terms such as NWSSTG space, see Chapter 11, “OS/400 components of the Windows 2000 server” on page 263.

2.4.1 Windows 2000 server C: and D: drive sizes

Take the following considerations into account when you estimate the size requirements for your Windows 2000 server’s C: and D: drives:

- The more memory you install on the Integrated xSeries Server, the larger you need to make the C: drive. Refer to the following section for more information on how the amount of memory installed on the Integrated xSeries Server affects the size of the C: drive.
- When applications are installed on the Windows 2000 server, many of them install at least some of their files on the system drive, which, in this case, is the C: drive. You need to allow for this requirement.
- When you install a Windows 2000 service pack, you have the option of saving the files that are replaced in case you need to uninstall the service pack. If you choose the uninstall option, you may need up to 100 MB of additional free space on the system drive.
- Future versions of the Windows 2000 server may require free space on the C: drive to allow an upgrade of the existing installation.
- The D: drive only needs to be large enough to accommodate the Windows 2000 server installation source files and any future service updates to the OS/400 integration software (provided by service packs).

In practice, the D: drive can be from 360 to 2047 MB in size, and must remain formatted as FAT. The C: drive can be from 1024 MB to 8000 MB in size, and if it is larger than 2047 MB, it must be formatted as NTFS.

2.4.2 Windows 2000 server virtual memory paging file

The Windows 2000 server creates a virtual memory paging file (pagefile.sys) on the system drive. This file is used to handle the swapping (exchanging) of data in and out of memory. It is also used as a temporary dump file for STOP (blue screen) errors.

The Windows 2000 server calculates the size of the paging file based on the amount of physical memory (RAM) installed on the server. We generally recommend that you allow at least 150% of the installed memory size as additional disk storage on the system drive to accommodate the paging file. For example, on an Integrated xSeries Server with 512 MB of RAM, you should allow for a paging file size of 768 MB when considering how large to make the system drive. The more memory that is installed on your Integrated xSeries Server, the greater the amount of disk space you should reserve on your C: drive for the paging file.

2.4.3 User file storage

User files should be stored in NWSSTG spaces that have been created and linked to the Windows 2000 server after installation. We do not recommend the use of the server’s C: or D: drives for storing user data because the growth of data files could overflow the drive’s capacity and it is difficult to enlarge the

system drive. Also, it is good practice to store system files, application files, and user data on different drives for backup purposes.

The Windows 2000 server sees a NWSSTG space as a physical disk drive that you would install in a PC. NWSSTG spaces can be from 1 MB to 64000 MB in size depending on which file system format you choose at the time of creation. See 5.2.2, “Windows 2000 file systems” on page 91, for a comparison of the various Windows 2000 file systems.

Because iSeries disk data management can scatter data over a number of disk drives, you do not need to worry about how many disk arms are accessing your Windows 2000 server data. Therefore, you can make your NWSSTG spaces as large as you want without worrying about adversely affecting performance. However, you should avoid creating an NWSSTG space that far exceeds your short to mid-term storage capacity needs. It not only wastes disk storage that could be used by the iSeries server, but could also have serious implications for your Windows 2000 server backup strategy. Refer to Chapter 7, “Backup and restore” on page 151, for more information on backing up an iSeries integrated Windows 2000 server.

2.4.4 User auxiliary storage pools (ASPs)

When you install the Windows 2000 server on the Integrated xSeries Server, you can choose to create the C: and D: drive storage spaces in the system auxiliary storage pool (ASP) or a user ASP. You have the same flexibility when creating new NWSSTG spaces for the Windows 2000 server. This gives you the ability to choose how the data in your storage spaces is protected: RAID-5, mirroring, or no protection.

Locating NWSSTG spaces in user ASPs could improve performance because you may be able to move user data to lightly used disk units or move infrequently used data to slow disks.

User ASPs should only be set up on larger systems with several disk arms by someone who is familiar with this technology.

We recommend that you do not use user ASPs unless you have fully investigated their applicability to your environment.

2.4.5 Disk storage recommendations

We recommend the following minimum sizes for the Windows 2000 server C: and D: drives:

- C: drive: 1,250 MB + (1.5 x installed memory)
- D: drive: 400 MB

The Windows 2000 operating system requires approximately 800 MB. The recommended figure allows some additional disk storage for application files, which may need to reside on the system drive. You may want to make the C: drive considerably larger than the minimum recommended size to allow for the installation of additional memory and applications.

2.5 Hardware and software checklists

Make sure that you have all the hardware and software that you need by checking each item in the following lists.

2.5.1 Hardware checklist

Table 2 provides a checklist of the minimum hardware prerequisites that need to be installed on the iSeries server before you install the Windows 2000 server on the Integrated xSeries Server. Refer to Chapter 10, “Integrated xSeries Server hardware and software” on page 255, for more details regarding the hardware.

Table 2. Hardware checklist

A Pentium II 333 MHz Integrated Netfinity Server or Pentium III 700 MHz Integrated xSeries Server adapter with at least 128 MB of RAM installed	
One or more LAN adapters installed with the Integrated xSeries Server (including cables for attachment to the network)	
A VGA or SVGA PC monitor connected to the Integrated xSeries Server	
A keyboard connected to the Integrated xSeries Server	
A mouse connected to the Integrated xSeries Server	
At least 2 GB of free disk space on the iSeries server	

2.5.2 Software checklist

Table 3 provides a checklist of the minimum software requirements needed to complete the installation of the Windows 2000 server on the Integrated xSeries Server. Refer to Chapter 10, “Integrated xSeries Server hardware and software” on page 255, for more details regarding the software.

Table 3. Software checklist

OS/400 Version 4 Release 5 (5769-SS1)	
Integration for Windows Server (5769-WSV) Version 4 Release 5 (base licensed program *and* option 2 - Integration for Windows 2000)	
AS/400 PTFs are listed on the Web site `http://www.as400.ibm.com/windowsintegration` under **Service Information ->OS/400 PTF Descriptions**.	
The latest OS/400 Integration for Windows 2000 Service Pack is specified on the Web at `http://www.as400.ibm.com/windowsintegration` under **Service Information ->Service Packs**.	
OS/400 Client Access Express for Windows installed on a PC that can connect to the iSeries server [1]	
OS/400 Version 4 Release 5 (5769-SS1), option 12 - Host servers [2]	
Windows 2000 server installation CD-ROM or an image of it copied to the IFS (Windows 2000 Advanced Server and Datacenter Server are not supported at this time)	
License CD-ROM if installing from an upgrade CD-ROM	
A supported Windows 2000 server service pack from Microsoft	

Notes:	
1. OS/400 Client Access Express for Windows is optional and is shipped free of charge with OS/400 Version 4 Release 5. It is only required if you want to complete a full setup of AS/400 NetServer or want to use the new Administration plug-in for integrated Windows servers included with Operations Navigator. 2. Host servers is a prerequisite for OS/400 Client Access Express for Windows and AS/400 NetServer printer support. Therefore, it is optional.	

2.6 Installation worksheet

The installation of the Windows 2000 server on the Integrated xSeries Server is started on the iSeries server using the Install Windows Server (INSWNTSVR) command. The installation worksheet provided in Table 4 follows the layout of the INSWNTSVR command as closely as possible and is designed to help you collect the information necessary to perform the installation. Make sure that you fully complete the worksheet before you start the installation.

The Parameter column on the installation worksheet contains a parameter description and CL parameter name for each parameter of the INSWNTSVR command. You can view the CL parameter names by pressing F11 when you prompt for the INSWNTSVR command. For example, the parameter description for the first parameter in the worksheet is *Network server description*. It's corresponding CL parameter name is *NWSD*. You will see references to the CL parameter name in this chapter and in Chapter 3, "Installing the Windows 2000 server" on page 37.

The term *port* used in the worksheet refers to the LAN adapter or adapters (token-ring or Ethernet) installed with the Integrated xSeries Server. Section 11.3, "Common components" on page 270, provides an overview of the LAN structure of the Integrated xSeries Server.

Table 4. Installation worksheet

Parameter	Description and instructions	Value
Network server description: NWSD	Defines the operating characteristics and communications connections of the network server that controls the Windows 2000 server. Choose a name that is easy to remember. It can have up to eight characters. Use only the characters A to Z and 0 to 9 in the name, and use a letter for the first character. This name will also become the Computer Name and TCP/IP Host Name of the Windows 2000 server.	
Resource name: RSRCNAME	Identifies the hardware to be used for this Windows 2000 server. Enter `WRKHDWRSC *CMN` on the OS/400 command line to determine the resource name. If you have an Integrated xSeries Server Model 2850 or 2890 (PCI), look for a name with the format LINxx and the description File Server IOA. For a Model 6617 (SPD), look for a name with format CCxx and description of File Server IOP.	LIN_____ or CC_____

Parameter	Description and instructions	Value
Domain role: DMNROLE	Identifies the role of the Windows 2000 server. **Note:** Specify a value of *SERVER for this parameter. Specifying *DMNCTL for this parameter will not cause an error, but the Windows 2000 server will still be created as a server rather than a domain controller. If you intend to make the server a Domain Controller, you have to run the DCPROMO program on the Windows 2000 server console once the installation has completed.	*SERVER
Windows server version: WNTVER	Identifies the version of the Windows server to install. Specify a value of *WIN2000 for this parameter.	*WIN2000
Windows source directory: WNTSRCDIR	Identifies the location of the Windows 2000 server installation source code. **Note:** Specify *DFT if you are installing from the CD-ROM drive. If you copied the CD-ROM image to a directory within the IFS, specify the path name where this can be found, for example, '/dir1/dir2'.	
Install option: OPTION	Identifies the Windows 2000 server installation method. Specify *INSTALL for this parameter.	*INSTALL
TCP/IP port configuration: TCPPORTCFG	Specifies the Windows 2000 server's TCP/IP configuration settings for each LAN adapter (port) installed on the Integrated xSeries Server. For each port, provide the following information: 1. IP address 2. Subnet mask 3. Gateway address If you plan to enable the external host LAN function and your hardware configuration supports it, use the Port 1 and Port 2 parameters found later on the worksheet to provide this information, instead of specifying it here. In which case, specify a value of *NONE, or provide only Port 3 TCP/IP configuration settings here if appropriate.	Port 1: a) ____.____.____.____ b) ____.____.____.____ c) ____.____.____.____ Port 2: a) ____.____.____.____ b) ____.____.____.____ c) ____.____.____.____ Port 3: a) ____.____.____.____ b) ____.____.____.____ c) ____.____.____.____
TCP/IP local domain name: TCPDMNNAME	Identifies the TCP/IP local domain name associated with this Windows 2000 server. You can specify *SYS to use the same value that the iSeries server uses.	
TCP/IP name server system: TCPNAMSVR	Identifies the IP address of the DNS server that is used by this Windows 2000 server. You can specify up to three IP addresses, or you can specify *SYS to use the same settings as the iSeries server.	

Parameter	Description and instructions	Value
Server message queue and library: MSGQ	Identifies the name and location of the message queue that is to receive any errors or event logs associated with this Windows 2000 server. Specify a message queue and library. If the message queue does not already exist, it will be created during the installation process. Alternatively, you can specify a value of *JOBLOG to have all non-severe messages sent to the network server monitor job log and severe messages sent to QSYSOPR. If you specify a value of *NONE, only severe errors are sent to QSYSOPR. Use care if the QSYSOPR message queue is specified because the volume of Windows 2000 server event log messages is unpredictable.	Queue: Library:
Event log: EVTLOG	Identifies the type of Windows 2000 server event log messages that are mirrored to the OS/400 server message queue specified on the previous parameter. The Windows 2000 server Event Log is the central repository for error reporting on the Windows 2000 server. It consists of system (*SYS), security (*SEC), and application (*APP) messages. The default is to monitor all three message types (*ALL). However, you can choose to mirror a combination of these message types to the server's message queue, or none (*NONE) of them. Specify one or a combination of these values. You can change the level of message logging in OS/400 at a later time if necessary, using the Change Network Server Description (CHGNWSD) command. Notice that, if the security log is mirrored, be sure to set up the message queue with an appropriate level of security because the status of user accounts and password changes may appear in the log.	
Server storage space sizes: SVRSTGSIZE	Identifies the size of the Windows 2000 server system drive (C:) and installation source drive (D:) storage spaces. Specify an installation source drive size that is large enough to hold the contents of the I386 directory on the Windows server installation CD-ROM and the OS/400 Integration for Windows server code (must be at least 360 MB). Specify a system size that is large enough to hold the Windows 2000 server operating system. If a value of *CALC is specified, a system drive size equal to double the amount of RAM installed on the Integrated xSeries Server plus 500 MB will be used (must be at least 1024 MB).	Install source (D: drive) size: _____ MB System (C: drive) size: _____ MB
Storage space ASP: SVRSTGASP	Identifies the auxiliary storage pool (ASP) in which to create each of the Windows 2000 server's storage spaces. Specify a value that identifies the ASP to be used for each of the storage spaces. If you are not familiar with the concept of ASPs on the iSeries server, we recommend that you specify the default value of 1 in each case that represents the system ASP.	Install source (D: drive) ASP: System (C: drive) ASP:

Parameter	Description and instructions	Value
Convert to NTFS: CVTNTFS	Identifies whether the Windows 2000 server's system drive (C:) is to be formatted as FAT or NTFS during the installation process. Specify a value of *YES to format the system drive as NTFS or a value of *NO to leave it as FAT. If you specified a size of 2048 MB or greater for the system drive, it is automatically formatted as NTFS during the installation, regardless of the value you specify here. We recommend that you format the system drive as NTFS to provide improved performance and enhanced security options on the Windows 2000 server.	
To workgroup: TOWRKGRP	Identifies the name of the workgroup in which this Windows 2000 server is to participate. Specify a valid name.	
To domain: TODMN	Identifies the name of the *existing* domain that this Windows 2000 server is to join. Specify a valid name. If this is the first Windows 2000 server to be installed in a new domain, or if it is to become a domain controller of a new domain, specify a value on the To workgroup parameter instead.	
Full name and organization: FULNAM/ORG	Identifies the full name of the individual and organization that holds the Windows 2000 server license. Specify valid names.	
Language version: LNGVER	Identifies the language in which the OS/400 Integration for Windows 2000 Server-related text and messages are displayed. Specify a value corresponding to the language version of the Windows 2000 server being installed on the Integrated xSeries Server.	
Synchronize date and time: SYNCTIME	Identifies how often the date and time on the Windows 2000 server is synchronized with the iSeries. Specify a value of *YES to enable the date and time to be synchronized when the Integrated xSeries Server is varied on (started) and every 30 minutes thereafter. Otherwise, specify a value of *NO to only enable synchronization when the server is varied on.	
Windows license key: WNTLICKEY	Identifies the Windows 2000 server license key supplied with the software. Specify the license key exactly as it is printed on the sticker, which can usually be found on the back of the CD-ROM case. Make sure you include any dashes, for example, '12345-abcde-67890-fghijk-76543'.	

Parameter	Description and instructions	Value
License mode: LICMODE	Identifies whether Windows 2000 server is to be installed in a per seat or per server license mode. Specify *PERSEAT for the License type value if a client license has been purchased for each computer that intends to access this server. Leave the Client licenses and Desktop licenses values set to *NONE in this case. Specify *PERSERVER for the License type value if client licenses have been purchased for the server, to allow a certain number of concurrent client connections to it. Specify the number of licenses for the Client licenses value. Leave the Desktop licenses value set to *NONE.	License type: Client licenses: Desktop licenses: *NONE
Restricted device resources: RSTDDEVRSC	Identifies any iSeries tape and CD-ROM drives to which you *do not* want this Windows 2000 server to have access. Specify a value of *NONE if you do not want to restrict access to any of the iSeries tape or CD-ROM drives. Specify a value of *ALL if you want to restrict access to all of the iSeries tape and CD-ROM drives. Specify a value of *ALLTAPE or *ALLOPT to restrict access to all of the iSeries tape drives or CD-ROM drives respectively. Otherwise, specify a list of up to ten devices by name to which you do not want the Windows 2000 server to have access.	
Description: TEXT	Provide a text description (up to 50 characters) to help identify this Windows 2000 server's on the iSeries server.	
Note: You must press F10 within the INSWNTSVR command display to view the following parameters.		
Keyboard layout: KBDTYPE	Identifies the keyboard layout to install on the Windows 2000 server. If you want to install a keyboard type on the Windows 2000 server other than the default, specify the hexadecimal keyboard layout identifier. Valid keyboard layout identifiers are listed in the TXTSETUP.SIF file in the i386 directory of the Windows 2000 server installation source.	
Internal LAN port: INTLANPORT	Identifies the IP addresses for both the iSeries end and Windows 2000 server end of the internal LAN. Specify the default value of *GEN to configure the internal LAN configured automatically. If you know for sure that the default IP addresses are going to cause a conflict on the network, specify alternative addresses here.	AS/400 Internet address: ____.____.____.____ Windows Internet address: ____.____.____.____

Parameter	Description and instructions	Value
Port 1 & Port 2: PORT1 PORT2	Specifies the configuration of the OS/400 line descriptions, TCP/IP interfaces, and the Windows 2000 server TCP/IP settings for each port that is to have external host LAN support enabled. Only specify values here if you intend to use the external host LAN function, and your hardware supports it. Otherwise, use the TCP/IP port configuration parameter near the start of this worksheet. For each port, provide the following information: **Line type:** Specify the type of LAN to which the Integrated xSeries Server is connected. If no LAN adapter is present or this port is not to be enabled for external host LAN, specify `*NONE`. Otherwise, valid values are `*ETH10M` or `*ETH100M` for Ethernet, and `*TRN4M` or `*TRN16M` for token-ring. **Local adapter address (LAA):** You must specify the local adapter address to use. This 12-digit hexadecimal address is also called the *Media Access Control (MAC) address*. Every network adapter on the LAN must have a unique MAC address. For Ethernet line types, valid values range between 020000000000 and 7EFFFFFFFFFF, where the second digit must be 2, 6, A, or E. For token-ring line types, valid values range between 400000000000 and 7EFFFFFFFFFF. **Maximum transmission unit (MTU):** Specify the maximum size (in bytes) of IP datagrams that can be transmitted. The default value is 1492, but specifying a larger size may increase the efficiency of sending and receiving data. However, problems can arise if your network has bridges or routers that cannot accommodate larger sizes. **AS/400 Internet address and subnet mask:** Specify the IP address and subnet mask to be used for AS/400 external host LAN communications. **Windows Internet address, subnet mask, and gateway address:** Specify the TCP/IP configuration settings for this Windows 2000 server.	Port 1 Line type: _____ LAA: _____ MTU: _____ AS/400 Internet address: ____.____.____.____ AS/400 subnet mask: ____.____.____.____ Windows Internet address: ____.____.____.____ Windows subnet mask: ____.____.____.____ Windows gateway address: ____.____.____.____ Port 2 Line type: _____ LAA: _____ MTU: _____ AS/400 Internet address: ____.____.____.____ AS/400 subnet mask: ____.____.____.____ Windows Internet address: ____.____.____.____ Windows subnet mask: ____.____.____.____ Windows gateway address: ____.____.____.____
Configuration file and library: CFGFILE	If you created a configuration file for the purpose of customizing the unattended installation of the Windows 2000 server, specify the name and its location here. Otherwise, specify the default value of `*NONE` for this parameter.	Configuration file: Library:

Chapter 3. Installing the Windows 2000 server

This chapter describes how to install the Windows 2000 server on the Integrated xSeries Server.

3.1 Overview

Before you attempt to install the Windows 2000 server on the Integrated xSeries Server, we strongly advise you to read Chapter 2, “Installation planning” on page 17, and complete the following checklists and worksheet:

- Hardware checklist (Table 2 on page 29)
- Software checklist (Table 3 on page 29)
- Installation worksheet (Table 4 on page 30)

The installation worksheet is important because you need this information to enter values when you prompt the Install Windows Server (INSWNTSVR) command. The descriptions in the worksheet explain each parameter to ensure you have the correct information ready when you start the installation.

3.1.1 Installation steps

The installation of the Windows 2000 server on an Integrated xSeries Server consists of the following steps:

1. Completing the pre-installation tasks
2. Starting the Windows 2000 server installation from the iSeries server
3. Completing the server installation from the Windows 2000 console
4. Completing the post-installation tasks

Each of these steps is described in the following sections. Before you begin, make sure you have completed the installation worksheet.

3.2 Completing the pre-installation tasks

Before you install the Windows 2000 server on an Integrated xSeries Server, you may need to perform some or all of the following pre-installation tasks:

1. Install the Windows 2000 integration software.

   To make sure that the integration software is installed on the iSeries, follow these steps:

   a. Type `GO LICPGM` on a command line, and press Enter.

   b. Select option `10` to display the installed programs, and press Enter.

   c. Look for 5769-WSV *BASE Integration for Windows Server and 5769-WSV 2 Integration for Windows 2000 as shown in Figure 12 on page 38. If they are both installed, skip to step 2.

```
                    Display Installed Licensed Programs
                                                          System:   AS23
Licensed  Product
Program   Option   Description
5769RD1    8       OnDemand Client for 32 bit Windows
5769RG1    *BASE   ILE RPG for AS/400
5769RG1    5       RPG for AS/400
5769RG1    6       *PRV ILE RPG for AS/400
5798RZG    *BASE   AS/400 Service Director
5769SA2    *BASE   IBM Integration Services for FSIOP
5769ST1    *BASE   DB2 Query Mgr and SQL DevKit for AS/400
5769TC1    *BASE   TCP/IP Connectivity Utilities for AS/400
5769WSV    *BASE   Integration for Windows Server
5769WSV    1       Integration for Windows NT 4.0
5769WSV    2       Integration for Windows 2000
5763XD1    *BASE   Client Access/400 Optimized for Windows
5769XE1    *BASE   Client Access/400 Express for Windows
5769XW1    *BASE   Client Access/400 Windows Family Base
                                                                More...
```

Figure 12. Dispalay Installed Licensed Programs screen

d. Insert the CD-ROM containing the integration software into the iSeries server CD-ROM drive.

e. Return to the Work with Licensed Programs (`GO LICPGM`) menu. Select option `11` (Install Licensed Programs), and press Enter.

f. Page down the list of licensed programs until you see the descriptions for Integration for Windows server and Integration for Windows 2000. Type `1` in the Option column for both licensed programs, and press Enter.

g. Type the correct device name for your CD-ROM drive (typically OPT01), and press Enter.

2. Install any available program temporary fixes (PTFs).

   Before you install the Windows 2000 server on the Integrated xSeries Server, make sure you have the latest code updates installed on your iSeries server. Most of the errors that occur during installation are due to the fact that the latest code updates have not been installed.

   The latest information on available PTFs can be found at the OS/400 Integration for Windows Web site:
   `http://www.as400.ibm.com/windowsintegration`

3. Copy the Windows 2000 installation CD-ROM to the integrated file system (IFS).

   This step is optional and is only necessary if you want to install from a directory in the IFS, rather than from the CD-ROM. If you do not want to copy the installation CD-ROM to the IFS, you can install Windows 2000 directly from the CD-ROM drive, which is the default. To copy the i386 directory from a CD-ROM containing the server code to a directory in the IFS, use AS/400 NetServer. Refer to Chapter 14, “AS/400 NetServer” on page 345, for information on how to set up AS/400 NetServer.

   Follow these basic steps to copy a CD-ROM to an IFS directory:

   a. On a command line, type:

      ```
      MD DIR('first_level_directory')
      ```

Press Enter to create the target directory as a first level directory in the IFS, such as W2KCD.

b. On a command line, type:

```
MD DIR('first_level_directory/second_level_directory')
```

Press Enter to create a second level target directory (for example, i386), if required.

c. Use AS/400 NetServer to share the first level IFS directory you just created. You can find it under the root file system when you browse the IFS.

d. From a Windows client, click **Start->Find->Computer** to connect to AS/400 NetServer. You may need an entry in your LMHOSTS file on the PC. From the Windows client, map a drive to the first level directory you created in the IFS.

e. Copy the i386 directory and all its subdirectories from the CD-ROM to the i386 directory you created in the IFS.

The target directory can also be a folder ('QDLS/folder_name').

4. Set the performance adjustment (QPRFADJ) system value.

To vary on the Integrated xSeries Server, there must be enough memory in the machine pool. Rather than calculating how much more memory you need and then manually adjusting the machine pool size, we suggest that you turn on automatic performance adjustment (if it is not already active). To change the QPFRADJ system value, follow these steps:

a. On a command line, type:

```
WRKSYSVAL SYSVAL(QPFRADJ)
```

Press Enter.

b. Type `2` in the Option column, and press Enter.
c. Change the QPFRADJ system value to `2`. This is the default.

5. Set the offset from Greenwich Mean Time (QUTCOFFSET system value).

It is important that you set the QUTCOFFSET system value correctly because this value is used to set the time on the Windows 2000 server when it boots up. Because the Integrated xSeries Server does not have a clock, the integration software uses the value of QUTCOFFSET to calculate the correct time for the Windows 2000 server to use, regardless of the time zone that the server operates in.

You can determine the offset for your time zone by using a Windows 95, 98, NT, or 2000 workstation. Click **Start->Settings->Control Panel-> Date/Time->Time Zone**. Click the drop-down list, and find the correct offset for your region. Then, go back and set it on the iSeries server. Do not forget to type the preceding **+** or **-** sign.

To set the QUTCOFFSET system value on the iSeries server, on an OS/400 command line, type:

```
WRKSYSVAL SYSVAL(QUTCOFFSET)
```

Press Enter. Select option `2` to change it if necessary.

6. Enable AS/400 NetServer support.

   For integration software service packs to be installed on the Windows 2000 server, AS/400 NetServer must be set up on the iSeries server. This should be done before installation is started, to enable the automatic download of any existing integration service packs when the installation process finishes. Refer to 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358, for a description of how to do this.

7. Configure TCP/IP on the iSeries server.

   The installation program allows you to automatically pass OS/400 TCP/IP configuration data, specified in the INSWNTSVR command, across to Windows 2000. If you intend to use this feature, make sure that a local domain name and one or more domain name servers are configured on the iSeries server. Use the Configure TCP/IP (CFGTCP) command to check this. If you have never set up TCP/IP on your iSeries server, you do not need to use this feature. In fact, you do not have to configure anything concerning TCP/IP on your iSeries server. The install command (INSWNTSVR) creates the required internal LAN TCP/IP interfaces on the iSeries server. Also, TCP/IP on the iSeries is started automatically when the Integrated xSeries Server is varied on using the Vary Configuration (VRYCFG) command.

   There are some network configuration parameters that are *not* automatically passed across from the iSeries server, and not specified in the INSWNTSVR command. One such attribute is the WINS Server IP address. Determine the WINS Server IP address or addresses by asking your network administrator.

   If you need information regarding TCP/IP configuration on the iSeries, refer to *TCP/IP Configuration and Reference*, SC41-5420.

8. Handle more than one LAN adapter in the Integrated xSeries Server.

   If your Integrated xSeries Server has two LAN adapters connected to the same network segment, Windows 2000 may detect itself on the LAN and wrongly think that its computer name is already being used on the network. Therefore, disconnect one of the LAN adapters from the network before installing the server. To disconnect the adapter, unplug the cable that connects the adapter to the network from either the hub, or socket on the back of the adapter. After the installation is complete, you can reconnect the adapter to the network. You are instructed when to do this.

9. Change the QSYSOPR message queue delivery mode to something other than *BREAK so that the installation is not interrupted.

3.3 Starting the Windows 2000 server installation from the iSeries server

The installation of Windows 2000 on an Integrated xSeries Server for iSeries is performed in two phases. Phase one runs on the iSeries server and is triggered by the INSWNTSVR command. During phase one, the following tasks are performed:

- A network server description (NWSD) that contains a description of the Windows environment and associates the Integrated xSeries Server hardware resource name with the Windows 2000 server is created.
- Network server storage (NWSSTG) spaces for the Windows 2000 installation source drive (D:) and system drive (C:) are created in the auxiliary storage pool specified.

- The contents of the \i386 directory and its subdirectories are copied from the Windows 2000 installation CD-ROM to the D: drive.
- Programs, files, and device drivers specific to Windows 2000 running on the Integrated xSeries Server are copied into a directory named \i386\OEM on the D: drive.
- An UNATTEND.TXT file that contains all the Windows 2000-specific information entered in the INSWNTSVR command and allows for an almost unattended installation of Windows 2000 is created. An example UNATTEND.TXT file can be found in Appendix C, “Installation files” on page 459.
- TCP/IP on the iSeries server is started, if it is not already active.
- The network server description is varied on to start the DOS mini-boot image on the C: drive. The AUTOEXEC.BAT file on the drive C: contains the necessary statement to start the unattended installation of the Windows 2000 server. If you watch the Windows 2000 server console, you will see the normal boot process of a PC, followed by DOS starting, and then the first stage of a standard Windows 2000 installation.

Phase two runs on the Integrated xSeries Server and consists of four stages called *modes*, which comprise the normal Windows 2000 installation process. The first three modes are completely unattended, while the fourth mode requires input from the Windows 2000 console.

- **Mode 1:** Character mode copies all files necessary to complete the setup process from the CD-ROM to a temporary directory and prepares the disk image for the next phase of the install. The server restarts.
- **Mode 2:** Text mode copies all files required to create the server from the temporary directory to the installation folders. The server restarts.
- **Mode 3:** Convert mode transforms the Windows 2000 server installation partition from the default FAT format to NTFS if CVTNTFS(*YES) was specified in the INSWNTSVR command or if the size specified for the system drive in the INSWNTSVR command is 2048 MB or greater. The server restarts, and TCP/IP on the iSeries server is started (if it is not already active).
- **Mode 4:** GUI mode displays the Windows 2000 console and prompts for additional information required to customize the installation of the Windows 2000 server.

If the INSWNTSVR command fails before mode 4, the iSeries server attempts to clean up and remove the following objects that are created during installation:

- Network server description
- C: and D: drive NWSSTG spaces
- Line descriptions
- TCP/IP interface for the internal LAN
- Message queue (if specified)

In this case, you must restart the installation from the beginning. Before you attempt another installation, make sure all the objects are really deleted. Refer to Chapter 4, “General administration” on page 57, for details.

If the Install Windows Server (INSWNTSVR) command fails during mode 4 (when the network server description is varied on, and Windows 2000 is started in GUI

mode for the first time), the OS/400 side of the installation is complete. In this case, the OS/400 does not attempt to clean up. You simply need to sign on to the Windows 2000 server and attempt to complete the installation. If you are still unable to recover, you need to un-install the server, as described in Chapter 4, “General administration” on page 57, and start again.

You are now ready to start the installation of the Windows 2000 server on the Integrated xSeries Server. Make sure you complete the worksheet so that you have all the necessary information in front of you.

Be sure you sign on to the iSeries server with a profile that has *IOSYSCFG, *ALLOBJ, and *SECADM special authorities.

Time required

As a guide, the time required from the start of the INSWNTSVR command on the iSeries server to the point where the basic Windows 2000 server is installed is approximately one hour. This does not include any customization tasks such as promoting the server to a domain controller or completing the post-installation tasks. Your time may vary, depending on the performance rating of your iSeries server and the processor speed of the Integrated xSeries Server.

To start the installation, follow these steps:

1. Sign off your current session and then sign on again with the user profile you will use to perform the installation. Signing on again starts a new job log that captures the installation process.
2. Make sure the iSeries CD-ROM drive is varied on. Insert the Windows 2000 installation CD-ROM (if you are *not* installing from a directory in the IFS).
3. On the OS/400 command line, type:

   ```
   INSWNTSVR
   ```

   Press F4.
4. Type the information required to complete the first Install Windows Server (INSWNTSVR) display shown in Figure 13. Use the information from your worksheet in Table 4 on page 30.

```
                    Install Windows Server (INSWNTSVR)

Type choices, press Enter.

Network server description. . . > as4win2k      Name
Resource name  . . . . . . . . . > lin09         Name
Domain role  . . . . . . . . . . > *server       *DMNCTL, *BKUCTL, *SERVER
Windows server version . . . . . > *win2000      *NT40, *WIN2000
Windows source directory . . . .   *DFT

Install option . . . . . . . . .   *INSTALL      *INSTALL, *UPGRADE
TCP/IP port configuration:
  Port . . . . . . . . . . . . .   1             *NONE, 1, 2, 3
  Windows internet address . . .   10.10.10.1
  Windows subnet mask  . . . . .   255.255.255.0
  Windows gateway address  . . .   10.10.10.9
            + for more values
TCP/IP local domain name . . . .   *SYS


                                                                       More...
```

Figure 13. INSWNTSVR screen (Part 1 of 5)

5. Enter information from the worksheet into the second and third displays of the Install Windows Server (INSWNTSVR) command. Examples are shown in Figure 14 and Figure 15 on page 44.

```
                    Install Windows Server (INSWNTSVR)

Type choices, press Enter.

TCP/IP name server system  . . .   *SYS
            + for more values
Server message queue . . . . . .   *JOBLOG       Name, *JOBLOG, *NONE
  Library  . . . . . . . . . . .                  Name, *LIBL, *CURLIB
Event log  . . . . . . . . . . .   *ALL          *ALL, *NONE, *SYS, *SEC, *APP
            + for more values
Server storage space sizes:
  Install source size  . . . . . > 400           200-2047
  System size  . . . . . . . . . > 2000          500-8000, *CALC
Storage space ASP:
  Install source ASP . . . . . .   1             1-16
  System ASP . . . . . . . . . .   1             1-16
Convert to NTFS  . . . . . . . .   *YES          *NO, *YES
To workgroup . . . . . . . . . .
To domain  . . . . . . . . . . .   w2kdomain

                                                                       More...
```

Figure 14. INSWNTSVR screen (Part 2 of 5)

```
                    Install Windows Server (INSWNTSVR)

Type choices, press Enter.

Full Name  . . . . . .   Jane Doe

Organization . . . . . .   Fictitious

Language version . . . . . .   *PRIMARY      *PRIMARY, 2911, 2922, 2923...
Synchronize date and time  . . .   *YES          *YES, *NO
Windows license key  . . . . . .   11111-22222-33333-44444-55555

License mode:
  License type . . . . . .   *PERSEAT      *PERSEAT, *PERSERVER
  Client licenses  . . . . . .   *NONE         5-9999, *NONE
  Desktop licenses . . . . . .   *NONE         5-9999, *NONE
Restricted device resources  . .   *NONE         Name, *NONE, *ALL...
              + for more values
Text 'description' . . . . . .   Windows 2000 server

                                                                  Bottom
```

Figure 15. INSWNTSVR screen (Part 3 of 5)

6. Press F10 to see additional parameters as shown in Figure 16 and Figure 17. This is only necessary if you plan to do any of the following tasks:
   - Use a keyboard layout identifier, other than the default, on the Windows server.
   - Use your own IP addresses for the internal LAN of the Integrated xSeries Server.
   - Set up the LAN ports on the Integrated xSeries Server to use the external host LAN capability. This capability is not supported on the 700 MHz adapter or on the 333 MHz adapter when it is installed in a migration tower.
   - Use an NWSD configuration file. For information about customizing the installation, refer to *Networking Operating Systems, Windows Server on AS/400*, which is available from the iSeries 400 Information Center via CD-ROM or the Web at:
     `http://publib.boulder.ibm.com/pubs/html/as400/v4r5/ic2924/info/index.htm`

     Click **Network Operating Systems** and then **Windows server on AS/400**.

```
                    Install Windows Server (INSWNTSVR)

Type choices, press Enter.


                           Additional Parameters

Keyboard layout  . . . . . .   *DEFAULT      Hexadecimal value, *DEFAULT
Internal LAN port:
  AS/400 internet address  . . .   *GEN
  Windows internet address . . .   *GEN
Port 1:
  Line type  . . . . . .  . . .   *NONE       *NONE, *ETH10M, *ETH100M...
  Local adapter address  . . . .              020000000000-7FFFFFFFFFFF
  Maximum transmission unit  . .              Number
  AS/400 internet address  . . .
  AS/400 subnet mask . . . . . .
  Windows internet address . . .
  Windows subnet mask  . . . . .
  Windows gateway address  . . .
                                                                   More...
```

Figure 16. INSWNTSVR screen (Part 4 of 5)

```
                    Install Windows Server (INSWNTSVR)

Type choices, press Enter.

Port 2:
  Line type  . . . . . .  . . .   *NONE       *NONE, *ETH10M, *ETH100M...
  Local adapter address  . . . .              020000000000-7FFFFFFFFFFF
  Maximum transmission unit  . .              Number
  AS/400 internet address  . . .
  AS/400 subnet mask . . . . . .
  Windows internet address . . .
  Windows subnet mask  . . . . .
  Windows gateway address  . . .
Configuration file . . . . . .   *NONE       Name, *NONE
  Library  . . . . . .  . . . .              Name, *LIBL, *CURLIB




                                                                   Bottom
```

Figure 17. INSWNTSVR screen (Part 5 of 5)

7. Press Enter after you complete the parameters on the display. The installation process starts (unless you made an error or omitted a mandatory parameter).

Job log

The INSWNTSVR command writes an extensive job log that contains information about any problems encountered during the installation. Make sure you save this job log after the installation is complete because it can be used to diagnose any problems that were encountered during the installation process. You are instructed when to do this.

3.4 Completing the installation from the Windows 2000 console

During the first three modes of the Windows 2000 installation, no user interaction is required. During mode 4, you are prompted for input on the Windows 2000 console as follows:

1. The Windows 2000 server console should display the Microsoft License Agreement. Click **I accept this agreement** to continue. Windows 2000 automatically detects and installs the Integrated xSeries Server devices.
2. If you did not enter a Windows 2000 server license key in the INSWNTSVR prompt, or you entered the key incorrectly, you are prompted for it now. You must enter a valid key.
3. You are prompted to enter a password for the Windows 2000 Administrator. Enter the password, write it down, and store it in a safe place, if you have not already done so.
4. The Date/Time Properties window is displayed.

   Set the time zone in which this server will operate, and either select or deselect the **Automatically adjust clock for daylight saving changes** box as required.
5. The Workgroup or Computer Domain window is displayed.

   If you entered information in the To workgroup or To domain parameters on the INSWNTSVR command, a window appears like the example in Figure 18, but the input fields are grayed out. The next window automatically appears after a few seconds, or you can click **Next**.

   If you did not enter anything in the To workgroup or To domain parameters on the INSWNTSVR command, you must specify whether the server will be part of a workgroup or domain by selecting the appropriate option as shown in Figure 18. Then, enter the name of the workgroup or domain in the box provided. Click **Next**.

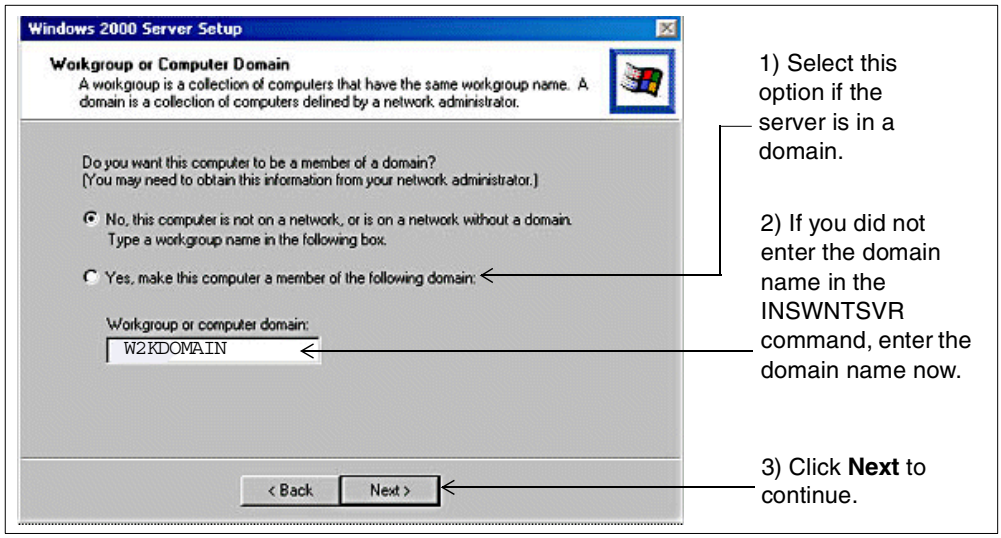

Figure 18. The Workgroup or Computer Domain window

6. If the server is part of a domain, the next window prompts you to enter the name and password of the user account, which authorizes this server to join

the existing specified domain. Enter the account name and password, and then click **Next** to continue.

7. The Install Components window appears. At this time, the Windows 2000 server installs the components that you specified earlier. After this process completes, the Performing Final Tasks window appears. Follow the instructions on the display, and click **Finish** when you are done.
8. On the Windows 2000 Setup window, click the **Restart Now** button, or wait for 15 seconds before the server automatically restarts itself. When the server restarts, the OS/400 session from which you ran the INSWNTSVR command unlocks. You should see a series of messages on the status line of the OS/400 session that indicate that the installation of the Windows Server has completed successfully.
9. After the Windows 2000 server has restarted, you are prompted to sign on as Administrator. After you have sign on, you are prompted with the Windows 2000 Configure Your Server display. You can use the wizard to customize the setup on your Windows 2000 server. However, we recommend that you complete the steps in this chapter first. In this case, select the option **I will configure this server later** to configure the server later. Click **Next**.
10. Close the Windows 2000 Configure Your Server window.

    If you correctly set up AS/400 NetServer and there is an integration service pack available, the OS/400 Level Check window should appear after a few seconds, as shown in Figure 19.

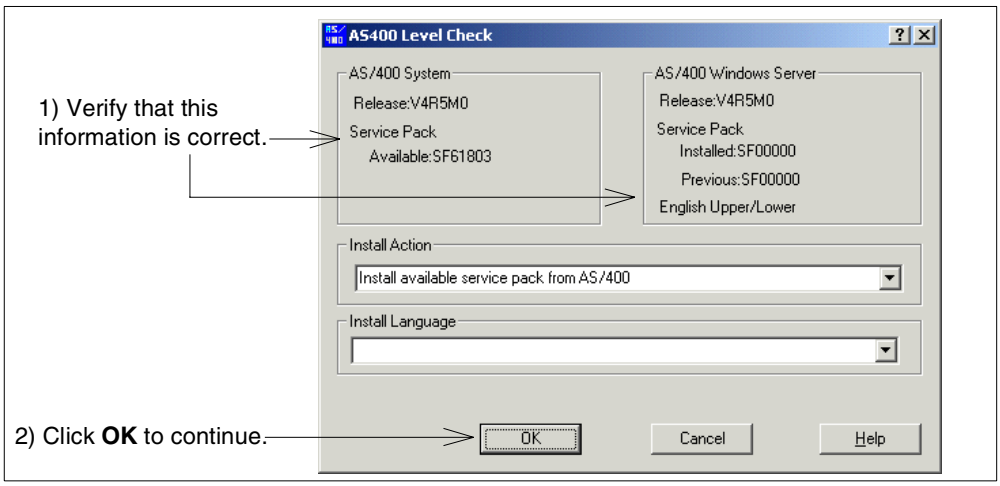

Figure 19. AS/400 Level Check window

If you installed the latest cumulative PTF package and any integration service pack PTFs available for your release of OS/400, you should be prompted to install a service pack on the Windows 2000 server. Take the opportunity to install any available service packs now.

If the OS/400 Level Check window does not appear automatically, NetServer may not be set up correctly. If it appears and the Service Pack Available is shown as SF0000, there may be no service pack PTFs installed on your iSeries server. In either case, you need to check your AS/400 NetServer setup and check that you installed the latest PTF levels on the iSeries server. You are instructed when to do this in the next section.

11. Now that the installation of the Windows 2000 server on the Integrated Netfinity Server is finished, print and read the installation job log. Check for any anomalies. We recommend that you keep the job log and installation worksheet for reference. To print the job log, follow these steps:

    a. Without pressing Enter, type `SIGNOFF` on the command line of the OS/400 session from which you ran the INSWNTSVR command.

    b. Press F4, and change the Job log parameter to `*LIST`. Press Enter.

    c. Sign on again with the same profile you used to run the INSWNTSVR command (normally QSECOFR), and type `WRKSPLF`. Press Enter.

    d. Page down to the bottom of the list and look for an entry of QPJOBLOG under the File column. The most recent entries are normally at the bottom of the list.

    e. Use option 5 to display the spooled file, and check the first entry in the file for the date and time stamps. These should correspond to the date and time at which you signed off the session.

    f. Scan the job log to confirm that the entries relate to the installation of the Windows 2000 server.

    g. Use option 2 to change the attributes of the spooled file so that it prints on an available printer. Store the printout for future reference.

The basic installation of your Windows 2000 server is complete. You may now want to upgrade your Windows 2000 server to a domain controller or perform other customization tasks. All such processes are performed through the Windows 2000 console and do not depend on the underlying hardware. Therefore, customization tasks are not described in this publication. Refer to the Windows 2000 online help, or consult the appropriate Microsoft documentation if you need assistance.

3.5 Completing the post-installation tasks

This section describes some additional tasks that you may need to perform to complete the setup. Notice that some of these tasks may not apply to your installation.

1. Reconnect the LAN adapter.

   If you physically disconnected one of your Integrated xSeries Server LAN adapters before the installation, reconnect it now. You will need to restart the server to make this line active.

2. Verify TCP/IP properties.

   To verify the TCP/IP properties, follow these steps:

   a. Click **Start->Settings->Network and Dial-up Connections**. The Network and Dial-up Connections window appears.

   b. Follow the instructions in Figure 20 to display the TCP/IP properties.

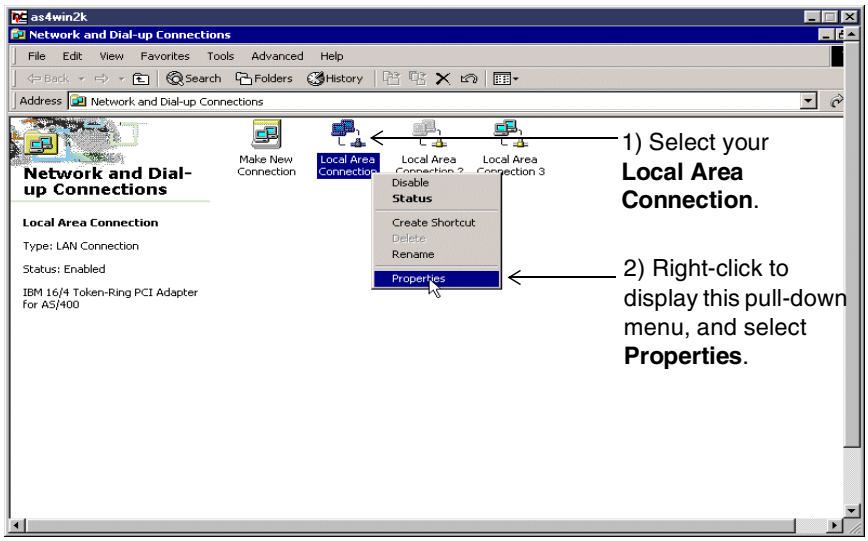

Figure 20. Network and Dial-up Connections window

c. The Local Area Connection Properties window appears. To display the TCP/IP Properties, follow the instructions in Figure 21.

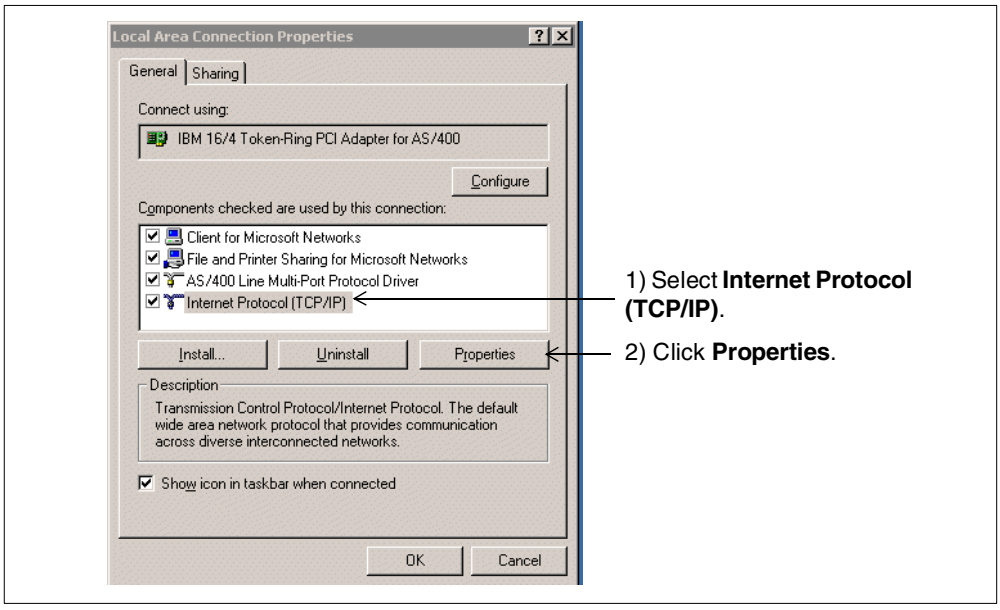

Figure 21. Local Area Connection Properties window

d. Confirm the TCP/IP Properties as shown in Figure 22 on page 50. If the parameters are correct, but the LAN connection is not functioning, refer to Chapter 9, “Integrated xSeries Server problem determination” on page 227.

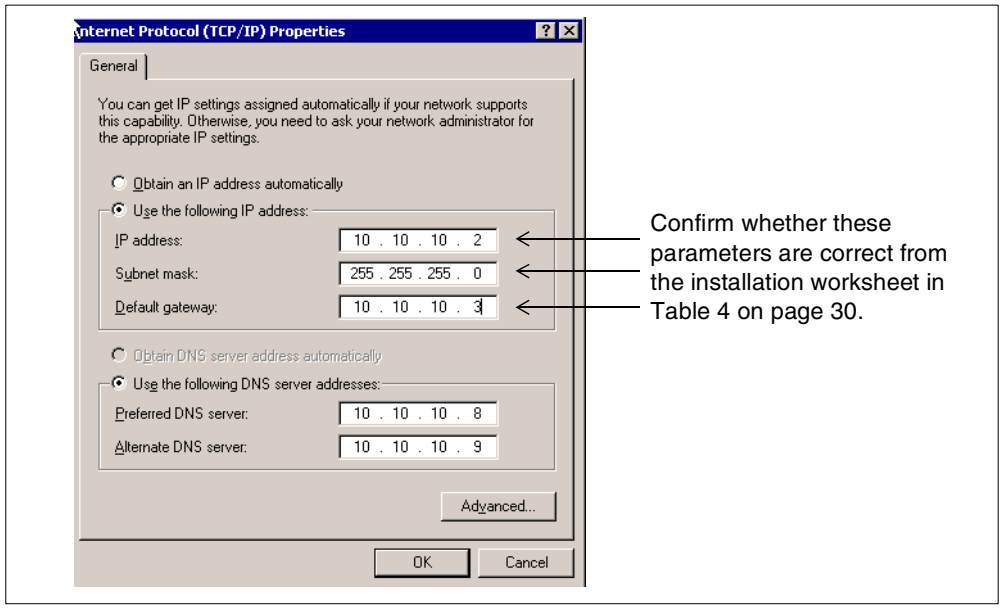

Figure 22. TCP/IP Properties window

3. Enable external host LAN support.

   If you want to set up external host LAN support, you need to configure Windows 2000 Local Area Connections. Notice that you can only set up external host LAN support if you entered values in the Port 1 and Port 2 parameters of the INSWNTSVR command, as shown in Figure 16 on page 45. Follow these steps:

   a. Click **Start->Settings->Network and Dial-up Connections**. The Network and Dial-up Connections window appears.

   b. Select the icon for the external LAN port you want to set up. Section 4.4.1, “Determining the resource ID of the LAN adapter” on page 65, tells you how to do this if you are not sure how to correlate the Local Area Connection icons with the physical LAN adapters.

      You may be able to determine which Local Area Connection to use by simply holding your mouse pointer over each Local Area Connection icon. After a few seconds, a box appears with a description of the LAN port, which the icon represents. Do *not* select the icon for the IBM AS/400 Internal LAN Adapter.

   c. Right-click the Local Area Connection icon you want to set up. Then, click **Properties**. The Local Area Connection Properties window appears. Make sure that the AS/400 Line Multi-Port Protocol Driver is installed, as shown in Figure 23.

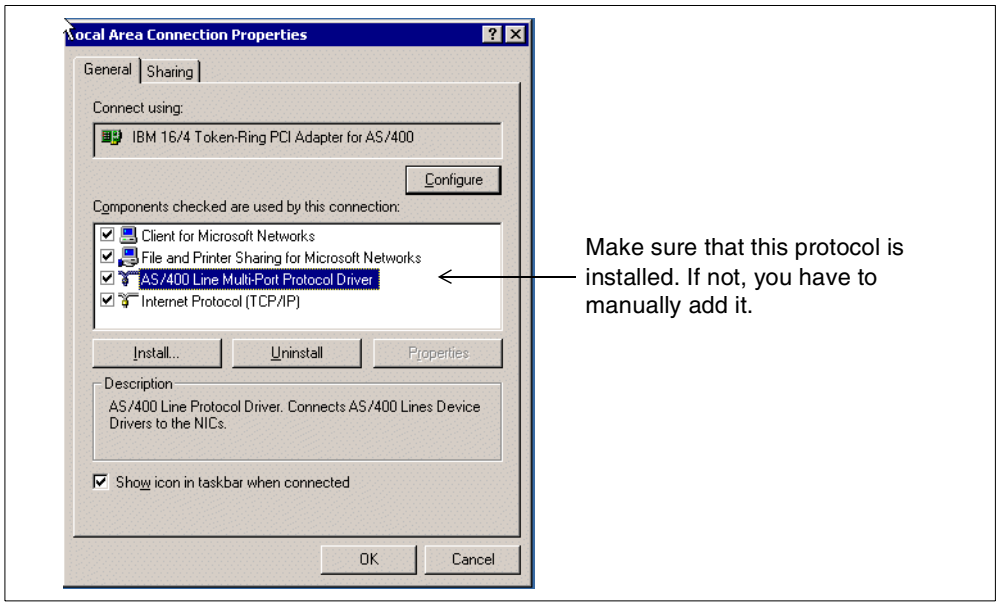

Figure 23. Local Area Connection Properties window

If this driver is not installed, install it by following these steps:

1. Click the **Install** button.
2. Click **Protocol** and then **Add**.
3. Click **IBM** and then **AS/400 Line Multi-Port Protocol Driver**. Click **OK**.

The driver should now be installed as shown in Figure 23. Click **Close**.

d. Enter the Work with Line Description (`WRKLIND`) command in an OS/400 interactive session, and display the description for the line corresponding to the Local Area Connection you are configuring. Record the value for the Local adapter address parameter.

e. Right-click the Local Area Connection icon you are setting up for the external host LAN. Click **Properties**.

f. Click the **Configure** button.

g. Enter the local adapter address (LAA) you recorded from the OS/400 line description, as shown in the steps in Figure 24 on page 52. The LAA as specified in the OS/400 line description and its corresponding value in Windows must match.

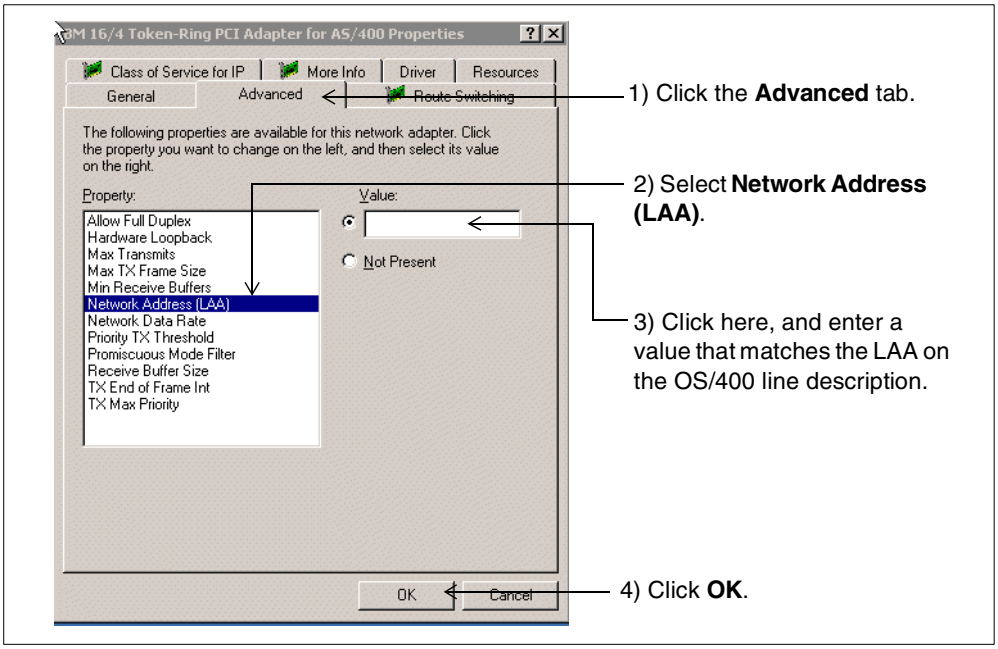

Figure 24. Entering the LAA for a Windows LAN adapter

h. To complete the setup for external host LAN, vary off the network server description, and then vary it back on. You should now be able to access the iSeries server through the Integrated xSeries Server LAN adapter.

4. Verify the console display settings.

   Verify the display settings for the console connected to the Integrated xSeries Server. We recommend that you change the screen resolution to something better than VGA (640 x 480).

5. Change the Windows 2000 CD-ROM drive letter.

   We recommend that you assign the CD-ROM to the X: drive to avoid the CD-ROM drive from changing drive letters every time a new storage space is linked to the server. Use Windows 2000 Disk Management to assign a new drive letter.

6. Change the retain server security (QRETSVRSEC) system value.

   If you want to propagate OS/400 user profile information across to Windows 2000, the iSeries value QRETSVRSEC must be set to `1` (retain data).

   a. On an OS/400 command line, type:

      ```
      WRKSYSVAL SYSVAL(QRETSVRSEC)
      ```

      Press Enter.

   b. Enter `2` in the Option column to change the system value. Change the system value to `1`, and press Enter.

7. Complete the Windows 2000 network configuration.

   If you have not already done so, go back and complete the Windows 2000 server network configuration by adding WINS server addresses, if applicable.

8. Vary on the Windows 2000 server at TCP/IP startup (this step only applies to Version 4 Release 4 and later levels of OS/400).

Notice that you can no longer change the Online at IPL parameter in the network server description at Version 4 Release 4 and later releases. However, you can configure TCP/IP on the iSeries server so that the network server description (and, therefore, the Windows 2000 server) is automatically varied on when you start TCP/IP.

To set up the network server description to automatically vary on when TCP/IP is started, perform these steps:

a. Type `CFGTCP` on an OS/400 command line, and press Enter.

b. Select option `1`, and press Enter.

c. Type `2` in the Option column next to the interface for the server's internal LAN line (ends in 00), and press Enter.

d. Type `*YES` for the Autostart parameter, and press Enter.

The network server description for the Windows 2000 server will now automatically vary on when you start TCP/IP.

Make sure that you only have one network server description defined for each Integrated xSeries Server with the internal LAN interface set to start automatically.

To start your Windows 2000 server automatically when the iSeries IPLs, we recommend that you start TCP/IP in your startup program. *Do not add* entries to the startup program to specifically vary on the network server description using the VRYCFG command. If you follow this recommendation, the possibility of the network server timing out while waiting for TCP/IP to start will be averted.

9. Change the command defaults.

   Before you work with the commands that control the Integrated xSeries Server, it is easier if you modify the system defaults for the commands that you are going to use. Table 5 shows a list of the commands and their suggested defaults.

Table 5. Command defaults

Command name	Command	Parameter	Original default	New default
Work with Network Server Enrollment	WRKNWSENR	SVRTYPE	*NWSUSRA	*WINDOWSNT
Work with Network Server Status	WRKNWSSTS	SVRTYPE	*NWSUSRA	*WINDOWSNT
Change Network Server User Attributes	CHGNWSUSRA	PMTCTL	*ALL	*WINDOWSNT
Submit Network Server Command	SBMNWSCMD	SVRTYPE	*NWSUSRA	*WINDOWSNT

   The command defaults are changed with the Change Command Default (CHGCMDDFT) command. For example, to change the default Prompt control parameter on the CHGNWSUSRA command from `*ALL` to `*WINDOWSNT`, you would enter:

```
CHGCMDDFT CMD(CHGNWSUSRA) NEWDFT('PMTCTL(*WINDOWSNT)')
```

10. Install the Windows 2000 Service Pack from Microsoft.

    Before you place a Windows 2000 server into regular operation, you *must* apply any required Windows 2000 Service Packs.

For the latest information on supported Windows 2000 Service Packs, visit the Web site: `http://www.as400.ibm.com/windowsintegration`

Select **Service Information** on the left side of the display and then **Service Packs** on the right side of the display.

11. Check for available integration service packs.

    Although the Level Check program should run automatically when you install Windows 2000 on the Integrated xSeries Server, you can run it manually to check the level of the currently installed service pack, or install a new one. To check for the availability of any service packs, click **Start->Programs->AS400 Windows Server->Level Check**. The AS400 Level Check window appears as shown in Figure 25. If a service pack is available, click **OK**. Then, the service pack will be downloaded from the iSeries server and installed on the Windows 2000 server. If the Service Pack Available is shown as blank or SF0000, then either AS/400 NetServer is not set up correctly or there are no service pack PTFs installed on your iSeries server. In this case, you need to check your AS/400 NetServer setup and that you installed the latest PTF levels on the iSeries server. Remember that you must set up at least a basic AS/400 NetServer configuration in order to run Level Check. Refer to 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358, for a description of how to do this.

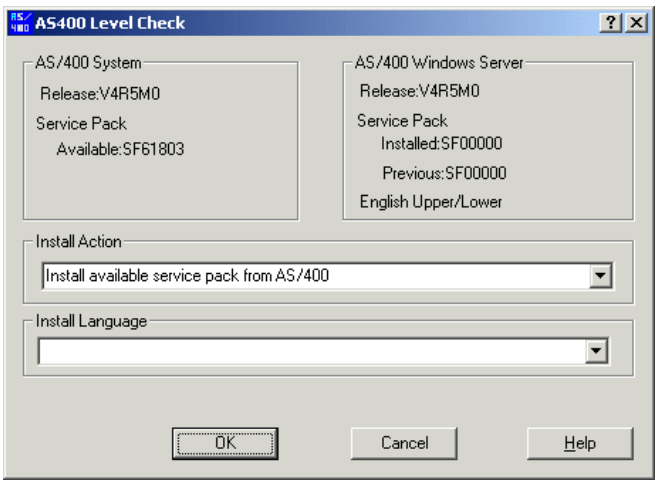

Figure 25. AS400 Level Check window

12. Reset the performance adjustment (QPRFADJ) system value.

    If you set the QPFRADJ system value to 2 or 3 before the installation, you may now want to set it back to its previous value. It is preferable to wait a day or so to ensure that the iSeries has had time to make adjustments to the size of the machine pool. Use the Work with System Values (WRKSYSVAL) command to reset it, if required.

13. Create APPC controllers automatically (optional).

    If you are using the external host LAN, the OS/400 line descriptions created by the INSWNTSVR command (ending with 01 and 02) have the AUTOCRTCTL parameter set to *NO, by default. If you are using SNA Communications, and you want your iSeries server to automatically create APPC controllers and devices for you, set this parameter to `*YES`. In this case, you may also decide to increase the default number of controllers (MAXCTL) to something higher

than 40. One reason to do this is if you are going to run OS/400 Client Access using SNA over these lines.

14. Install a switch box (optional).

    If you plan to run several Windows 2000 consoles on multiple Integrated xSeries Servers, and need to see only one server console at a time, you can use a switchable monitor, keyboard, and mouse. Connecting such a switch box to the Integrated xSeries Server enables one physical console to control multiple Windows 2000 servers.

15. Back up Windows 2000 system drives.

    We recommend that you back up the Windows server C: and D: drives at this time. This makes recovery easier if the Windows 2000 server becomes corrupted because you can simply restore a working copy of the failed drive. See Chapter 7, “Backup and restore” on page 151, for information about backing up your server.

You have now completed the installation of Windows 2000 on the Integrated xSeries Server. You should now read through the following chapters to learn how to customize your Windows 2000 server and perform day-to-day operational tasks:

- Chapter 4, “General administration” on page 57
- Chapter 5, “Disk storage administration” on page 87
- Chapter 6, “User administration” on page 121
- Chapter 7, “Backup and restore” on page 151
- Chapter 8, “Updating the integration software” on page 219

Chapter 4. General administration

This chapter describes operational tasks related to the Integrated xSeries Server that are of a general nature and are not covered in any of the other chapters.

There are two user interfaces from which general administration can be performed:

- Text-based (also called green-screen) interface

  Administration for Windows NT and 2000 running on the Integrated xSeries Server is primarily conducted through the text-based interface. Therefore, most of this chapter is devoted to describing the commands that you can use to perform general administration through this interface.

- Operations Navigator graphical interface

  Beginning with Version 4 Release 5, you can perform some general administration tasks using Client Access Express V4R5 Operations Navigator. This interface is described in 4.10, “Operations Navigator interface” on page 78.

4.1 Basic OS/400 administration commands

To manage the OS/400 objects you created, use these OS/400 commands:

- To check the status of the Windows 2000 server and objects that are associated with the network server description (NWSD), use the Work with Configuration Status command, as shown in the following example:

  ```
  WRKCFGSTS CFGTYPE(*NWS)
  ```

- To manage your Windows 2000 server environment, use the Work with Network Server Description command, as shown in the following example:

  ```
  WRKNWSD NWSD(network-server-name)
  ```

- To manage line descriptions that are created when you install the Windows 2000 server, use the Work with Line Description (WRKLIND) command, as shown in the following example:

  ```
  WRKLIND LIND(network-server-name)
  ```

- To manage TCP/IP interfaces that are created during server installation, you can use either of these commands:
  - Work with TCP/IP Network Status, option 1:

    ```
    NETSTAT
    ```

  - Configure TCP/IP, option 1

    ```
    CFGTCP
    ```

- To monitor system utilization, use these commands:
  - Work with Disk Status:

    ```
    WRKDSKSTS
    ```

  - Work with Network Server Status, option 5:

    ```
    WRKNWSSTS SVRTYPE(*WINDOWSNT)
    ```

– Work with System Status:

```
WRKSYSSTS
```

- To manage Network Server Storage (NWSSTG) spaces, use the Work with NWSSTG Spaces (`WRKNWSSTG`) command.
- To monitor jobs running in OS/400 on the iSeries server, use the Work with Active Jobs (`WRKACTJOB`) command.
- To monitor CPU usage of jobs running in OS/400 on the iSeries server, use the Work with System Activity (`WRKSYSACT`) command (requires Performance Tools, 5769-PT1).

4.2 Starting and stopping Windows 2000 on the Integrated xSeries Server

You can stop and restart the Windows 2000 server on the Integrated xSeries Server from either OS/400 or the Windows 2000 server.

It is important to remember that when you shut down the Windows 2000 server, you terminate communications through the Integrated xSeries Server to the iSeries server when using the external host LAN function. This is why we recommend that you install an additional LAN adapter, outside the control of the Integrated xSeries Server, for communication with native OS/400 applications. Then LAN communication with the iSeries server is not disrupted when the Windows 2000 server is shut down or restarted. Notice that the external host LAN is not supported on the new 270 and 8xx servers.

Starting up and shutting down the Windows 2000 server is described in the following sections.

4.2.1 Starting the Windows 2000 server

When you start an integrated Windows 2000 server, the iSeries performs a hardware reset on the processor card of the Integrated xSeries Server. You see the big blue IBM logo on the Windows 2000 server console attached to the Integrated xSeries Server, the same as you do on any IBM PC that was purchased recently. However, be aware that the BIOS has been modified. You cannot press F1 to enter the Setup facility or Esc to speed up Power On Self Test (POST).

The BIOS boot logic passes control to the boot sector on drive C:, which starts the operating system (OS) loader. You see the typical Windows 2000 menu, where you can select to boot the Windows 2000 server or PC-DOS. The latter is the DOS mini-boot image that is used during the installation of Windows 2000 on the Integrated xSeries Server.

PC-DOS boot option

If you have chosen to format the Windows 2000 system drive (C:) as NTFS, as is the case with any system drive that is created larger than 2047 MB in size, *do not* select the option from the menu to boot PC-DOS. This option is only valid when the Windows 2000 system drive has been left formatted as FAT.

Once you select Windows 2000 server from the menu, or the time-out period expires, the server starts and the logon panel is displayed.

When you start an integrated Windows 2000 server, TCP/IP starts if it is not already started, and all associated TCP/IP interfaces are activated on the iSeries server. You can also automatically start a Windows 2000 server when TCP/IP is started by using the Configure TCP/IP (CFGTCP) command to change the Autostart parameter on the internal LAN line interface. Refer to 3.5, “Completing the post-installation tasks” on page 48, for a description of how to do this.

If you have created any NWSSTG spaces in user auxiliary storage pools, the iSeries server automatically mounts the file systems. In this case, a message is sent to the QSYSOPR message queue.

You should not shut down the Windows 2000 server immediately after you start it. Wait several minutes to allow the Windows 2000 server to start completely. This also allows the service control manager to alert you to any device or service failures. If you have problems starting the Windows 2000 server, refer to 9.3, “Problems starting the network server” on page 236.

To restart Windows 2000 server from an OS/400 interactive session, vary off the network server description associated with it and then vary on again.

If you shut down a server from the Windows 2000 console, you can restart the server only from an OS/400 interactive session.

To vary on the server, perform these steps:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *NWS
   ```

   Press Enter.

2. Type `1` in the Opt column next to the network server description that you want to vary on, and press Enter.

The Windows 2000 server starts. If you have any network server storage (NWSSTG) spaces in user auxiliary storage pools, the iSeries server automatically mounts that file system (and logs a message to the QSYSOPR message queue).

You should not vary off the network server immediately after varying it on. Wait several minutes to allow the Windows 2000 server to start completely. This also allows the Windows service control manager to alert you to any device or service failures. If you have problems varying on a Windows 2000 server, refer to 9.3, “Problems starting the network server” on page 236.

4.2.2 Starting the Windows 2000 server without starting external host LAN

You can start the Windows 2000 server without starting the external host LAN connections on the iSeries server. You might find this useful if you are trying to perform OS/400 or Windows 2000 maintenance tasks, such as applying PTFs.

To start the Windows 2000 server without starting the OS/400 external host LAN connections, follow these steps:

1. Type `VRYCFG` on an OS/400 command line, and press F4.
2. Type the name of the server that you want to start in the Configuration object parameter.

3. Type *NWS in the Type parameter.
4. Type *ON in the Status parameter, and press F9 for additional parameters.
5. Type *NO in the Start TCP/IP interfaces parameter, and press Enter.

The network server you specified starts, without starting the external host LAN connections.

4.2.3 Starting multiple integrated servers

If multiple Integrated xSeries Servers are installed in your iSeries server, starting them all interactively can take a long time because of locking considerations during the vary on process. A way around this is to submit the commands to start the servers to batch using a CL program. An example is shown in Figure 26.

```
/*********************************************************************/
/*                                                                   */
/* PROGRAM TO VARY OFF MULTIPLE Integrated xSeries */
/*                                                                   */
/*********************************************************************/
     PGM
     MONMSG     MSGID(CPF0000)
     HLDJOBQ    JOBQ(QGPL/QBATCH)
     CHGJOBQE   SBSD(QSYS/QBATCH) JOBQ(QGPL/QBATCH) MAXACT(16)
     SBMJOB     CMD(VRYCFG CFGOBJ(INS01) CFGTYPE(*NWS) +
                  STATUS(*OFF)) JOBQ(QGPL/QBATCH)
     SBMJOB     CMD(VRYCFG CFGOBJ(INS02) CFGTYPE(*NWS) +
                  STATUS(*OFF)) JOBQ(QGPL/QBATCH)
     SBMJOB     CMD(VRYCFG CFGOBJ(INS03) CFGTYPE(*NWS) +
                  STATUS(*OFF)) JOBQ(QGPL/QBATCH)
/* ADD MORE ENTRIES FOR MULTIPLE Integrated xSeries */
     RLSJOBQ    JOBQ(QGPL/QBATCH)
     ENDPGM
```

Figure 26. CL program to vary on multiple Integrated xSeries Servers

4.2.4 Shutting down the Windows 2000 server from an OS/400 session

You can shut down the Windows 2000 server by varying off the network server description for the server from an OS/400 interactive session. If you shut down the server this way, you need to restart the server by varying on the network server description. You cannot restart the server from the Windows 2000 console.

If you shut down the Windows 2000 server from the Windows console, you must complete the shut down process from an OS/400 interactive session. Again, you cannot restart the server from the Windows 2000 console.

When you run the Windows 2000 server on an Integrated xSeries Server in your iSeries, always shut down the Windows 2000 server from either the Windows console or an OS/400 interactive session before you power down the iSeries server. If you do not, you risk losing the Windows 2000 server data. Using the PWRDWNSYS *IMMED command does not vary off network server descriptions. The PWRDWNSYS *CNTRLD command initiates a vary off, but there is no guarantee that it will complete before the system shuts down. Corruption of the server or NWSSTG spaces is possible if the iSeries server powers down before the Windows 2000 server shuts down completely.

Notice that if you vary off a network server that has a TCP/IP interface defined on at least one of the Integrated xSeries Server physical LAN ports (that is, you are using the external host LAN), you are forced to reply to the inquiry message: `CPA2614 Network server (network-server-name) cannot be varied off at this time. (C G)`, on the QSYSOPR message queue. You must respond whether you want the vary off to continue (G) or to be canceled (C). To avoid responding to this message, use one of the following methods:

- You can end the *external* OS/400 TCP/IP interfaces using the End TCP/IP Interface (`ENDTCPIFC`) command before you vary off the network server description (you do not need to end the interface for the internal LAN).
- Set up a reply list entry to automatically issue a reply to the CPA2614 inquiry message.
- Specify `FRCVRYOFF(*YES)` on the Vary Configuration (VRYCFG) command to avoid this inquiry message.

Keep in mind that you need to use one of these options to vary the network server off cleanly if you want to perform an unattended backup of user storage spaces from a CL program.

To vary off Windows 2000 server, follow these steps:

1. Ensure that the server has no active TCP/IP interfaces:
   a. Type `NETSTAT` on an OS/400 command line, and press Enter.
   b. Type `1` to work with TCP/IP interface status.
   c. Type `10` in the Opt column to change the status of any external host LAN TCP/IP interfaces to inactive.
2. On an OS/400 command line, type:

   ```
   WRKCFGSTS *NWS
   ```

3. Type `2` in the Opt column next to the network server description you want to vary off, and press F4. To avoid any inquiry messages caused by active external host LAN TCP/IP interfaces, specify:

   ```
   FRCVRYOFF(*YES)
   ```

   This is an alternative to step 1.
4. Press Enter.

The Windows 2000 server shuts down.

4.2.5 Shutting down Windows 2000 from Windows 2000 console

You can shut down the Windows 2000 server from the Windows 2000 server console the same as you would on a PC-based server. If you shut down from the Windows 2000 console, you must complete the shutdown process from an OS/400 interactive session before you can restart the server.

Shutting down from the Windows 2000 console shuts down the server, but does not completely vary off the network server description. At the time when the Windows 2000 server displays the “It is now safe to turn off your computer” message, the Work with Configuration Status (`WRKCFGSTS *NWS`) display shows the network server description in status SHUTDOWN, and all the other configuration objects are in status FAILED. This is normal. Then, if you want to restart the Windows 2000 server after shutting down from the Windows 2000 console, you

must first vary off the network server description as described in 4.2.4, “Shutting down the Windows 2000 server from an OS/400 session” on page 60.

To shut down the Windows 2000 server from the server console, perform these steps:

1. Select **Shut Down...** from the Windows 2000 Start menu.
2. Select **Shut down** from the drop-down menu.

   When you install new software on the Windows 2000 server or perform other Windows 2000 server-side maintenance, you may need to shut down, and then immediately restart the Windows 2000 server. In these cases, select **Restart** instead of Shut down.
3. You may also see a Shut down confirmation window with the message:

   ```
   Shutting down will stop the external host LAN, and will also end
   OS/400communications. Continue?.
   ```

   If you are using the Integrated xSeries Server LAN ports to connect through to the iSeries server and do not want to lose the connection, select **No** to stop the shutdown. Select **Cancel** if you do not want this confirmation message to be displayed again. Otherwise, click **Yes**.

4.2.6 Shutting down multiple integrated servers

If you have multiple Integrated xSeries Servers installed in your iSeries, stopping them all interactively can take a long time because of locking considerations during the vary off process. A way around this is to submit the commands to stop the servers to batch using a CL program. An example is shown in Figure 27.

```
/*********************************************************************/
/*                                                                   */
/* PROGRAM TO VARY OFF MULTIPLE Integrated xSeries */
/*                                                                   */
/*********************************************************************/
     PGM
     MONMSG     MSGID(CPF0000)
     HLDJOBQ    JOBQ(QGPL/QBATCH)
     CHGJOBQE   SBSD(QSYS/QBATCH) JOBQ(QGPL/QBATCH) MAXACT(16)
     SBMJOB     CMD(VRYCFG CFGOBJ(INS01) CFGTYPE(*NWS) +
                  STATUS(*OFF)) JOBQ(QGPL/QBATCH)
     SBMJOB     CMD(VRYCFG CFGOBJ(INS02) CFGTYPE(*NWS) +
                  STATUS(*OFF)) JOBQ(QGPL/QBATCH)
     SBMJOB     CMD(VRYCFG CFGOBJ(INS03) CFGTYPE(*NWS) +
                  STATUS(*OFF)) JOBQ(QGPL/QBATCH)
/* ADD MORE ENTRIES FOR MULTIPLE Integrated xSeries */
     RLSJOBQ    JOBQ(QGPL/QBATCH)
     ENDPGM
```

Figure 27. CL program to vary off multiple Integrated xSeries Servers

4.3 Adding a LAN adapter to the Integrated xSeries Server

You can install a new LAN adapter card in a spare PCI slot that is under the control of the Integrated xSeries Server. You can also reinstall the virtual token-ring LAN adapter (internal LAN) should this be required for any reason.

With an SPD Integrated Netfinity Server, it is obvious into which slots you can install LAN cards. With PCI models of the iSeries, it is not so obvious which slots are under the control of the Integrated xSeries Server. To determine which slots are available for LAN cards in a PCI model of the iSeries, consult a publication such as the *iSeries and AS/400e System Builder*, SG24-2155.

If you install a new LAN adapter under the control of the Integrated xSeries Server, you must configure the new adapter on the Windows 2000 server.

To set up a new LAN adapter under the control of an Integrated xSeries Server, perform these tasks:

1. Install the new LAN adapter according to the instructions that are included with the hardware.
2. Set up the LAN adapter under Windows 2000.

   Refer to the following section.
3. Update the network server description.

   Refer to 4.3.2, “Updating the network server description” on page 64.

If you want to share the new adapter between the iSeries and Windows 2000 servers, you must perform some additional tasks. These are described in 4.4, “Setting up the external host LAN” on page 65.

External host LAN support

The new iSeries 270 and 8xx models *do not* support the external host LAN function. This restriction extends to the Pentium II 333 MHz Integrated xSeries Server when it is installed in a 50xx Migration Tower.

The external host LAN capability is generally not recommended, even where it is supported.

To remove a network adapter, see 4.5, “Removing LAN adapters from the Integrated xSeries Server” on page 69.

4.3.1 Setting up a LAN adapter under Windows 2000

To set up a LAN adapter and add adapter TCP/IP address information under Windows 2000, follow these steps:

1. Click **Start->Settings->Network and Dial-up Connections**.
2. OS/400 LAN adapters are Plug and Play, so the new LAN adapter should be automatically configured under Windows 2000. To check, simply hold the mouse pointer over each of the Local Area Connection icons, and a description of the adapter appears. Assuming that the new LAN adapter is connected to the network, the adapter should be fully operational. There should not be an “x” on the icon to indicate a broken connection.
3. Right-click the icon for the new LAN adapter, and select **Properties**. You should see a window similar to the example in Figure 28 on page 64.

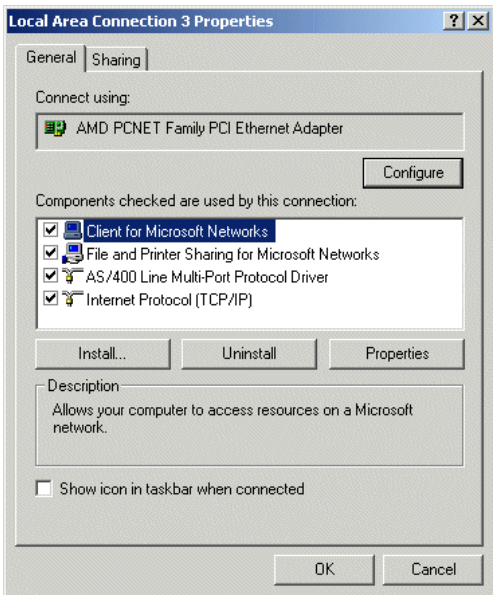

Figure 28. LAN adapter properties

4. Select **Internet Protocol (TCP/IP)**, and then click the **Properties** button.
5. Enter IP address and DNS server address information as required.
6. If you need to enter other information, such as an IP address for the Default gateway, or set up WINS, click the **Advanced** button.

You have now completed the LAN adapter setup. Proceed to the next section.

4.3.2 Updating the network server description

You now need to add the Windows 2000 server side networking information to the network server description (NWSD) on the iSeries server.

To add the information, follow these steps:

1. On an OS/400 command line, type:

   `CHGNWSD`

   Press F4.
2. Type the name of your network server description in the Network server description parameter, and press Enter.
3. Page down to the TCP/IP port configuration information.
4. If the port you are trying to update is not shown, type a `+` (plus sign) in the field to the right of the words “+ for more values”, and press Enter.
5. Type the port number of the new adapter in the Port field. For the virtual token-ring adapter (internal LAN), this is `*INTERNAL`.

   To determine the port number of a new LAN adapter, simply count which slot the adapter is installed in relative to the Integrated xSeries Server card. For example, if the new LAN adapter is installed in the slot closest to the Integrated xSeries Server card, this is port 1. If it is installed in the next slot further away, then this is port 2; the next slot is port 3 (if available). Notice that the Integrated xSeries Server card itself takes up two slots, so don’t count the

slot directly adjacent to the slot where the VGA, keyboard and mouse, and USB cables connect.

6. Type the IP address that Windows 2000 uses for the new adapter in the Internet address parameter. For the virtual token-ring adapter (internal LAN), this value is `192.168.x.y+1`, where *192.168.x.y* is the value for the OS/400 end of the internal LAN. You can determine this by entering the NETSTAT command and selecting option 1. The internal LAN line, on which the interface is created, takes the name of the network server description and ends in 00.
7. Type the subnet mask that Windows 2000 uses for the new adapter in the Subnet mask parameter. For the virtual token-ring adapter (internal LAN), this value is always `255.255.255.0`.
8. Enter a value for the Maximum transmission unit (MTU) parameter, and press Enter. The default value is 1500, but for the token-ring, you can specify a larger size, which should increase the efficiency of sending and receiving data. However, problems can arise if your network has bridges or routers that cannot accommodate larger sizes.

4.4 Setting up the external host LAN

External host LAN support

The new iSeries 270 and 8xx models *do not* support the external host LAN function. This restriction extends to the Pentium II 333 MHz Integrated xSeries Server when it is installed in a 50xx Migration Tower or SPD attached expansion unit.

If you want to set up the external host LAN function, and your hardware supports it, follow these steps:

1. Determine the resource ID of the LAN adapter.

   Refer to 4.4.1, “Determining the resource ID of the LAN adapter”.
2. Create an OS/400 line description for the shared LAN adapter.

   Refer to the following section.
3. Add a TCP/IP interface for the shared LAN adapter.

   Refer to 4.4.3, “Adding a TCP/IP interface for a shared LAN adapter” on page 67.
4. Configure Windows 2000 for the shared LAN adapter.

   Refer to 4.4.4, “Configuring Windows 2000 for a shared LAN adapter” on page 68.

4.4.1 Determining the resource ID of the LAN adapter

If you have two or even three Windows 2000 Local Area Connection icons in addition to the internal LAN icon, it may not be obvious which Local Area Connection corresponds to the physical LAN adapter you want to enable for external host LAN. In fact, you may not be sure which physical LAN adapters are under the control of the Integrated xSeries Server on which your Windows 2000 server is running.

To identify the Local Area Connection icon and the corresponding physical LAN adapter you want to enable for external host LAN, follow these steps:

1. On an OS/400 command line, type:

   ```
   WRKHDWRSC *CMN
   ```

   Press Enter. The Work with Communication Resources display appears.

2. Look for an entry titled File Server IOA in the list. Type 7 next to the File Server IOA entry, and note the corresponding *Card position* (C04 for example). If you have more than one Integrated xSeries Server in your iSeries, repeat this procedure for each File Server IOA.

3. Compare the File Server IOA card position with the labels on the iSeries server frame to determine which physical Integrated xSeries Server corresponds to the Windows 2000 server you are viewing on your PC console.

4. Go back to the OS/400 display, and locate the correct File Server IOA entry. Notice that there may be up to three LAN adapter entries for each File Server IOA. Note the Resource ID for the new LAN adapter, and go to the following section.

   If you cannot determine which LAN adapter entry corresponds to the LAN adapter you installed, proceed with the following steps. For example, if there are multiple identical LAN adapter entries for the one File Server IOA, it may be difficult to determine which LAN adapter corresponds to which entry on the Work with Communication Resources display.

5. On the OS/400 Work with Communication Resources display, type 7 next to each LAN adapter entry for the File Server IOA that you identified in the previous steps. Note the *Card position* and corresponding *Resource* for each one.

6. Locate the card positions in the iSeries server frame that correspond to the LAN adapters identified in the previous step. Identify the correct resource ID for the new LAN adapter you installed.

7. If you are setting up external host LAN support on an existing LAN adapter, you may want to identify which physical LAN adapter corresponds to the Windows 2000 Local Area Connection you want to enable for the external host LAN. The easiest way to do this is to unplug the cable from one of the LAN adapters you identified in the previous step (make sure no one is using this adapter to access the Windows 2000 server).

   Go to the Windows 2000 console, where you will see an “x” on the corresponding Local Area Connection icon that indicates that the LAN connection has been broken. Reconnect the cable and repeat the procedure until you determine which physical LAN adapter corresponds to the Windows 2000 Local Area Connection you wish to enable for the external host LAN.

4.4.2 Creating a line description for a shared LAN adapter

Creating a line description is the next step in configuring a LAN adapter for sharing between the iSeries and the Windows 2000 server on an Integrated xSeries Server.

To create a line description, follow these steps:

1. Type one of the following commands on an OS/400 command line:

- For token-ring ports only, type `CRTLINTRN` and press F4. Then, press F9.
- For Ethernet ports only, type `CRTLINETH` and press F4. Then, press F9.
- For the virtual token-ring port (internal LAN), type `CRTLINTRN` and press F4. Then, press F9.

2. Type the name of your network server description in the Line description parameter, followed by a 0 (zero), and then the port number.

   For example, for an adapter in port 1 that you want to share between the iSeries and a network server description called AS400WIN, name the line description AS400WIN01. For the virtual token-ring adapter, the line description is always the network server description followed by 00.
3. Type `*NWSD` in the Resource name parameter.
4. Type the name of the network server description that uses the adapter in the Network server description parameter.
5. Type the Integrated xSeries port number where you inserted the card in the Port number parameter. For the virtual token-ring adapter, this value is `*INTERNAL`.
6. Type a unique 12-digit hexadecimal address for the adapter (*ADPT is not valid) in the Local adapter address parameter. Press F1 for valid address ranges. For the virtual token-ring adapter, this value is `400000000000`.

   Write down this address because you will need it in a later step.
7. Type the appropriate speed setting for this adapter in the Line speed parameter. For the virtual token-ring adapter, this value is `16M`.
8. Optionally for token-ring lines, page down to the Link speed parameter. Type the same value that you entered for the Line speed.
9. Optionally, page down to the Text 'description' parameter. Type a brief description for the line.
10. Press Enter to create the line description.

Next you need to add a TCP/IP interface for the new adapter.

4.4.3 Adding a TCP/IP interface for a shared LAN adapter

To communicate with the iSeries server through the Integrated xSeries Server using the TCP/IP protocol, you must add a TCP/IP interface for the line you created in the previous section.

To add a TCP/IP interface, follow these steps:

1. On an OS/400 command line, type:

   `ADDTCPIFC`

   Press F4.
2. Type the OS/400 IP address for this port in the Internet address parameter.

   For the virtual token-ring adapter, the IP address is of the form 192.168.x.y, where *x* and *y* can be any value in the range 1 to 254.
3. Type the name of the line description in the Line description parameter that you created in the previous section.

4. Type the OS/400 subnet mask for this port in the Subnet mask parameter, and press Enter.

4.4.4 Configuring Windows 2000 for a shared LAN adapter

To configure Windows 2000 for external host LAN support, follow these steps:

1. Click **Start->Settings->Network and Dial-up Connections**. The Network and Dial-up Connections window appears.
2. Select the icon for the external LAN port you want to set up. Section 4.4.1, “Determining the resource ID of the LAN adapter” on page 65, tells you how to do this if you are not sure how to correlate the Local Area Connection icons with the physical LAN adapters.

   You may also be able to determine which one it is by holding your mouse pointer over each Local Area Connection icon. After a few seconds, a box appears with a description of the LAN port that the icon represents. Do *not* select the icon for the IBM AS/400 Internal LAN Adapter.
3. Right-click the Local Area Connection icon you want to set up, and then click **Properties**. The Local Area Connection Properties window appears. Make sure that the AS/400 Line Multi-Port Protocol Driver is installed, as shown in Figure 29.

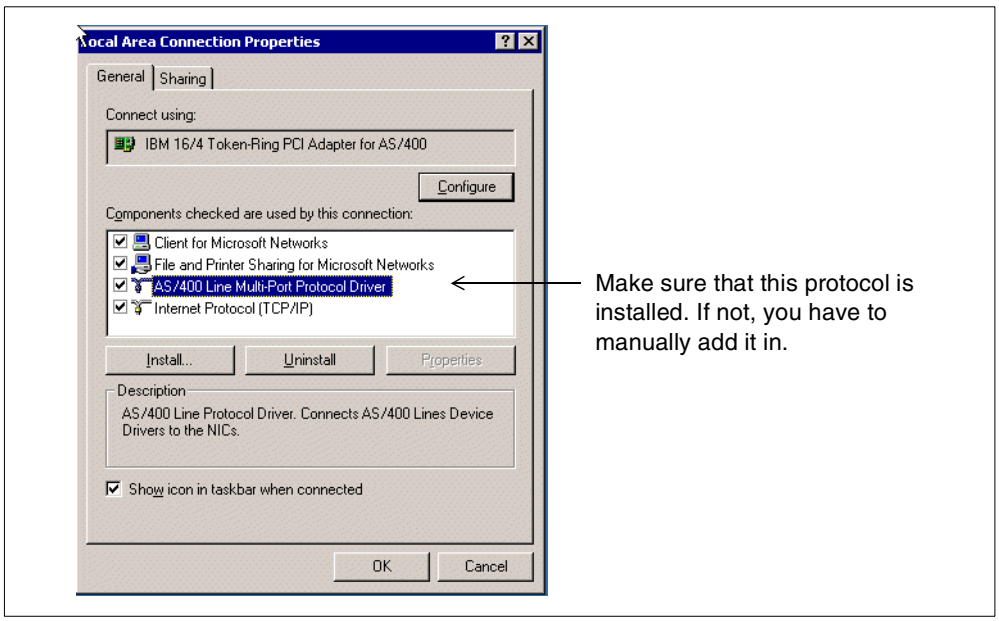

Figure 29. Local Area Connection Properties window

If this driver is not installed, install it by following these steps:

a. Click the **Install** button.
b. Click **Protocol** and then **Add**.
c. Click **IBM** and then **OS/400Line Multi-Port Protocol Driver**. Click **OK**.

The driver should now be installed as shown in Figure 29. Click **Close**.

4. Enter the Work with Line Description (`WRKLIND`) command in an OS/400 interactive session, and display the description for the line you created in 4.4.2, “Creating a line description for a shared LAN adapter” on page 66. Record the value you entered for the Local adapter address parameter.

5. Right-click the Local Area Connection icon you are setting up for external host LAN. Click **Properties**.
6. Click the **Configure** button.
7. Enter the Local Adapter Address (LAA) you recorded from the OS/400 line description, as shown in the steps in Figure 30. The LAA as specified in the OS/400 line description, and its corresponding value in Windows must match.

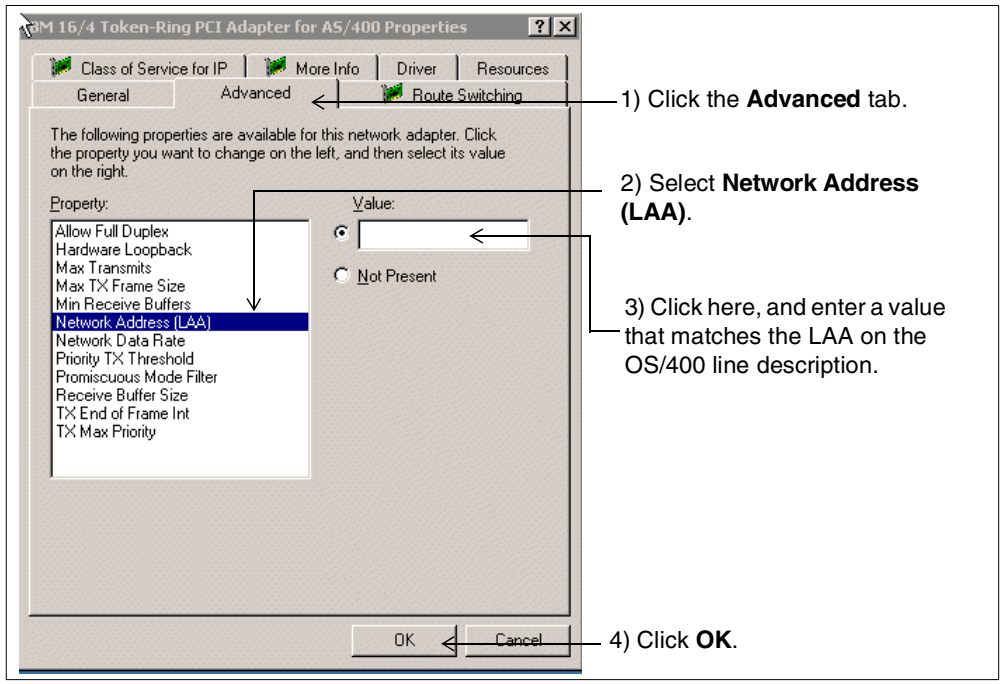

Figure 30. Entering the LAA for a Windows LAN adapter

8. To complete the setup for external host LAN, vary off the network server description and then vary it back on. You should now be able to access the OS/400 through the Integrated xSeries LAN adapter.

4.5 Removing LAN adapters from the Integrated xSeries Server

Before you remove a LAN adapter card from an Integrated xSeries Server, you need to uninstall it from Windows 2000. If the Windows 2000 server shares the network adapter card with the iSeries, you also need to uninstall it from the iSeries server.

To uninstall network adapters from the Windows 2000 server on an Integrated xSeries Server, perform the following tasks:

1. Type `WRKCFGSTS *NWS`. Press Enter to access the necessary information and vary off the network server description for the Windows 2000 server. The Work with Configuration Status display appears.

   If the external host LAN is *not* set up on the adapter that you want to remove, proceed to step 20. Otherwise, continue with the following steps.
2. Write down the name of the line description that corresponds to the LAN adapter (port) that you want to remove. Line descriptions are indented one level in from the network server description. The name begins with the

network server name followed by 01 or 02, depending on the port to which you attached it. The line description ending in 00 is the line description for the internal LAN. You do not want to change this line description.

3. Write down the name of the TCP/IP controller description, which appears directly under the line description for the LAN adapter (port) you are removing. The controller description name begins with the first five letters of the network server description, in addition to the letters NET.
4. Write down the name of the device description, which begins with the first five letters of the network server name, in addition to the letters TCP.
5. Type `2` in the Opt column to the left of the network server description you want to vary off. Press Enter to shut down the Windows 2000 server.
6. If you configured a special route for the adapter, remove the route by using the Remove TCP/IP Route (`RMVTCPRTE`) command.
7. Type `NETSTAT`, and select option `1`.
8. Write down the name of the Internet address of the line that corresponds to the LAN adapter you are removing. Press F3 to return.
9. Type `RMVTCPIFC` and press Enter.
10. In the Internet address field, specify the OS/400IP address of the LAN adapter you wrote down in step 9, and press Enter.
11. Type `WRKDEVD DEVD(*CMN)`, and press Enter.
12. Page down until you see the name of the device description that you wrote down for the line of the adapter you are removing.
13. Type `4` in the Opt column to the left of the device description, and press Enter.
14. Type `WRKCTLD CTLD(*CMN)`, and press Enter.
15. Page down until you see the controller description that you noted for the line of the adapter you are removing.
16. Type `4` in the Opt column to the left of the controller description, and press Enter.
17. Type `WRKLIND` and press Enter.
18. Page down until you see the line description that you wrote down for the adapter you are removing.
19. Type `4` in the Opt column to the left of the line description, and press Enter.
20. Use the `WRKCFGSTS` command to vary off the network server description, if it is not already varied off.
21. Power down the iSeries server.
22. Follow the instructions in your hardware documentation to physically remove the LAN adapter card from the iSeries server.
23. Vary on the Windows 2000 server.

4.6 Uninstalling Windows 2000 from an Integrated xSeries Server

The following tasks describe how to uninstall the Windows 2000 server from an Integrated xSeries Server:

1. Shut down the Windows 2000 server from an OS/400 interactive session.

   Refer to 4.2.4, “Shutting down the Windows 2000 server from an OS/400 session” on page 60.

2. Unlink NWSSTG spaces that are associated with the server.

   Refer to 5.3.3, “Unlinking a network server storage space” on page 98.

3. Delete NWSSTG spaces that are associated with the server.

   Refer to 5.3.4, “Deleting a network server storage space” on page 100.

4. Delete the network server description that defines the server environment on the iSeries server.

   Refer to the following section.

5. Delete line descriptions that are associated with the server.

   Refer to 4.6.2, “Deleting network server line descriptions” on page 72.

6. Delete controller descriptions that are associated with the server.

   Refer to 4.6.3, “Deleting network server TCP/IP controller descriptions” on page 72.

7. Delete device descriptions that are associated with the server.

   Refer to 4.6.4, “Deleting network server TCP/IP device descriptions” on page 72.

8. Delete TCP interfaces that are associated with the server.

   Refer to 4.6.5, “Deleting network server TCP/IP interfaces” on page 73.

9. Delete the server message queue (if one was created).

   Refer to 4.6.6, “Deleting the server message queue” on page 73.

10. (Optional) If you remove all your Windows 2000 servers from the iSeries server and do not plan to install any more, you can delete the integration code licensed program product (5769-WSV) to free up the disk storage the product uses.

    Refer to 4.6.7, “Deleting OS/400 Integration for Windows Server (5769-WSV)” on page 73.

4.6.1 Deleting the network server description

Before you delete a network server description, you need to vary it off and unlink and delete NWSSTG spaces that are associated with the server (including the Windows 2000 system (C:) and installation code image (D:) drives).

To delete the network server description for a Windows 2000 server on an Integrated xSeries Server, follow these steps:

1. Type `WRKNWSD` on an OS/400 command line, and press Enter.
2. Press F23 for more options. Type `8` in the Opt column to the left of the network server description, and press Enter.
3. If the status of the network server description is anything other than VARIED OFF, type `2` in the Opt column of the network server description, and press Enter.
4. Press F3 to return to the previous display.

5. Type 4 in the Opt column to the left of the network server description, and press Enter.
6. On the Confirm Delete of Network Server Descriptions display, press Enter.

4.6.2 Deleting network server line descriptions

To delete all of the line descriptions for a Windows 2000 server on an Integrated xSeries Server, follow these steps:

1. Type WRKLIND on an OS/400 command line, and press Enter.
2. Page down until you see the line descriptions that relate to the network server you want to delete.

   The names of the line descriptions are the same as the names of the network server descriptions followed by 00, 01, and 02. This depends on the port number to which the line is attached. There will always be a 00 line, but you may not see a 01 or 02 line. This depends on the number of LAN adapters that are under the control of the Integrated xSeries Server, and whether you have chosen to configure these lines for communication with the native side of the iSeries.
3. Type 4 in the Opt column next to the line descriptions you want to remove, and press Enter.

4.6.3 Deleting network server TCP/IP controller descriptions

To delete the TCP/IP controller descriptions for a Windows 2000 server on an Integrated xSeries Server, follow these steps:

1. Type WRKCTLD on an OS/400 command line, and press Enter.
2. Page down until you see the controller descriptions that you want to delete.

   The names of the controller descriptions start with the first five characters of the network server description name, followed by NET. For example, if the network server description name is AS400WIN, the controller name might be AS400NET.
3. Type 4 in the Opt column to the left of the controller descriptions you want to remove, and press Enter.

4.6.4 Deleting network server TCP/IP device descriptions

To delete the TCP/IP device descriptions for a Windows 2000 server running on an Integrated xSeries Server, follow these steps:

1. Type WRKDEVD on an OS/400 command line, and press Enter.
2. Page down until you see the device descriptions that you want to delete.

   The names of the device descriptions start with the first five characters of the network server description name, followed by TCP. For example, if the network server description name is AS400WIN, the device name might be AS400TCP.
3. Type 4 in the Opt column to the left of the device descriptions you want to remove, and press Enter.

4.6.5 Deleting network server TCP/IP interfaces

To delete TCP/IP interfaces that are associated with a Windows 2000 server on an Integrated xSeries Server, follow these steps:

1. Type `CFGTCP` on an OS/400 command line, and press Enter.
2. Select option `1` (Work with TCP/IP interfaces) from the Configure TCP/IP menu.
3. Type `4` in the Opt column next to the TCP/IP interfaces you want to remove, and press Enter.

   You can identify the TCP/IP interfaces that are associated with the network server description (NWSD) by looking at the name of the attached line description. This name consists of the network server description name, followed by 00, 01, or 02.

4.6.6 Deleting the server message queue

To delete the server message queue (if one was created), follow these steps:

1. Type the Work with Objects (`WRKOBJ`) command, and press F4.
2. Type the name of the OS/400 message queue and the library where it is stored. Press Enter.
3. A display showing the object with type *MSGQ should appear. Type `4` in the Opt column to the left of the object, and press Enter.

4.6.7 Deleting OS/400 Integration for Windows Server (5769-WSV)

If you do not plan to reinstall Windows 2000 on the Integrated xSeries Server, you may also want to remove the integration code from the iSeries. Removing 5769-WSV frees the storage space it occupies on the iSeries server.

Notice that removing this option does not automatically delete existing network server descriptions or user storage spaces. However, it renders them unusable.

To delete the Integration for Windows Server licensed program product, follow these steps:

1. Type `GO LICPGM` on an OS/400 command line, and press Enter.
2. Select option `12` from the Work with Licensed Programs menu, and press Enter.
3. Page down through the list of licensed programs until you see the licensed program 5769-WSV.
4. Type `4` in the Option column to the left of the program, and press Enter. The licensed program is deleted.

Remember to perform a new system save operation after you complete the delete operation. This ensures that the deleted objects are reflected in the save media.

4.7 Reinstalling Windows 2000 on the Integrated xSeries Server

If the Windows 2000 server becomes damaged, you may still be able to either log on to the server, or press F8 during startup to access the Windows 2000 Advanced Options Menu. In either case, you may be able to recover without

reinstalling Windows 2000 from scratch (the beginning) and, therefore, preserve the installed applications and user data. Consult the appropriate Microsoft documentation for the full range of recovery options.

Before you reinstall the Windows 2000 server, find out if you have a recent backup of your system (C:) drive. It is usually easier and faster to rebuild the server from an OS/400 backup tape, rather than to reinstall the Windows 2000 server from scratch. For restore options, refer to Chapter 7, “Backup and restore” on page 151.

To reinstall the server from the Windows 2000 command prompt, follow these steps:

1. If you are attempting the operation on a server in a domain, first remove the server from the domain, if possible.
2. If you are attempting to repair a domain controller, remove the domain controller from the domain.
3. Vary on the Integrated xSeries Server on which you want to repair Windows 2000. If the server does not come up, you need to follow the procedures for recovering the server as described in 9.13, “Windows 2000 server recovery tools” on page 251.
4. Assuming that the Windows 2000 server comes up, click **Start->Programs->Accessories->Command Prompt**.
5. When the command prompt appears, type the following commands:

   ```
   D:
   CD\I386
   WINNT /T:C /S:D:\I386 /U:D:\UNATTEND.TXT
   ```

   C: is the system drive, *D:\i386* is the source directory, and *D:\UNATTEND.TXT* is the response file to be used.
6. When prompted by the Windows 2000 installation program, select the option to *replace* the operating system, not to upgrade it.
7. When the installation is finished, you need to re-apply the Microsoft Service Packs for Windows 2000, and promote the server to a domain controller as required.

4.8 Varying input/output devices on and off

An integrated Windows 2000 server does not have a CD-ROM or tape drive of its own, unless you have attached an external device to the server using a USB serial or parallel port attachment. Generally, the Windows 2000 server shares the iSeries server CD-ROM and tape devices. These devices must be made available on the iSeries in order for the Windows 2000 server to use them.

4.8.1 Varying the CD-ROM drive on and off

The CD-ROM drive must be varied on before you can use it from the Windows 2000 or iSeries servers. If the CD-ROM drive is varied off, follow these steps to vary it on:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *DEV *OPT
   ```

Press Enter.

2. Type `1` in the Opt column next to the desired optical device (typically OPT01) to vary on the drive, and press Enter.

The CD-ROM drive varies on.

To make the CD-ROM drive unavailable to both the iSeries and Windows 2000 servers, you can vary the drive off. Follow these steps to vary the CD-ROM drive off:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *DEV *OPT
   ```

   Press Enter.

2. Type `2` in the Opt column next to the desired optical device (typically OPT01) to vary off the drive, and press Enter.

The CD-ROM drive varies off.

4.8.2 Varying the tape drive on and off

The tape drive must be varied on before you can use it from the iSeries server. If the tape drive is varied off, follow these steps to vary it on:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *DEV *TAP
   ```

   Press Enter.

2. Type `1` in the Opt column next to the desired tape device (typically TAP01) to vary on the drive, and press Enter.

The tape drive varies on.

To make the tape drive unavailable to the iSeries server, you can vary the drive off. Notice that the tape drive must be varied off before you can lock the drive to Windows 2000. Follow these steps to vary the tape drive off:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *DEV *TAP
   ```

   Press Enter.

2. Type `2` in the Opt column next to the desired tape device (typically TAP01) to vary off the drive, and press Enter.

The tape drive varies off.

4.9 Submitting commands to the network server from the iSeries server

You can use the Submit Network Server Command (SBMNWSCMD) command from an OS/400 session to submit line (batch) commands to the Windows 2000 server running on the Integrated xSeries Server. You can use the SBMNWSCMD command in a CL program to run Windows 2000 batch commands unattended from the iSeries server.

Before you submit any commands, verify that the following statements are true:

- The network server description is active.
- Your user profile is enrolled to the domain or local server, or you sign on with the QSECOFR user profile.
- You have authority to run SBMNWSCMD (which requires *JOBCTL special authority). You must also have at least *USE authority to the QSYS/SBMNWSCMD *CMD object.

Before you use the SBMNWSCMD command, read 4.9.1, “Guidelines for running the SBMNWSCMD command” on page 77.

To submit a line command to a Windows 2000 server, follow these steps:

1. Type `SBMNWSCMD` on an OS/400 command line, and press F4. The Submit Network Server Command display appears.
2. Type the command or commands you want the Windows 2000 server to run in the Command parameter. Windows 2000 commands that can run in batch mode without user interaction will work.

   Notice that you can prevent the SBMNWSCMD command from logging the command you send to the server. If the command string contains sensitive data, such as passwords that you do not want logged in error messages, perform the following steps:

   a. Type `*NOLOGCMD` as the command string.

   b. When the Command (not logged) parameter appears, enter the command to execute in this field.

   The *NOLOGCMD value does not affect data that the Windows 2000 command returns. If the command returns sensitive data, you can use the Command standard output (CMDSTDOUT) parameter to store the output in a secure location, such as an IFS file.
3. Type the name of the Windows 2000 server on which you want the command to run in the Server column. The server must be an Integrated xSeries Server on the local iSeries server and must be active.
4. Press Enter. Additional fields appear.
5. Type `*WINDOWSNT` in the Server type parameter.
6. Leave `*SVRTYPE` in the Command type parameter.
7. Specify the domain where your user ID is to be authenticated in the Authentication domain parameter. The default, `*PRIMARY`, logs you on to the primary domain of the server you specified. When you specify `*LOCAL`, you log on to the server itself. You can also enter the name of another trusted domain.
8. You can direct standard output from the Windows 2000 command to your job log (`*JOBLOG`), to a spooled file (`*PRINT`), or to stream file in an integrated file system (IFS) object. Standard error data always goes to the job log.

   If you specify `*PRINT`, the Work with Spool File (WRKSPLF) display shows SBMNWSCMD in the User Data parameter for the spooled file. If you select option 8 to display the attributes, the names of the specified Windows 2000 server and Windows 2000 command appear in the user-defined data field. When you specify an IFS object, the path name must exist. If the object name does not exist, the command creates it.

9. In the Convert standard output parameter, you can specify `*YES` to convert output from the Windows 2000 server code set to the coded character set identifier (CCSID) of the OS/400 job. Output that you direct to an existing IFS object is converted to the CCSID of the IFS object. Output that you direct to a new member of an existing file in the /QSYS.LIB file system is converted to the CCSID of the existing file.

4.9.1 Guidelines for running the SBMNWSCMD command

When you use the Submit Network Server Command (SBMNWSCMD) command on the iSeries to remotely submit Windows 2000 server commands, consider the following guidelines:

- Do not use the /u parameter with the Windows 2000 command.
- You can combine Windows 2000 commands into a single command string by using features of the Windows 2000 cmd.exe command interpreter. For example, on the SBMNWSCMD command line, you can enter the following command to collect statistics:

  ```
  net statistics workstation && net statistics server
  ```

  However, commands that you combine in a single SBMNWSCMD request should not return mixed data (for example, a combination of ASCII and Unicode data) or data in mixed code sets. If the commands return different types of data, SBMNWSCMD may end abnormally with a message, indicating that a problem occurred in the data output conversion. In this case, run the commands separately.
- Do not use characters that are not normally available from the Windows 2000 keyboard. In rare cases, an EBCDIC character in the active jobs coded character set may not have an equivalent in the active code page on Windows 2000. Applications handle the conversion discrepancies differently.
- Submit Network Server Command does not initialize your logon environment. It uses environmental variables from the local system environment. Therefore, environmental variables that an interactive logon normally sets to user-specific values may not exist or may be set to system default values. Any scripts or applications that rely on user-specific environmental variables may not operate correctly.
- If the home directory for your user account on Windows 2000 is mounted on the local server, Submit Network Server Command sets the current directory to your home directory. Otherwise, it tries to use /home/default or the local system drive.
- You can use the SBMNWSCMD command to run Windows 2000 applications as long as they do not require user intervention. The commands run in a background window, not on the Windows 2000 server console.
- You can also run commands that require a *yes* or *no* reply to proceed. You do this by using input pipe syntax to provide the response. For example, `echo y|format f: /fs:ntfs` lets the format proceed after the `Proceed with Format?` question raised by the format command. Notice that the *y* and the | (pipe symbol) do not have a space between them.

4.10 Operations Navigator interface

Operations Navigator provides a Windows-style graphical user interface (GUI) to the iSeries server. It started back in 1995 with the advent of OS/400 Version 3 Release 1 and was named System Object Access (SOA). It's fair to say that SOA had very limited functionality. Since then, its functionality has increased with each new version of OS/400 that has become available. Now with OS/400 Version 4 Release 5, it can be used to manage your integrated Windows 2000 server in addition to many other aspects of the iSeries server.

The Operations Navigator interface is provided with the OS/400 Client Access Express for Windows product, shipped free of charge with OS/400 Version 4 Release 5. Throughout the rest of this chapter, we assume that you have a PC with this product already installed and that it can connect to the iSeries server using TCP/IP. We also assume that Operations Navigator and all of its components are fully installed. If this is not the case, and you need assistance with the installation or usage of Client Access Express for Windows, or more specifically Operations Navigator, the following resources are available to help you:

- iSeries 400 Information Center via CD-ROM or on-line at:
  `http://publib.boulder.ibm.com/pubs/html/as400/infocenter.html`
- *AS/400 Client Access Express for Windows: Implementing V4R4M0*, SG24-5191
- *Managing AS/400 V4R4 with Operations Navigator*, SG24-5646

4.11 Displaying an integrated Windows 2000 server's status and properties

Once you install Windows 2000 on the Integrated xSeries Server, you can monitor the server's status and change certain operational characteristics from the iSeries using either Operations Navigator or an OS/400 session.

The new Windows Administration plug-in for Operations Navigator can be used to view the current status of any installed Windows servers running on the Integrated xSeries Server, as shown in Figure 31.

Note

At the time this redbook was written, the Integrated xSeries Server option was not available on the displays for this process. As the following displays indicate, you may still need to select **Integrated Netfinity Server**.

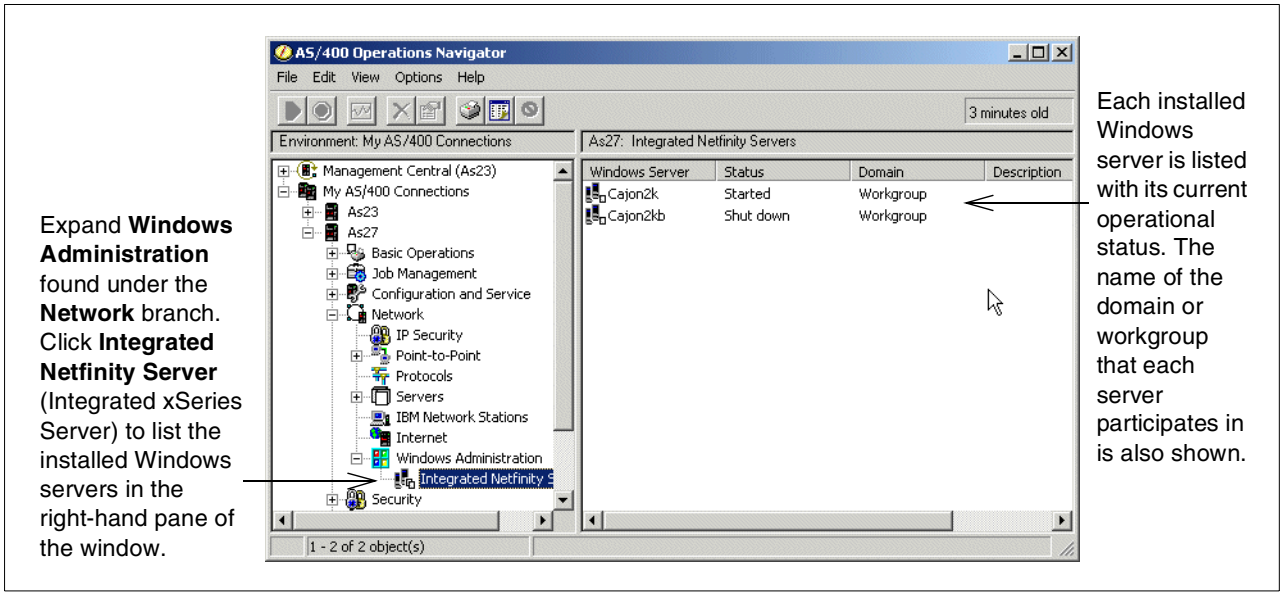

Figure 31. Viewing the status of integrated Windows servers

A more detailed status can be displayed using the Windows Administration plug-in as illustrated in Figure 32, provided the selected Windows server is active.

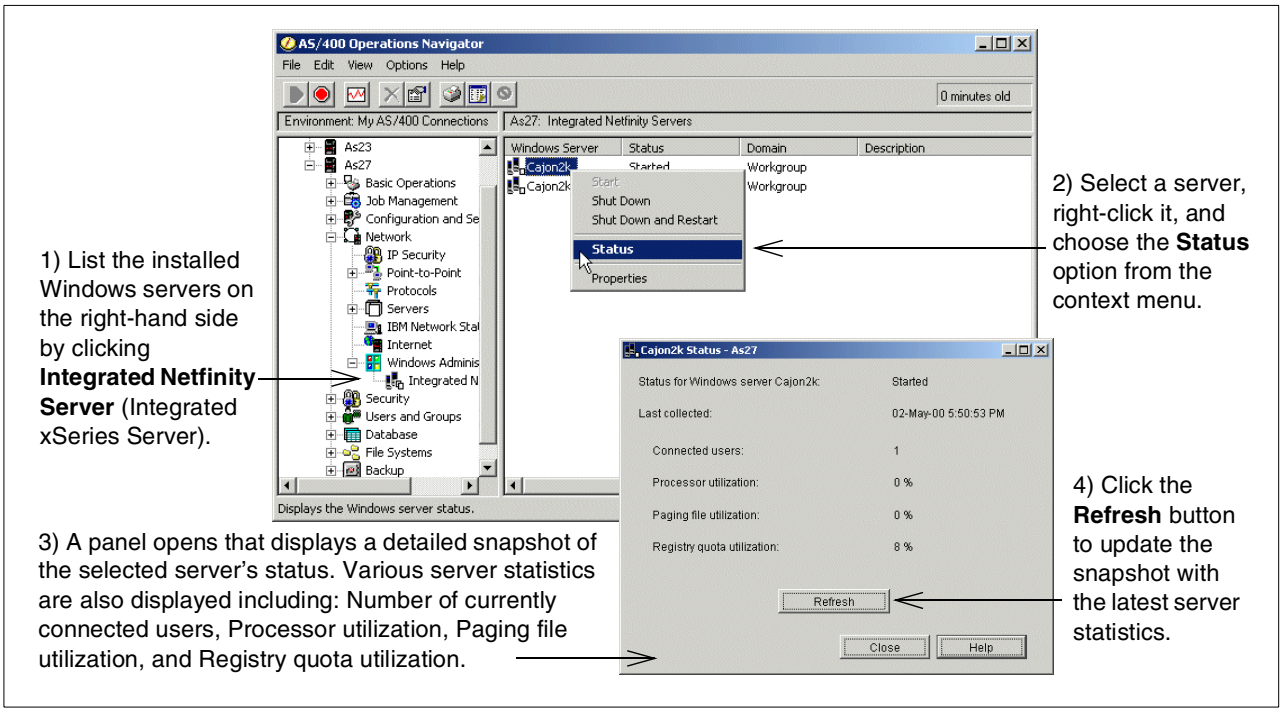

Figure 32. Displaying an active server's status using

If you choose to view the status of a server that is currently shut down, you see a panel similar to the example shown in Figure 33 on page 80, and you are given the opportunity to view the System Operator's message queue.

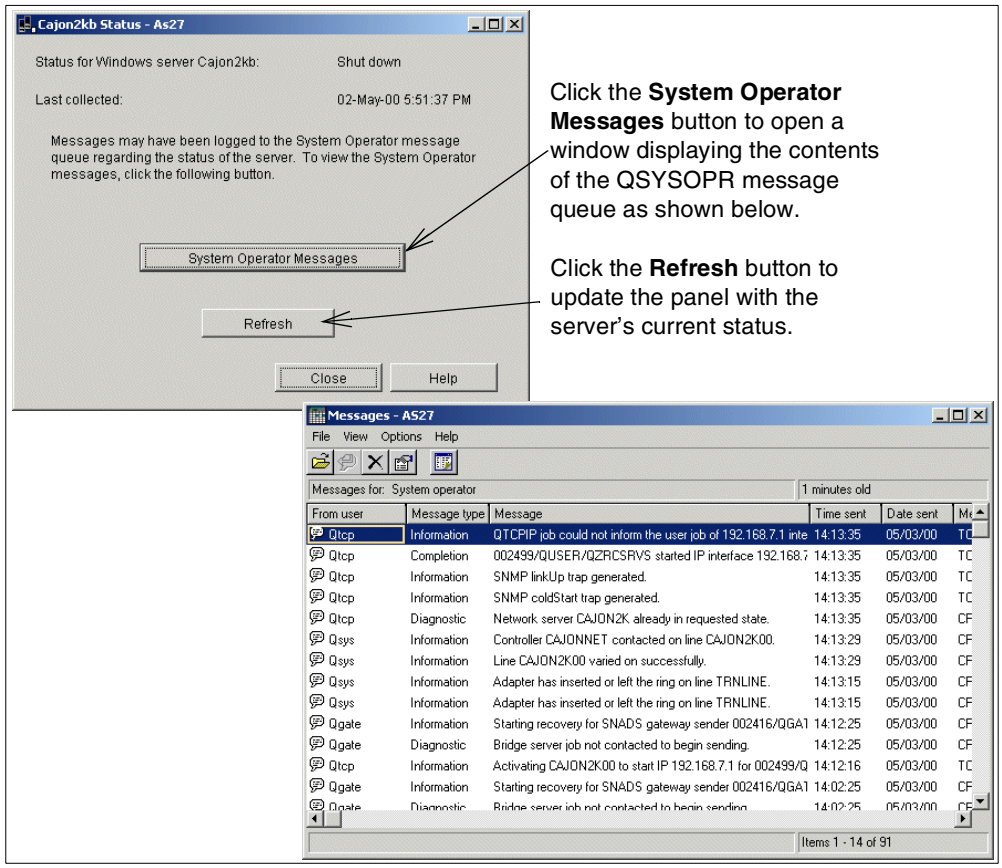

Figure 33. Viewing the detailed status of a shutdown server

The Windows Administration plug-in can also be used to display, and to some extent change, many integrated Windows 2000 server properties, as illustrated in Figure 34 through Figure 36 on page 83.

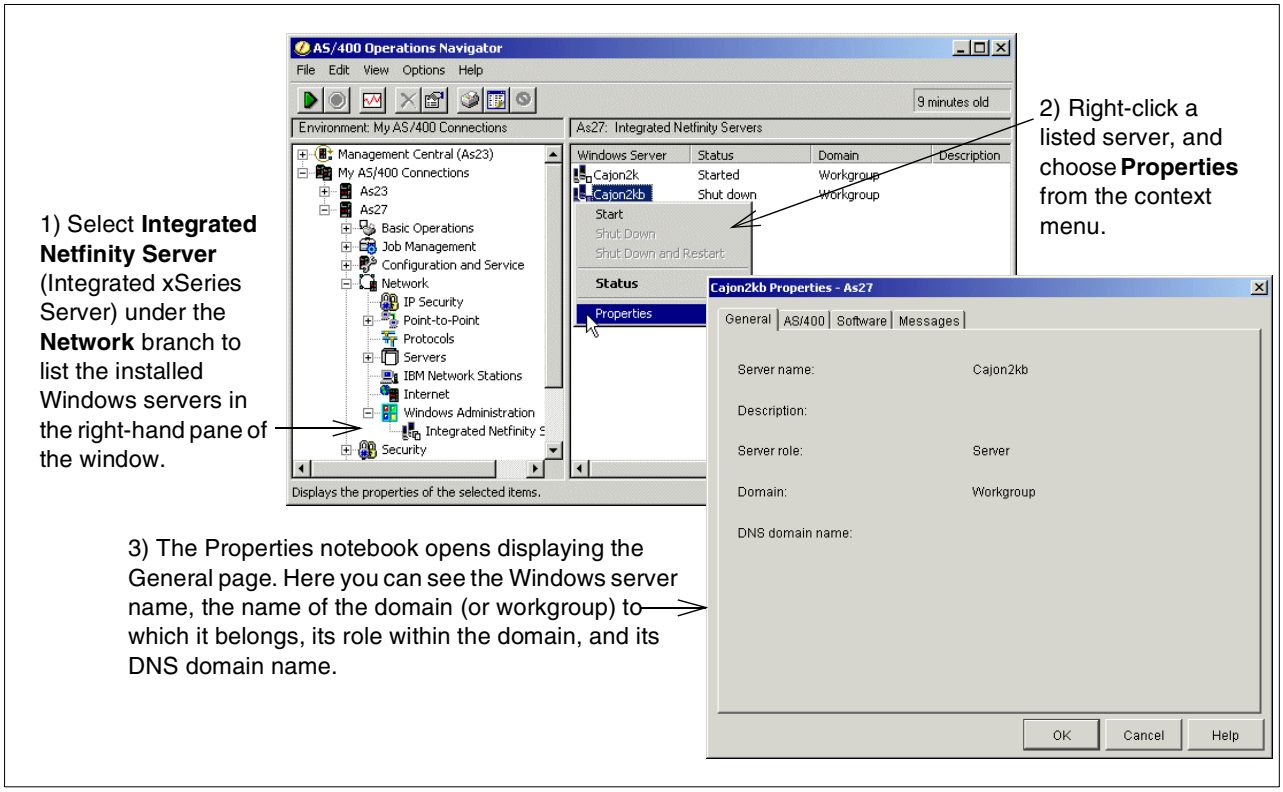

Figure 34. Displaying the general properties of an integrated Windows server

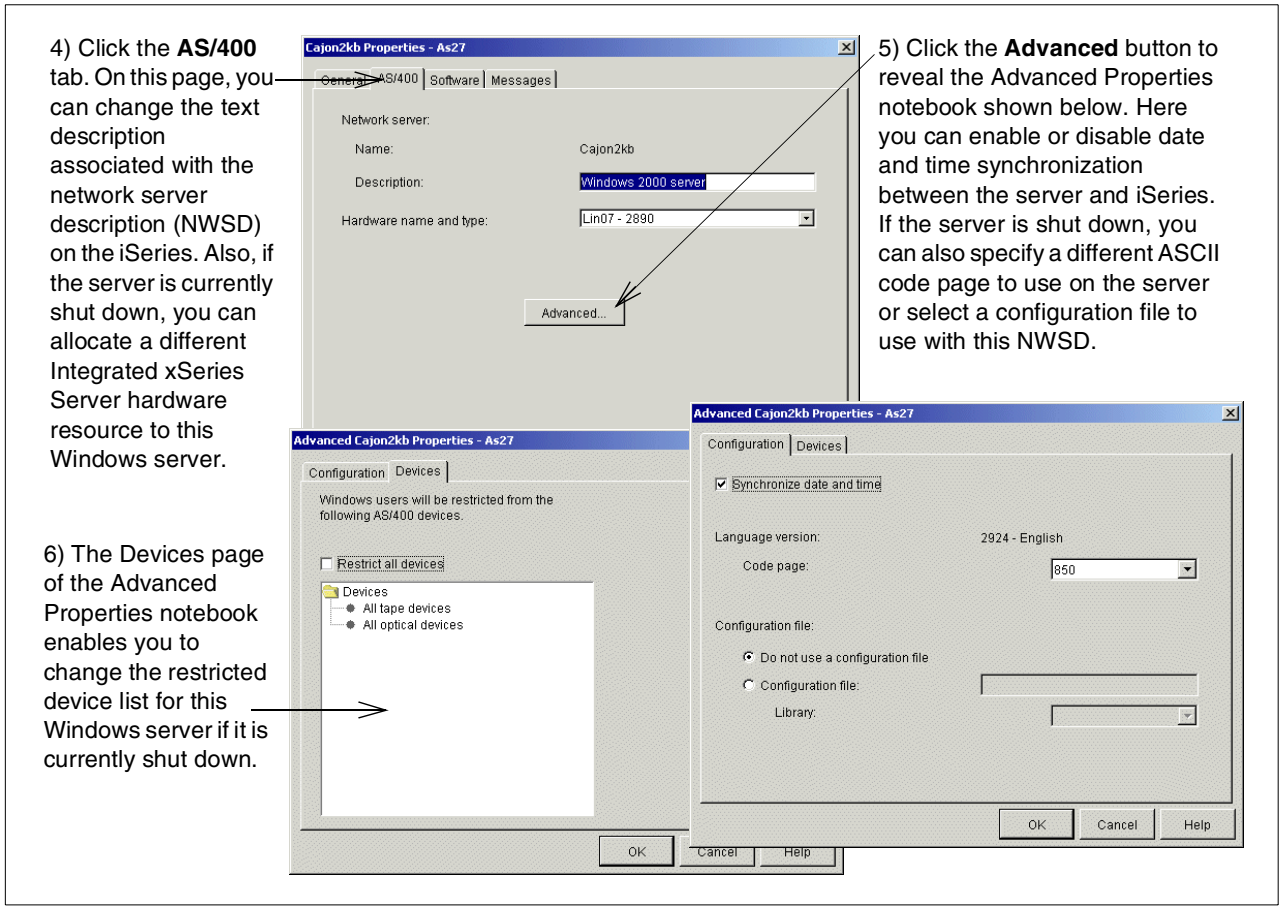

Figure 35. Displaying the AS/400 properties of an integrated Windows server

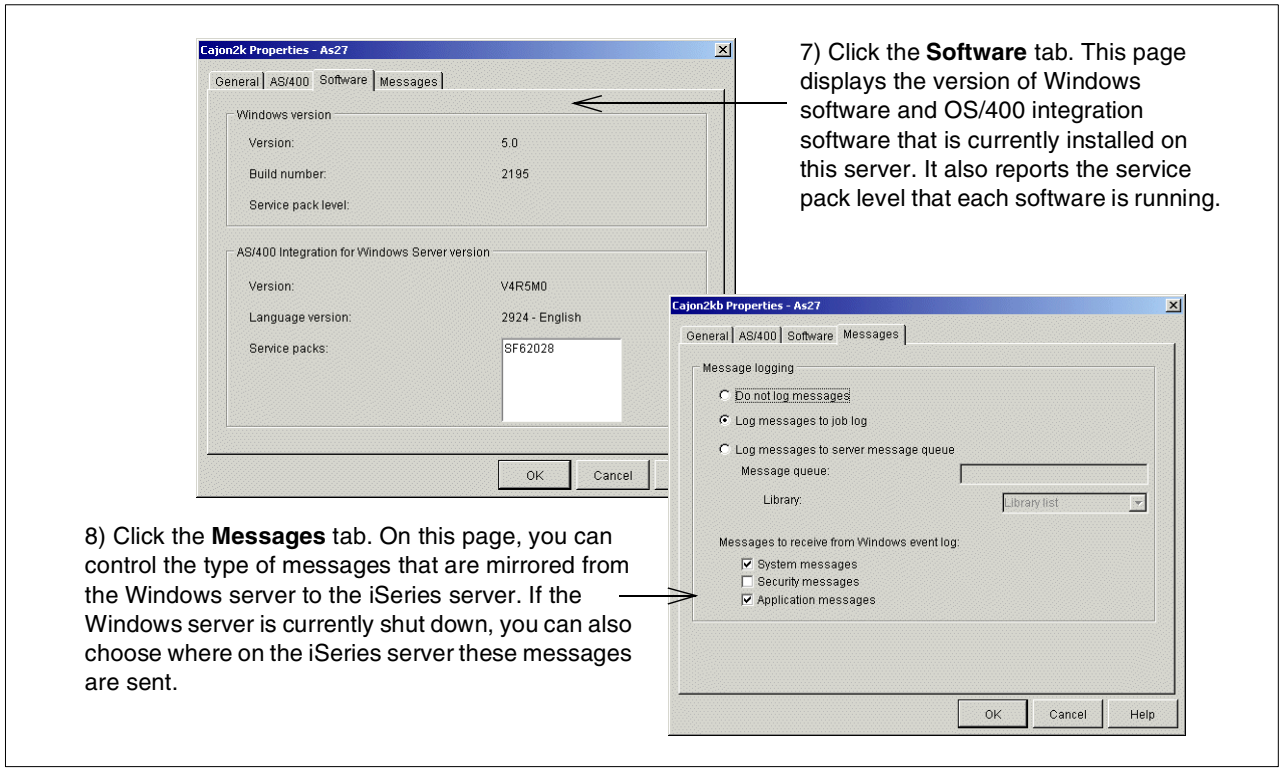

Figure 36. Displaying software and messaging properties of an integrated Windows server

4.12 Starting and stopping an integrated Windows 2000 server

When the Windows 2000 server is running on an Integrated xSeries Server, ultimately the iSeries has control over it. For this reason, you generally start (boot up) and stop (shut down) the server from the iSeries using either OS/400 Operations Navigator or an OS/400 session. The Windows 2000 server console can also be used to shut down or restart the server. But, unlike an external PC server, there is no power button on an Integrated xSeries Server that you can use to initiate a cold boot up of the server.

4.12.1 Starting the Windows 2000 server

When you start an integrated Windows 2000 server, the iSeries performs a hardware reset on the processor card of the Integrated xSeries Server. You see the big blue IBM logo on the Windows 2000 server console attached to the Integrated xSeries Server, the same as you do on any IBM PC that was purchased recently. However, be aware that the BIOS has been modified. You cannot press F1 to enter into the Setup facility or Esc to speed up Power On Self Test (POST).

The BIOS boot logic passes control to the boot sector on drive C:, which starts the operating system (OS) loader. You see the typical Windows 2000 menu, where you can select to boot Windows 2000 server or PC-DOS. The latter is the DOS mini-boot image that is used during the installation of Windows 2000 on the Integrated xSeries Server.

PC-DOS boot option

If you have chosen to format the Windows 2000 system drive (C:) as NTFS, as is the case with any system drive that is created larger than 2047 MB in size, *do not* select the option from the menu to boot PC-DOS. This option is only valid when the Windows 2000 system drive is formatted as FAT.

Once you select the Windows 2000 server from the menu, or the time-out period expires, the server starts and the logon panel is displayed.

When you start an integrated Windows 2000 server, TCP/IP starts if it is not already started, and all associated TCP/IP interfaces are activated on the iSeries server. You can also automatically start a Windows 2000 server when TCP/IP is started by using the Configure TCP/IP (CFGTCP) command to change the Autostart parameter on the internal LAN line interface. See 3.5, “Completing the post-installation tasks” on page 48, for a description of how to do this.

If you created any NWSSTG spaces in user auxiliary storage pools, the iSeries automatically mounts the file systems. In this case, a message is sent to the QSYSOPR message queue.

Figure 37 illustrates how to start your Windows 2000 server using Operations Navigator.

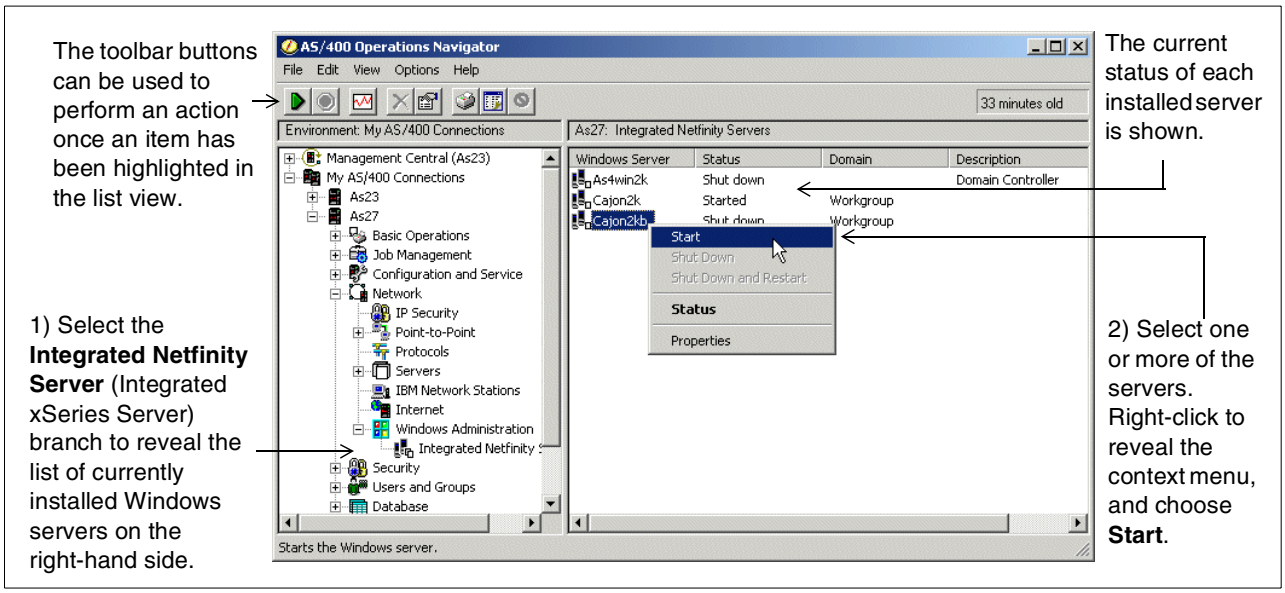

Figure 37. Starting a server using OS/400Operations Navigator

If you do not have access to a PC with Operations Navigator installed on it, you can start the integrated Windows 2000 server from an OS/400 session. This is described in 4.2, “Starting and stopping Windows 2000 on the Integrated xSeries Server” on page 58.

You should not shut down the Windows 2000 server immediately after you start it. Wait several minutes to allow the Windows 2000 server to start completely. This also allows the service control manager to alert you to any device or service

failures. If you have problems starting Windows 2000 server, see 9.3, “Problems starting the network server” on page 236.

4.12.2 Shutting down the Windows 2000 server

It is possible to initiate a shut down of an integrated Windows 2000 server from either the iSeries or Windows 2000 server console.

Always shut down Windows 2000 server before you power down the iSeries server. If you do not, you run the risk of losing valuable data or corrupting the Windows 2000 server’s system files. If you issue the `PWRDWNSYS OPTION(*IMMED)` command on the iSeries, a shut down of any integrated Windows 2000 servers is not initiated. The `PWRDWNSYS OPTION(*CNTRLD)` command initiates a shutdown of all integrated Windows 2000 servers, but there is still no guarantee that they will shut down before the iSeries completes its power down.

External host LAN support

If you implemented external host LAN support, it is important to remember that shutting down the Windows 2000 server also terminates any iSeries communications using the LAN adapters being controlled by the Integrated xSeries Server.

4.12.2.1 Shutting down the server from the iSeries server

Figure 38 illustrates how to shut down or restart a Windows 2000 server using Operations Navigator.

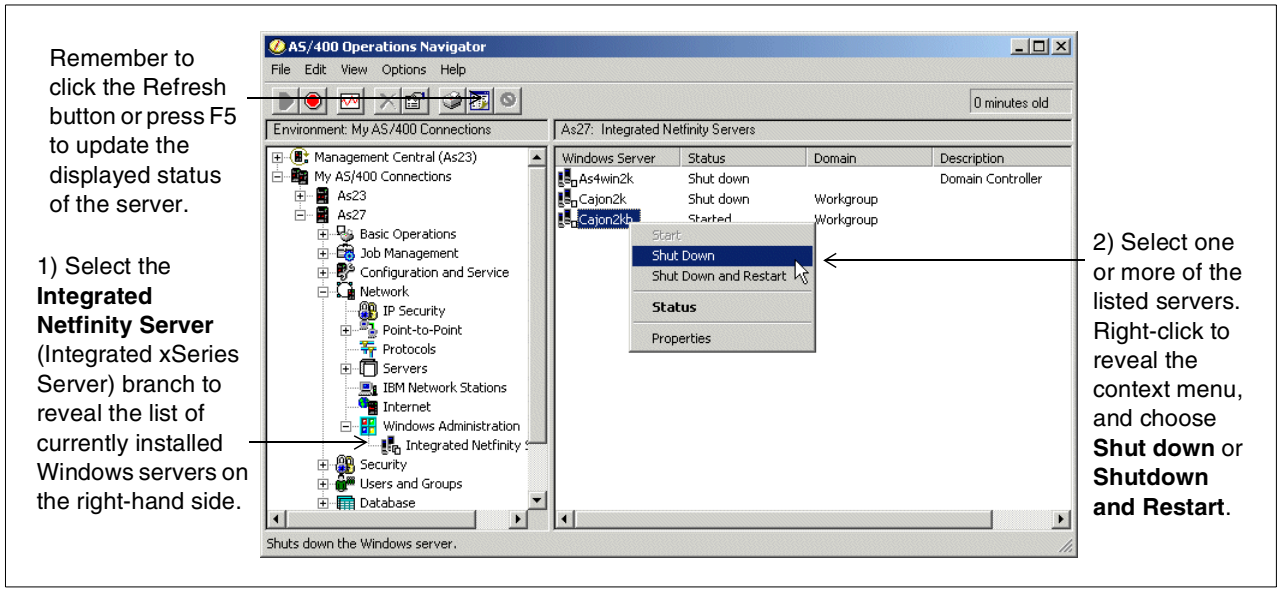

Figure 38. Shutting down a Windows 2000 server using Operations Navigator

If you do not have access to a PC with Operations Navigator installed on it, you can shut down the integrated Windows 2000 server from an OS/400 session. This is achieved by varying off the network server description associated with the particular Windows 2000 server you want to shut down.

4.12.2.2 Shutting down the server from the server console

You can shut down Windows 2000 from the Windows 2000 server console the same as you would on a PC-based server. To do so, select **Start** and then **Shut Down**.

Shutting down from the Windows 2000 server console shuts down the server, but does not completely vary off the network server description on the iSeries server. When the *It is now safe to turn off your computer* dialog box is displayed on the Windows 2000 server console, on an OS/400 command line, enter:

```
WRKCFGSTS *NWS
```

The Work with Configuration Status display shows the network server description in a status of SHUTDOWN, and all the other configuration objects are in FAILED status. This is normal. However, you need to shut down the server completely from the iSeries before it can be restarted.

Once you shut down the server from the Windows 2000 server console, you must restart it from the iSeries server using either Operations Navigator or an OS/400 session. Because of this, we recommend that you *only* use the Windows 2000 server console to shut down the server when you intend to immediately restart it. An example may be after you install new applications that require a reboot before use or after you apply any service pack updates to the server. In this case, you would use the Restart option on the Shut Down menu.

Chapter 5. Disk storage administration

This chapter provides you with information and advice on how to manage disk space allocated to the Windows 2000 server.

When the Windows 2000 server is running on the Integrated xSeries Server, it uses a portion of the iSeries disk capacity. For this reason, the administration of the Windows 2000 server disk storage has both an OS/400 component and a Windows 2000 server component. The OS/400 component is used to define and allocate the storage available to the Windows 2000 server. OS/400, which provides disk storage management, relieves the Windows 2000 server from the responsibility of providing physical device support. Therefore, the common disk administration problems encountered in stand-alone PC servers (disk drivers, addressing, configuration and protection) are eliminated when you use the Integrated xSeries Server.

The Windows 2000 server component of disk storage administration is used to perform the remainder of the disk administration tasks including partition and volume management. These tasks are performed on the Integrated Netfinity Server in exactly the same way that they are on stand-alone PC servers.

Note

While all of the Windows 2000 server disk administration tools are supported on the Integrated xSeries Server for iSeries, many are redundant with support that is automatically provided by the iSeries server.

This chapter is divided into four major sections. The first section provides an overview of OS/400 storage management concepts. This section is particularly valuable for experienced Windows 2000 administrators that are using the iSeries for the first time. The second section provides an overview of Windows 2000 storage management concepts. We also discuss the applicability of various Windows 2000 storage management features in an Integrated xSeries Server environment.

The last two sections describe, in detail, the various operational tasks that are necessary when administering disk storage, both from the OS/400 and the Windows 2000 user interfaces.

5.1 iSeries storage management concepts

The following sections describe how disk storage is managed on the iSeries server.

5.1.1 OS/400 and disk drives

OS/400, the operating system that runs on an iSeries server, provides storage management functions for all disk storage that is attached to the iSeries server. This includes storage used by the Integrated xSeries Server. However, OS/400 does not deal directly with the disk drives. A level of software, underneath OS/400, called *System Licensed Internal Code (SLIC)*, “hides” the physical disk drives and manages the physical storage of objects on these drives by mapping a

virtual address space over the physical disk space. OS/400 addresses all objects through these virtual addresses, rather than physical addresses such as disk drive IDs, cylinders, and sectors. Objects needed by OS/400 are *paged in* from this virtual address space into the address space of main memory.

Since OS/400 is not aware of the physical location of an object, SLIC can balance disk utilization by scattering a single object over multiple disks. When a large object is loaded into main memory, several disk arms simultaneously read parts of the object, which results in greatly improved performance. Since SLIC takes care of putting the pieces together, OS/400 is not concerned on which disk or disks an object is stored. More importantly, an OS/400 system administrator does not need to worry about monitoring the size of individual objects or the utilization of individual disk drives. Objects cannot overflow a disk drive, because they are not limited to one drive. As long as there is disk space available somewhere on the system, the object can expand. This makes disk administration of an iSeries server much easier than with other systems.

5.1.2 Auxiliary storage pools (ASPs)

An auxiliary storage pool (ASP) is a logical grouping of one or more iSeries disk drives. There is at least one ASP on every iSeries server, which is called the *system ASP*, and is always ASP 1. You can create up to fifteen additional ASPs, which are called *user ASPs*, and are numbered 2 through 16.

ASPs provide an iSeries administrator with a mechanism to control where data is physically stored. Most often ASPs are implemented to support journaling or hierarchical storage management.

SLIC and OS/400 always reside in the system ASP. Server storage spaces, used in servers that were installed prior to V4R5, are limited to the system ASP. Network server storage spaces can be created in any ASP.

5.1.3 iSeries disk protection

iSeries disks can be protected in two ways:

- RAID-5
- Mirroring

5.1.3.1 iSeries RAID-5 protection

RAID-5 groups from four to ten disks together form an array. Each disk holds checksum information on the other disks in the same array. If a disk fails, the RAID-5 disk controller can re-create the data of the failing disk with the help of the checksum information on the other disks. The iSeries continues to function normally. When the failing disk is replaced with a new one, the information from the failed disk is automatically rebuilt on the new blank disk, again with the help of the checksum information on the other disks. The disks in a RAID-5 set do not have to be in the same ASP.

5.1.3.2 iSeries mirroring protection

Mirroring keeps two copies of the same data on separate disk drives. Write operations are performed on both disks at the same time. Read operations can be performed from either disk. Two different read operations can be performed simultaneously on both disks of a mirrored pair. If one disk fails, the information on the second disk is used, and the iSeries server continues to function normally.

When the failing disk is replaced with a new one, the data from the intact disk is automatically copied to the new blank disk. This level of protection is called *device level mirroring*.

To further increase the level of protection, mirrored disks can be attached to two different disk controllers. If one controller, and with it, one set of disks fails, the other controller and disks can be used and the iSeries server continues to function normally. This is called *IOP-level mirroring*. Similarly, mirrored pairs can be configured on separate iSeries busses. This is called *bus-level mirroring*. Mirroring can only be implemented at the ASP level.

Each auxiliary storage pool (ASP) defined on an iSeries system can have a different level of protection, or no protection at all. You can decide how important the availability of a particular applications or database is and locate it in a storage pool with the right amount of protection.

To learn more about iSeries disk protection and availability options, read *OS/400 Backup and Recovery*, SC41-5304.

5.1.4 Storage spaces

There are two different types of storage spaces used in the iSeries server. *Server storage spaces* are used for boot, install image, and some system drives, by servers that were installed prior to V4R5. Server storage spaces reside in the QUSRSYS library and are limited to a maximum size of 1007 MB. *Network server storage spaces* are used for all drives on servers first installed at V4R5. Network server storage spaces reside in the OS/400 Integrated File System directory /QPFNWSSTG and can be created up to 64 000 MB.

5.1.4.1 Storage spaces for new V4R5 servers

Table 6 summarizes the storage space characteristics for the Windows 2000 servers newly installed under V4R5.

Table 6. Windows 2000 storage spaces for example server AS4WIN2K, first installed at V4R5

	Windows 2000 C: drive	**Windows 2000 D: drive**	**Windows 2000 E: to Z: drives**
Purpose	Boot *and* Windows 2000 system drive	Windows 2000 CD-ROM install image	Windows 2000 user's files and applications
OS/400 object type	Network server storage space	Network server storage space	Network server storage space
Format	FAT or NTFS *	FAT	FAT, FAT32, or NTFS
IFS directory	/QFPNWSSTG/	/QFPNWSSTG/	/QFPNWSSTG/
Name of object	AS4WIN2K1	AS4WIN2K2	Any valid OS/400 name
Size	500 MB to 8000 MB *	200 MB to 2047 MB	1 MB to 64000 MB
Allowed ASP?	System or User	System or User	System or User

* If you specify a size of 2047 MB or larger for your C: drive, it is formatted as an NTFS drive. Otherwise, it is formatted as a FAT drive. NWSD configuration files cannot be used on an NTFS drive.

5.1.4.2 Storage spaces for servers upgraded from pre-V4R5

Table 7 summarizes the storage space characteristics for the Windows 2000 servers that were upgraded from Windows NT servers that were installed on pre-V4R5 systems.

Table 7. Windows 2000 storage spaces for example server AS4WIN2K, upgraded from pre-V4R5

	Windows 2000 C: drive	Windows 2000 D: drive	Windows 2000 E: drive *	Windows 2000 E: drive *	Windows 2000 F: to Z: drives
Purpose	DOS boot drive	Windows 2000 CD-ROM image	Windows 2000 system drive	Windows 2000 system drive	Windows 2000 user's files and applications
OS/400 object type	Server storage space	Server storage space	Server storage space	Network server storage space	Network server storage space
Format	FAT	FAT	FAT or NTFS	FAT or NTFS	FAT, FAT32, or NTFS
Library or IFS directory	QUSRSYS	QUSRSYS	QUSRSYS	/QFPNWSSTG	/QFPNWSSTG
Name of object	AS4WIN2K1	AS4WIN2K2	AS4WIN2K3	AS4WIN2K3	Any valid OS/400 name
Size	10 MB	200 MB to 1007 MB	500 MB to 1007 MB	1008 MB to 8000 MB	1 MB to 64000 MB
Allowed ASP?	System	System	System	System or user	System or user

* If you specify a size for your E: drive of up to 1007 MB, it is created as a server storage space in the QUSRSYS library. Above 1007 MB, it is created as a network server storage space in the /QFPNWSSTG directory.

Drive letter

For the remainder of this chapter, any references to drive letters assumes a server first installed at V4R5 as detailed in Table 6 on page 89. Use Table 7 to cross-reference drive letters for Windows 2000 servers upgraded from pre-V4R5 Windows NT servers.

5.2 Windows 2000 storage management concepts

The following sections describe how disk storage is managed on Windows 2000.

Keep in mind that many of the Windows 2000 Disk Management facilities were designed for use in the stand-alone PC server environment. Before you implement one of these facilities, carefully consider whether the functionality is already provided by OS/400. In many cases, the use of OS/400 facilities to manage storage spaces will yield superior results.

5.2.1 Disk Management

The Disk Management capability within Computer Management is the tool that you use to administer disk drives from Windows 2000. Server and network server storage spaces appear to Disk Management as individual physical disk drives.

Disk Management enables you to perform tasks, such as formatting drives, assigning and reassigning drive letters, partitioning drives, and creating volume sets, all of which are described in greater detail later in this chapter.

5.2.2 Windows 2000 file systems

Windows 2000 supports three different file systems: FAT, FAT32, and NTFS. The file system defines the overall structure for naming, storing, and organizing files.

FAT is an acronym for File Allocation Table and was the first widely used file system on IBM personal computers. FAT32 is an enhancement of the FAT file system, which implements 32-bit addresses. FAT32 supports smaller cluster sizes, which results in more efficient use of disk space. NTFS is an acronym for NT File System and was introduced with early versions of Windows NT.

When the Windows 2000 server is installed on an Integrated xSeries Server, it is installed on the C: drive. If you specify a size for the C: drive of 2048 MB or greater, or if you specify *YES in the Convert to NTFS (CVTNTFS) parameter on the Install Windows 2000 Server (INSWNTSVR) command, the drive is formatted as NTFS. Otherwise, the C: drive is formatted as FAT.

After the installation is completed, a system drive formatted as FAT may be manually converted to NTFS by using the CONVERT command in a command prompt window. The command is `CONVERT C: /FS:NTFS /V`. See the Windows 2000 server help for details.

NTFS has the following advantages over FAT:

- File level security
- Better performance on large drives
- Better use of space on large drives

If you convert the C: drive to NTFS, you achieve slightly better performance, and you can use enhanced NTFS security as well as share-level security. However, if there is a problem with the Windows 2000 server that prevents it from starting, you cannot boot PC-DOS on the C: drive because DOS cannot access NTFS drives. Further, you cannot boot with error recovery diskettes because the Integrated xSeries Server does not have a diskette drive.

Note: Do not convert the D: drive. It contains the Windows 2000 server CD-ROM install image and must remain in FAT format.

5.2.3 Basic disks

During installation of the Windows 2000 server, the system and installation drives are created as basic disks. In addition, any new network server storage spaces created on the iSeries server appears to the Windows 2000 server as basic disks. Basic disks comply with the Windows NT Server 4.0 disk organization. A Windows 2000 basic disk fully supports partitions and provides *limited support* for volume sets, stripe sets, RAID-5 volumes, and mirrored volumes.

The main reason to use basic disks is to retain compatibility with Windows Server NT 4.0 or Windows 95 or 98 when running on a stand-alone PC server with dual boot. Since the Integrated xSeries Server does not support dual boot, all Windows 2000 server disks on the Integrated xSeries Server should be upgraded to dynamic disks.

5.2.3.1 Partitions

Partitioning is a way to split a basic disk into smaller units. Each unit or partition is assigned a drive letter or is used as a mounted drive. The following list shows the different types of partitions:

- Primary partitions
- Extended partitions (can be broken into smaller partitions)
- Logical drives

5.2.3.2 Volume sets

The Windows 2000 server does not support the creation of new volume sets on basic disks. Only existing volume sets, originally created on Windows NT Server 4.0, and upgraded to the Windows 2000 server, are supported. See 5.2.4.2, “Spanned volume”, for information on creating comparable volumes on dynamic disks.

Volume sets are a way to combine multiple drives, which span several Windows 2000 disks, into a single unit to form a *volume set*. A volume set is assigned a single drive letter or is used as a mounted volume.

5.2.3.3 Striped sets

The Windows 2000 server does not support the creation of new striped sets on basic disks. Only existing striped sets that were originally created on Windows NT Server 4.0 and upgraded to the Windows 2000 server are supported. See 5.2.4.3, “Striped volume”, for information on creating comparable volumes on dynamic disks.

Striped sets are similar to volume sets. However, the data is written in stripes across two or more Windows 2000 disks, which results in significantly faster access than a volume set. A striped set is assigned a single drive letter or used as a mounted drive. Striped sets do *not* provide fault tolerance.

5.2.3.4 Fault tolerance on basic disks

The Windows 2000 server does not support the creation of new RAID-5 sets or mirror sets on basic disks. Only existing sets that were originally created on the Windows NT Server 4.0 and upgraded to the Windows 2000 server are supported.

See 5.2.4.4, “Mirrored volume”, and 5.2.4.5, “RAID-5 volume”, for information on creating fault tolerant volumes on dynamic disks.

5.2.4 Dynamic disks

Dynamic disks are a new form of disk organization, supported only by the Windows 2000 server. Dynamic disks are required to support the following dynamic volumes:

- Simple volume
- Spanned volume
- Striped volume
- Mirrored volume
- RAID-5 volume

Basic disks may be upgraded to dynamic disks by selecting the appropriate function in Disk Management. You can revert a dynamic disk back to a basic disk.

However, you must first delete all of the volumes on the dynamic disk. Changes made to dynamic disks are immediately available without rebooting the server. Dynamic disks support any of the Windows 2000 server file systems: FAT, FAT32, and NTFS.

5.2.4.1 Simple volume

A *simple volume* is made up of some or all of the free space on a Windows 2000 server dynamic disk. Simple volumes may be assigned a drive letter, mounted to a folder, or both. A simple volume may be extended if the volume is formatted as NTFS.

5.2.4.2 Spanned volume

A *spanned volume* is made up of some or all of the free space from more than one Windows 2000 server dynamic disk. Spanned volumes may be assigned a drive letter, mounted to a folder, or both. A spanned volume may be extended if the volume is formatted as NTFS.

5.2.4.3 Striped volume

A *striped volume* is similar to a spanned volume. However, the data is written in stripes across two or more disk drives, which results in significantly faster access than with a spanned volume on a stand-alone PC server. On an Integrated xSeries Server, Windows 2000 striped volumes do not provide any performance advantage since SLIC has already scattered the data across multiple physical disk drives. Striped volumes may be assigned a drive letter, mounted to a folder, or both. A striped volume may *not* be extended. Striped volumes do *not* provide fault tolerance.

5.2.4.4 Mirrored volume

A *mirrored volume* duplicates data onto two Windows 2000 server dynamic disks. This type of volume is used for fault tolerance. If one physical drive of the mirrored pair fails, the data can still be retrieved from the other drive. Mirrored volumes may be assigned a drive letter, mounted to a folder, or both.

Mirrored protection may be suspended or deleted. When mirrored protection is suspended by “breaking the mirror,” updates are no longer written to the second volume in the pair. In effect, the files on the second volume are frozen at a point in time and the second volume is assigned its own drive letter. This may be useful for certain backup and application requirements. Mirroring can then be restarted between the original pair (assuming the original second volume has subsequently been deleted) or with a new second volume. A mirrored volume may *not* be extended.

Note: Be sure to read the “Important” box in 5.2.6, “Windows 2000 disk fault tolerance: iSeries disk is unprotected” on page 94, before you implement mirrored volumes.

5.2.4.5 RAID-5 volume

A *RAID-5 volume* combines between three and 32 Windows 2000 server dynamic disks into an array. Each drive in the array stores parity information for the other drives in the array. If a single disk failure occurs, the data on that disk can be constructed by reading from the other drives in the array. This type of volume is used for fault tolerance and may be more cost effective than mirrored volumes. A RAID-5 volume may *not* be extended.

Note: Be sure to read the “Important” box in 5.2.6, “Windows 2000 disk fault tolerance: iSeries disk is unprotected”, before you implement mirrored volumes.

5.2.5 Windows 2000 disk fault tolerance: iSeries disk is protected

If the network server storage spaces used by the Windows 2000 server are stored in an iSeries auxiliary storage pool that is protected, Windows 2000 fault tolerance is redundant at best and ineffective at worst. Do not implement Windows 2000-based disk protection.

5.2.6 Windows 2000 disk fault tolerance: iSeries disk is unprotected

It is always preferable to implement iSeries-based disk protection, either RAID-5 or mirroring. It is, by far, the more robust and efficient solution. However, in a situation where the iSeries is unprotected, it is possible to implement Windows 2000 disk protection.

Important

To use Windows 2000 disk fault tolerance, each Windows 2000 disk (OS/400 network server storage space) *must* be created in a separate auxiliary storage pool. Otherwise, unknown to Windows 2000, iSeries SLIC might co-locate data from both mirrored pairs, or multiple RAID-5 volumes, onto the same physical disk drive.

For more information on managing auxiliary storage pools, see *OS/400 Backup and Recovery*, SC41-5304.

5.2.7 Drive letters and mounted volumes or partitions

The Windows 2000 server supports two ways to reference partitions or volumes. The first way is the traditional MS-DOS method of assigning a drive letter. The second way, which is new in Windows 2000, is mounted volumes or partitions.

5.2.7.1 Drive letters in Windows 2000

A Windows 2000 partition or volume may be assigned a drive letter between C: and Z:. This assignment is made in the Disk Management utility. The drive letter can be changed at any time, with the exception of the boot and system drive. Windows 2000 does not allow you to change the drive letter of the boot and system drive. A partition or volume can only be assigned one drive letter at a time. If you change a drive letter, you also have to change references to the drive letter in applications or files.

5.2.7.2 Mounted volumes or partitions in Windows 2000

A Windows 2000 partition or volume may be “pointed to” by an empty folder on any other NTFS volume or partition. This is called “mounting” the partition or volume.

For example, let’s say that you created a new simple volume of 8 GB. Perhaps, you are running out of available drive letters and do not want to assign this new volume its own drive letter. Instead, you create an empty folder called “PAYFILES” on another partition that happens to be on the J: drive. Next, you use the Disk Management utility to mount your new 8 GB partition to PAYFILES. From

this point forward, whenever J:\PAYFILES is referenced, Windows 2000 provides the new 8 GB simple volume.

This mounted drive support provides the following advantages:

- Eliminates the problem of running out of drive letters
- Provides a method to, in effect, “extend” a partition on a basic disk
- Allows creation of a fault tolerant directory on a non-fault tolerant disk

5.2.8 Windows 2000 virtual memory paging file (Pagefile.sys)

The Windows 2000 virtual memory paging file, named Pagefile.sys and initially stored as a hidden system file on the system drive, performs the following two distinct functions under Windows 2000:

- It acts as a swap file for programs and data that are being swapped in and out of memory.
- It acts as a temporary dump file for the contents of memory, if a STOP error occurs. If a STOP error occurs, the server can be configured to write the contents of the Pagefile to a permanent memory dump file at the start of the next re-boot of the server. This preserves the contents of the page file at the time of error and can be helpful in problem determination. By default, the Memory.dmp file is written to the system drive but can be configured to be written to any volume.

When the Windows 2000 server is installed, a minimum sized paging file is created. In most cases, you should increase the size of this file. The recommended paging file size is 1.5 times the amount of RAM installed on the Integrated xSeries Server. While the paging file may be split among several drives to improve performance on a stand-alone PC server, this does not apply to the Integrated xSeries Server. However, you may consider creating additional paging files on other volumes if you need to free up disk space on your system volume. See 5.4.9, “Configuring the Windows 2000 virtual storage file (Pagefile)” on page 117.

Dump file requirement

To configure your system to write a dump file if a STOP error occurs, the paging file on the system volume must be at least the size of physical RAM installed in the Integrated xSeries Server plus 1 MB. The remainder of the paging file capacity may be on any other volume.

5.2.9 Recommendations

We make the following recommendations:

- Upgrade all disks to dynamic disks.
- Convert the C: drive from FAT to NTFS.
- Increase the size of the system paging file.
- Do not alter the data or the file formats of the D: drives.
- Do not install applications on the C: drive if you can avoid it.
- Format network server storage spaces containing user data as NTFS.
- Do not use striped volumes since they will not enhance performance.
- Be very cautious about using Windows Disk fault tolerance features.

5.3 OS/400 operations

This section describes the following OS/400 operational tasks:

- Creating a network server storage space
- Linking a network server storage space
- Unlinking a network server storage space
- Deleting a network server storage space
- Increasing the size of a network server storage space

5.3.1 Creating a network server storage space

Creating a network server storage space is the first step in adding disk space for use by a Windows 2000 server running on an Integrated xSeries Server. The time that you need to create a network server storage space is proportional to the size of the space. After you create the storage space, you must link it to the network server description of your Windows 2000 server and format it before you can use it.

Follow these steps to create a network server storage space:

1. Type `CRTNWSSTG` on an OS/400 command line, and press F4. An example of this is shown in Figure 39.

```
                    Create NWS Storage Space (CRTNWSSTG)

Type choices, press Enter.

Network server storage space . .   WIN2KSTG3     Name
Size . . . . . . . . . . . . . .   64000         *CALC, 1-64000 megabytes
From storage space . . . . . . .   *NONE         Name, *NONE
Format . . . . . . . . . . . . .   *NTFS         *NTFS, *FAT, *FAT32, *HPFS
Auxiliary storage pool ID  . . .   1             1-16
Text 'description' . . . . . . .   Windows 2000 programs & data files

                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 39. Creating a network server storage space

2. Type a name for the network server storage space in the Network server storage space parameter. This is the name by which the storage space is known to the iSeries server. Windows 2000 sees the space as a disk drive. The name must be unique among all network server storage spaces in OS/400.
3. Type a value for the Size parameter. The valid values are:

- FAT: 1 MB to 2048 MB
- FAT32: 512 MB to 32 000 MB
- NTFS: 2 MB to 64 000 MB

If you are copying the data from another storage space, you can use *CALC in the From storage space field to retrieve the size of the storage space that you want to copy.

4. If you want to copy data from an existing network server storage space, use the From storage space field to identify the storage space you want to copy.

   Note: Network server storage spaces of 1023 MB or less can only be copied to a storage space with a maximum size of 1023 MB. In other words, you cannot enlarge a server storage space of 1023 MB or less, beyond 1023 MB. Network server storage spaces of 1024 MB or more can be copied to another storage space of up to 64000 MB.

5. Indicate the type of file system (*FAT, *FAT32, or *NTFS) that you are planning to use in the Format parameter. This parameter determines the maximum size that the CRTNWSSTG command will accept. The storage space is not formatted by the CRTNWSSTG command.
6. If you want to create the storage space in an auxiliary storage pool (ASP) other than the system ASP, specify a value 2 through 16 for the Auxiliary storage pool ID field.
7. In the Description field, you can type a description for the storage space.
8. Press Enter to create the storage space.

Next, link the new storage space to the network server description of your Windows 2000 server, as described in the following section.

When the CRTNWSSTG command is executed, the network server storage space is created but not formatted. The formatting must be done from Windows 2000 after the storage space is linked to a network server description. At the time the storage space is created, all of the required iSeries disk storage is allocated. No additional iSeries disk storage will be consumed because the storage space is used by the Windows 2000 server.

5.3.2 Linking a network server storage space

A network server storage space must be linked to a network server description to make it available to Windows 2000 on the Integrated xSeries Server. A storage space may only be linked to one server at a time. The server must be varied off in order to link a storage space to it.

To link a network server storage space, follow these steps:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *NWS
   ```

   Press Enter. Vary off the network server description if it is not already varied off.

2. On an OS/400 command line, type:

   ```
   ADDNWSSTGL
   ```

   Press F4. See Figure 40 on page 98.

3. Enter the name of the network server storage space that you want to link.

4. Enter the name of the network server description to which you want to link the storage space.
5. Press F9 to see additional parameters.

```
                    Add Server Storage Link (ADDNWSSTGL)

Type choices, press Enter.

Network server storage space . . > WIN2KSTG3     Name
Network server description . . . > AS4WIN2K      Name
Drive letter . . . . . .          *FIRSTAVAIL    K-Z
Network server type  . . . . .    *NWSD          Character value
Drive sequence number  . . . . .  *CALC         3-18, *CALC

                           Additional Parameters

Access . . . . . .                *UPDATE        *UPDATE, *READ

                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 40. Linking a network server storage space to a network server description

6. Ignore the Drive letter parameter and the Network server type parameter because they do not apply to Windows 2000 servers.
7. You can let the OS/400 assign the first available drive sequence number using the *CALC value, or you can select a free drive number 3 to 18. We recommend that you use *CALC. For compatibility with pre-V4R5 installations of the Windows NT 4.0 Server, which allocated 0, 1, and 2 for drives C:, D:, and E:, the first available drive sequence number is 3.

   If you want to manually assign a drive sequence number, use the WRKNWSSTG command to verify the numbers that are already in use by the network server description.
8. Ignore the access parameter. *UPDATE access is the only option allowed with Windows 2000 servers.
9. Press Enter to link the storage space.
10. Vary on the network server description.

You must now format the storage space from Windows 2000 Disk Management, as described in 5.4.3, “Creating and formatting a volume” on page 106. Each network server storage space appears as a physical disk drive in Windows 2000 Disk Management.

5.3.3 Unlinking a network server storage space

As far as Windows 2000 is concerned, removing the link between a network server storage space and a network server description is the same as removing a hard disk from a stand-alone PC server. The disk is no longer accessible by

Windows 2000, but the data remains on the disk. Unlinked storage spaces can still be backed up by using OS/400 commands. If you put the disk back in, Windows 2000 can access the data again. In the same way, if you re-link a network server storage space to a network server description, Windows 2000 can retrieve the data.

There are cases where the drive letter that Windows 2000 uses to refer to the network server storage space must to be preserved if the user storage space is unlinked and subsequently re-linked. For example, there may be entries in the Windows registry that refer to the contents of the storage space by a specific drive letter, or there may be applications that do the same. In these situations, make sure that you re-link storage space with the drive sequence number that was used before the storage space was unlinked.

Because you can simultaneously link only 16 storage spaces, you may sometimes want to unlink storage spaces that contain infrequently used data. You also need to unlink storage spaces if you are uninstalling the Windows 2000 server from an Integrated xSeries Server.

C: drive considerations

If you are un-installing a server with a system drive larger than 1007 MB, you must unlink the C: drive storage space.

If you unlink and re-link a Windows 2000 system drive, be careful to re-link the system drive as drive sequence number 3 prior to varying on the network server. Unpredictable results can occur if you do not re-link the system drive.

Use the Remove Network Server Storage Link (RMVNWSSTGL) command to remove a link. You may prefer to use the Work with Network Server Storage (WRKNWSSTG) command, which gives you an overview of all network server storage spaces. This command enables you to add or remove links, as well as create and delete network server storage spaces.

To unlink a network server storage space, follow these steps:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *NWS
   ```

   Press Enter. Vary off the network server description if it is not already varied off.

2. On an OS/400 command line, type:

   ```
   RMVNWSSTG
   ```

   Press F4. See Figure 41 on page 100.

3. Type the name of the storage space that you want to unlink in the Network server storage space field.

4. Type the name of the server from which you want to unlink the storage space in the Network server description field. Press F9.

```
                  Remove Server Storage Link (RMVNWSSTGL)

Type choices, press Enter.

Network server storage space . . > WIN2KSTG3     Name
Network server description . . . > AS4WIN2K      Name
Renumber link  . . . . . . . . .   *YES          *YES, *NO

                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 41. Unlinking a network server storage space from a network server description

5. If you want sequence numbers to be renumbered to eliminate gaps, use the default value *YES for the optional Renumber link parameter. If you plan to re-link this storage space later and want to preserve its disk drive number within Windows 2000, specify *NO.
6. Press Enter.

Although the network server storage space is no longer linked to a network server description, it continues to exist on OS/400. You may link it to the same or another network server description, or you may delete it.

5.3.4 Deleting a network server storage space

You can delete a network server storage space if you have the proper authority and it is not linked to a network server description. You may need to delete storage spaces when you are un-installing the Windows 2000 server from an Integrated xSeries Server.

Before you can delete a storage space, you must unlink it from your network server description. To find out how to unlink it, see 5.3.3, “Unlinking a network server storage space” on page 98. After you unlink it, use the Delete Network Server Storage (DLTNWSSTG) command or the Work with Network Server Storage (WRKNWSSTG) command interface.

To delete a network server storage space, follow these steps:

1. Type DLTNWSSTG on an OS/400 command line, and press F4.
2. Type the name of the storage space in the Network server storage space field, and press Enter.

5.3.5 Increasing the size of a network server storage space

When you define a network server storage space, you assign it a fixed size. If you need to increase the size of a storage space at a later date, follow the process that is explained in this section.

Note: Network server storage spaces of 1023 MB or less can only be copied to a storage space with a maximum size of 1023 MB. In other words, you cannot enlarge a network server storage space of 1023 MB or less, beyond 1023 MB. Network server storage spaces of 1024 MB or more can be copied to another storage space of up to 64000 MB.

You can use this method to increase the size of the C: drive (Windows 2000 system drive). However, consider the following points:

- You *cannot* use Windows 2000 Disk Management to format the part of the new partition that is not formatted. You must use a tool, such as Server Magic 2.0 from PowerQuest. You can find more information regarding Server Magic 2.0 on the Web site at: `http://www.powerquest.com/product/index.html`
- The network server storage space for your enlarged C: drive is created with a new name.

If you want to copy data from an existing network server storage space, follow these steps:

1. On an OS/400 command line, type:

   ```
   WRKCFGSTS *NWS
   ```

   Press Enter. Vary off the network server description if it is not already varied off.

2. On an OS/400 command line, type:

   ```
   WRKNWSSTG NWSD(network-server-name)
   ```

   Press Enter.

3. Type `3` in the Opt column next to the storage space that you want to copy, and press Enter. The Create NWS Storage Space display appears.
4. Type a name for the new storage space in the Network server storage space field.
5. The Size field already contains the size of the storage space from which you are copying. Enter the desired size of the enlarged network drive, as shown in Figure 42 on page 102.

```
                    Create NWS Storage Space (CRTNWSSTG)

Type choices, press Enter.

Network server storage space . .   WIN2KSTG4     Name
Size . . . . . . . . . . . . . .   64000         *CALC, 1-64000 megabytes
From storage space . . . . . . .   WIN2KSTG3     Name, *NONE
Format . . . . . . . . . . . . .   *NTFS         *NTFS, *FAT, *FAT32, *HPFS
Auxiliary storage pool ID  . . .   1             1-16
Text 'description' . . . . . . .   Additional Windows 2000 storage space

                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 42. Enlarging a network server storage space

6. For a description of the other parameters on this command, see the example in 5.3.1, “Creating a network server storage space” on page 96.
7. Press Enter to create the new storage space. The data from the old storage space is automatically copied into the new storage space.

Assuming that the new storage space is *not* the C: drive, you must now format it, as described in 5.4.3, “Creating and formatting a volume” on page 106.

5.4 Windows 2000 operations

Since dynamic disks are required to use the new Windows 2000 dynamic volumes, and since many functions are not supported on basic disks, the discussions in the section assume that you will be using dynamic disks.

This section describes the following operational tasks:

- Upgrading a basic disk to a dynamic disk
- Deleting a volume
- Creating and formatting a volume
- Converting a volume to NTFS format
- Assigning or changing a drive letter
- Mounting a volume
- Extending a volume
- Creating a spanned volume
- Relocating the Windows 2000 virtual storage file (Pagefile)

5.4.1 Upgrading a basic disk to a dynamic disk

You can upgrade a basic disk to a dynamic disk at any time. Upgrading a disk to dynamic is a prerequisite to use the new Windows 2000 dynamic volume features.

To upgrade a basic disk, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Administrative Tools->Computer Management**.
2. The Computer Management window appears. Click **Disk Management.**
3. The Disk Management window appears in the right pane. See Figure 43.

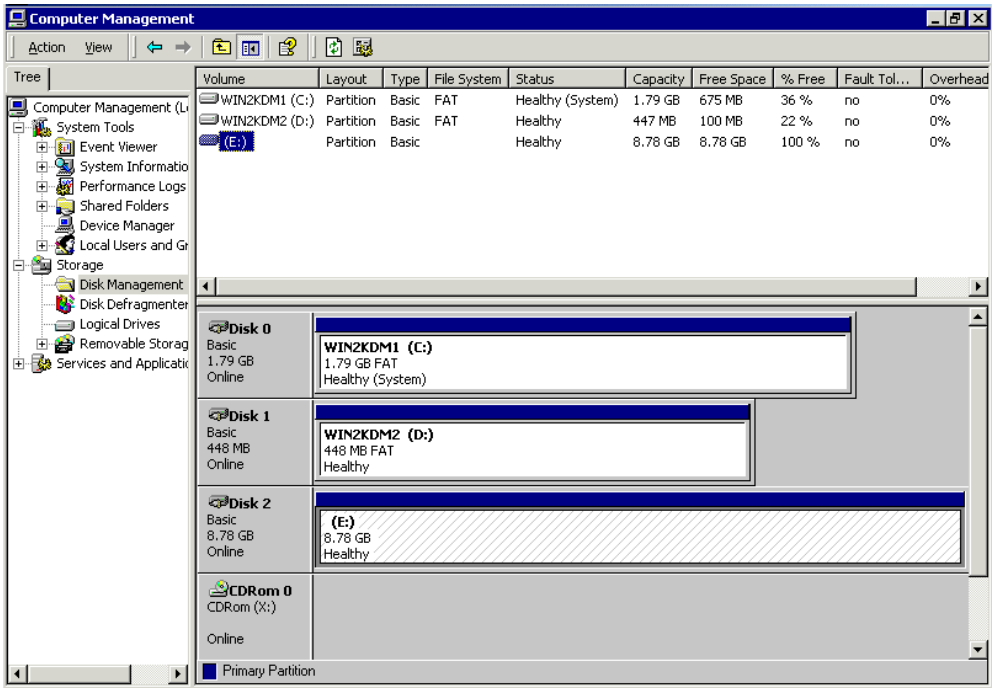

Figure 43. Disk Management: Disk 2 as a basic disk

4. Find the Windows 2000 disk that represents the network server storage space that you want to upgrade. In this case, we upgrade Disk 2, which is a newly created network server storage space. Disk 2 does not indicate a file system, since it has not yet been formatted. Disk 0 is the Windows 2000 boot and system drive. Disk 1 is the Windows 2000 CD-ROM install image.
5. Place the mouse pointer on the gray square labelled Disk 2. Right-click and select **Upgrade to Dynamic Disk...**. Do not move the mouse pointer on the larger rectangle labeled as E:. This area applies to partitions or volumes configured on the disk rather than the entire disk.
6. The Upgrade to Dynamic Disk selection windows appears. See Figure 44 on page 104. All of the basic disks are displayed. The disk that you right clicked is automatically selected. Click **OK**.

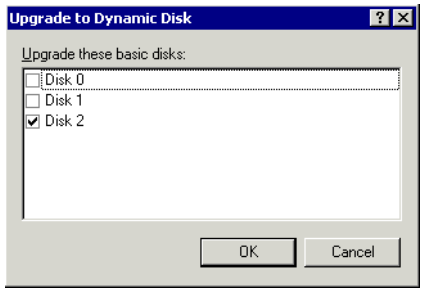

Figure 44. Upgrade to Dynamic Disk selection window

7. The Disks to Upgrade confirmation window (Figure 45) appears. You can click the Details button to see the partitions currently defined on the disk. Note that if the disk is in use by programs or contains the boot or system partition, Disk Management will delay the upgrade until the next system re-boot. Click **Upgrade**.

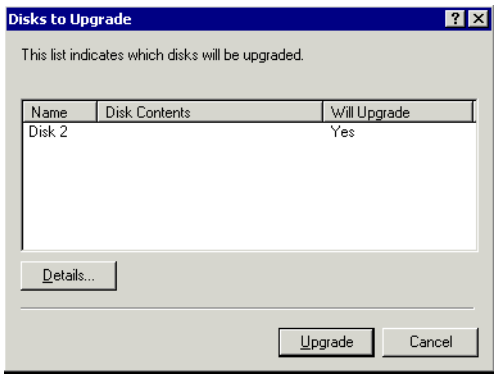

Figure 45. Disk to Upgrade confirmation window

8. A confirmation window appears and warns you that if you proceed with the upgrade, all volumes of the disk will be inaccessible to previous Windows operating systems. Click **Yes**.
9. Another confirmation window appears. This one warns that any file systems on the disk will be force dismounted. In our example, there are no file systems because the disk has not yet been formatted. Click **Yes**.

If the disk is not in use, after about a minute, the disk is converted to a dynamic disk. Otherwise, the upgrade is done during the next re-boot. Note in Figure 46 that Disk Management now indicates an 8.78 GB *simple volume* rather than a partition.

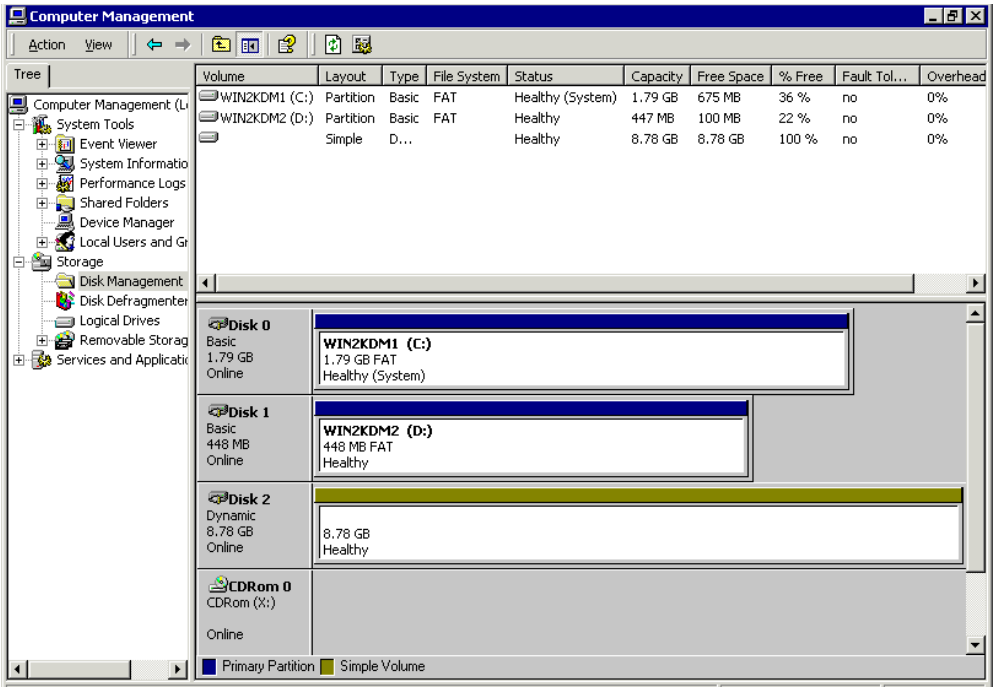

Figure 46. Disk Management: Disk 2 upgraded to a dynamic disk

5.4.2 Deleting a volume

Windows 2000 Disk Management provides the ability to delete volumes. Typically, you would do this only if you wanted to change the volume to another type of volume, for example, to convert two single volumes into one spanned volume.

Note: If you delete a volume, all data files stored on the volume are permanently deleted.

To delete a disk volume, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Administrative Tools->Computer Management**.
2. The Computer Management window appears. Click **Disk Management**.
3. The Disk Management window appears in the right pane. See Figure 46.
4. Find the Windows 2000 volume that you want to delete. In this example, we delete the volume on Disk 2, which is currently not formatted.
5. Place the mouse pointer on the horizontal rectangle that represents the volume that you want to delete. See Figure 47 on page 106. Right-click and select **Delete Volume...** Do not move the mouse pointer on the smaller gray square labeled Disk 2. This area applies to the entire disk, rather than a single volume or partition.

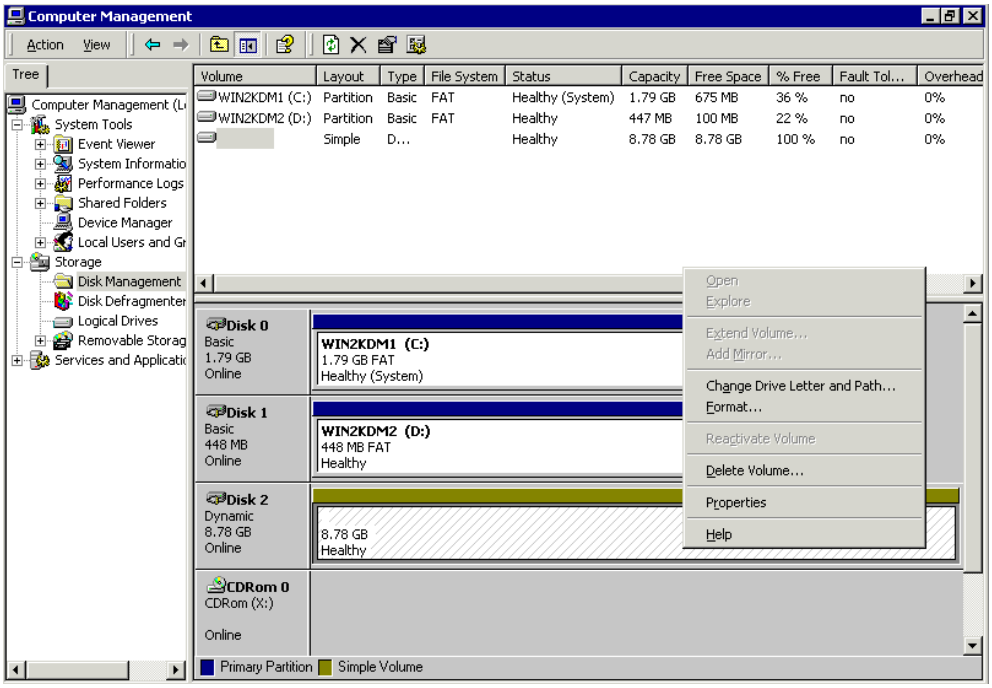

Figure 47. Deleting a volume

6. You receive a delete confirmation window, which indicates that if you continue, all data on the volume will be lost. Click **Yes**.

The volume is deleted, and the space is now listed as “Unallocated.”

5.4.3 Creating and formatting a volume

Before you can create a volume under Windows 2000, you must have an adequate amount of unallocated space on one of the Dynamic Disks. Refer to 5.3.1, “Creating a network server storage space” on page 96, and 5.3.2, “Linking a network server storage space” on page 97.

To create a volume, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Administrative Tools->Computer Management**.
2. The Computer Management window appears. Click **Disk Management.**
3. The Disk Management window appears in the right pane. Locate an area on one of the dynamic disks with sufficient unallocated space to store the new volume. In this example, we create a simple volume of 6 GB on Disk 2. Right-click the unallocated space, and select **Create Volume...**. See Figure 48.

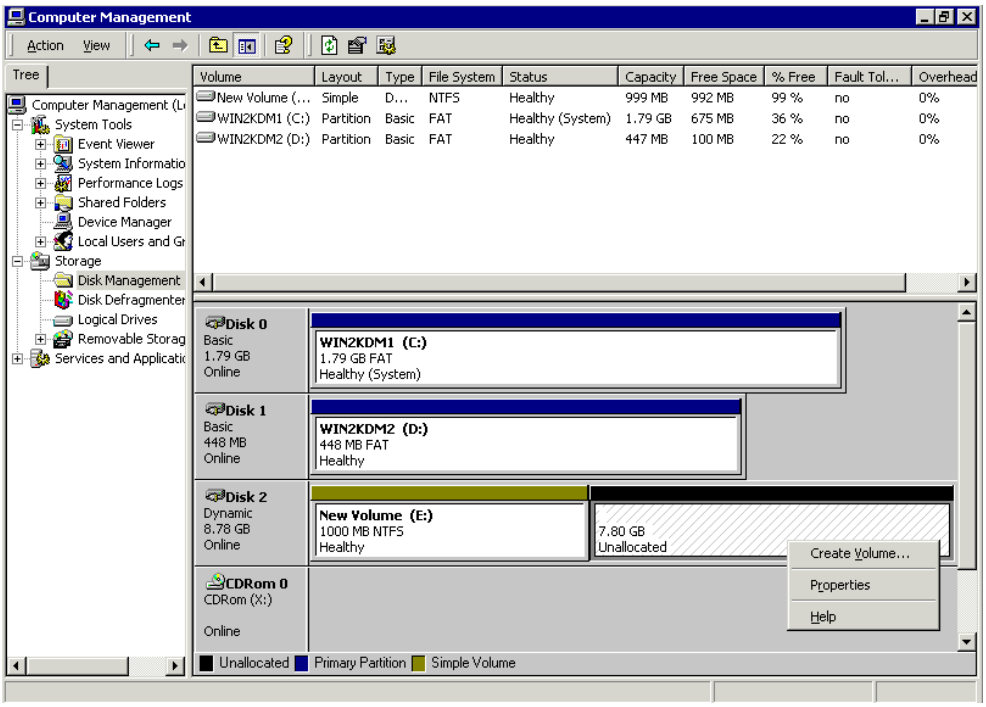

Figure 48. Creating and formatting a volume (Part 1 of 5)

4. The Create Volume Wizard is launched. Click **Next**.
5. The Select Volume Type window (Figure 49) is displayed. Select the type of volume that you want to create. In this example, we create a simple volume. Click **Next**.

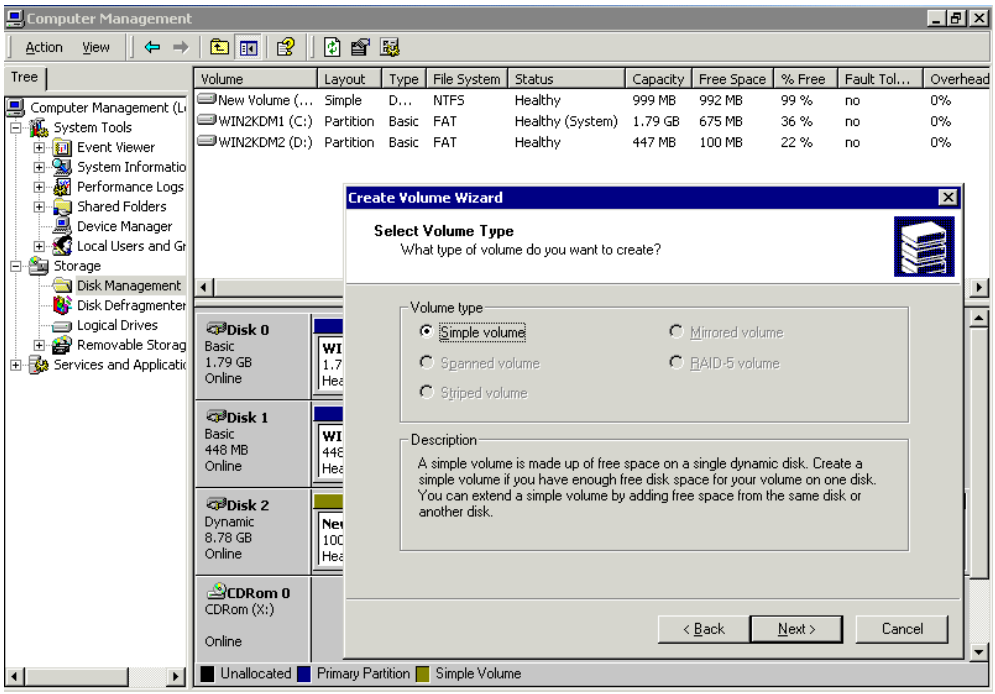

Figure 49. Creating and formatting a volume (Part 2 of 5)

6. The Select Disks window (Figure 50) is displayed. All disks with unallocated storage are displayed. Click the **Add** and **Remove** buttons to select the disk to be used to store the volume. Specify a size, in MB, for the new volume. In this example, we are creating 6 GB on Disk 2. Click **Next**.

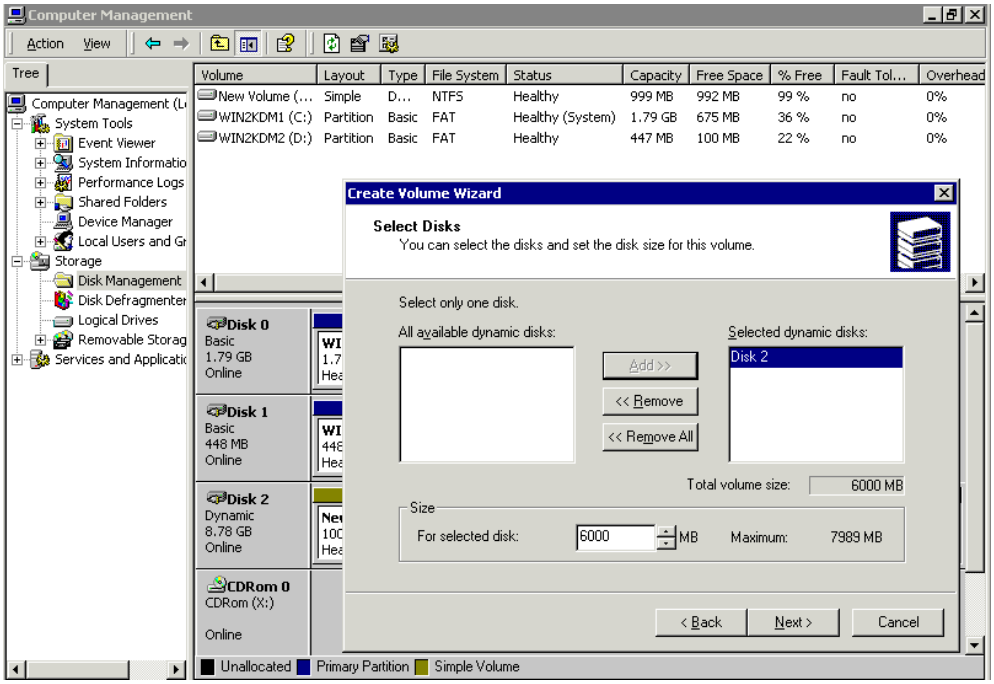

Figure 50. Creating and formatting a volume (Part 3 of 5)

7. The Assign Drive Letter or Path window (Figure 51) is displayed. By default, the next available drive letter is assigned. You can click the drop-down list to select from the available drive letters that appear. For more information on mounted drives, see 5.2.7.2, “Mounted volumes or partitions in Windows 2000” on page 94. In this example, we accepted the default of F:. Click **Next**.

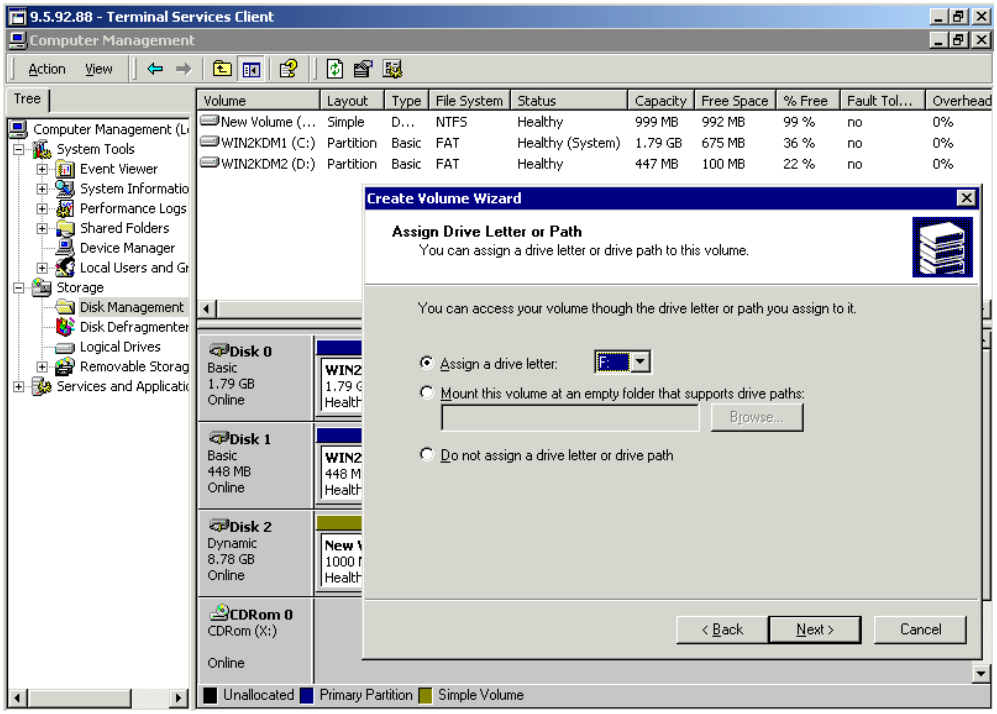

Figure 51. Creating and formatting a volume (Part 4 of 5)

8. The Format Volume window (Figure 52) is displayed. The formats that are available depend on the size you selected for the new volume. On this display, specify the volume format, the allocation unit size, a volume label, whether to perform a quick format, and whether to enable compression. Click **Next**.

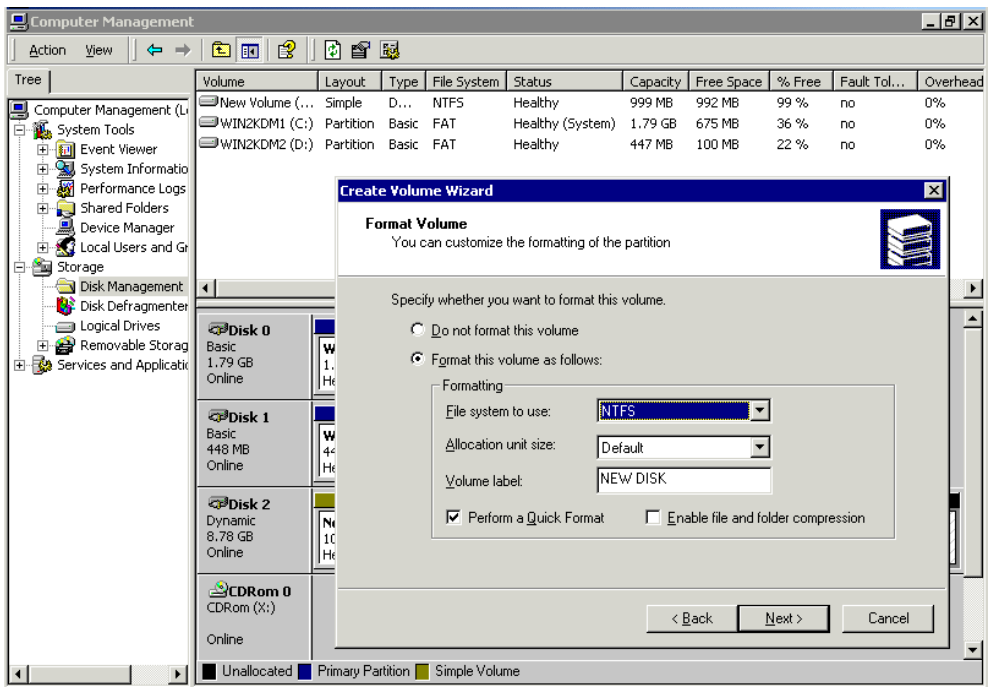

Figure 52. Creating and formatting a volume (Part 5 of 5)

9. A completing the wizard window appears that summarizes all of your selections. If necessary, you can click **Back** to revise your selections. Otherwise, click **Finish**.

The new volume is created, formatted, and ready to use.

5.4.4 Converting a volume to the NTFS format

A volume may be converted from FAT or FAT32 to NTFS at any time. You cannot convert to any other file system. Once a drive is converted to NTFS under Windows 2000, it can no longer by read by MS-DOS.

The CONVERT command, which must be run from Command Prompt, is the only method in Windows 2000 to invoke this process. Also, once a volume is converted to NTFS, you cannot revert back to FAT or FAT32.

If you specify the system drive, the conversion is deferred until the next system re-boot.

To convert a volume to NTFS, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Accessories-> Command Prompt**.
2. The Command Prompt window appears. Enter the following command:

   ```
   CONVERT x: /FS:NTFS
   ```

   Here, *x:* is the drive letter of the volume to convert. As a further validation, the command prompts you to enter the Volume ID prior to completing the conversion.

5.4.5 Assigning or changing a drive letter

With the exception of the system drive and the boot drive, you can assign or change the drive letter of a volume at any time. Windows 2000 does not allow changes to the system drive or boot drive letter. A volume may have only one drive letter assigned at a time.

In addition, be aware that when you assign a new drive letter to a volume, any programs that continue to refer to the volume by the old drive letter may not function.

To assign or change a drive letter, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Administrative Tools->Computer Management**.
2. The Computer Management window appears. Click **Disk Management**.
3. The Disk Management window appears in the right pane.
4. Find the Windows 2000 volume whose drive letter you want to assign or change. In this example, we change the first volume on Disk 2 from E: to K:. Right-click the volume, and select **Change Drive Letter and Path...**.
5. The Change Drive Letters and Path window appears. If a drive letter is already assigned, you can use the Edit button to change the drive letter assignment. If a drive letter is not assigned, click the **Add** button to assign a drive letter. To remove the drive letter assignment, select **Remove**. The drive will not be

accessible until a drive letter is assigned or the volume is mounted. Since we are changing the drive letter, click **Edit**.

6. The Edit Drive Letter or Path window (Figure 53) appears. If a drive letter is already assigned, it appears in this box. Click the down arrow on the drive letter selection box to see a list of available drive letters. In this example, we select K:. Click **OK**.

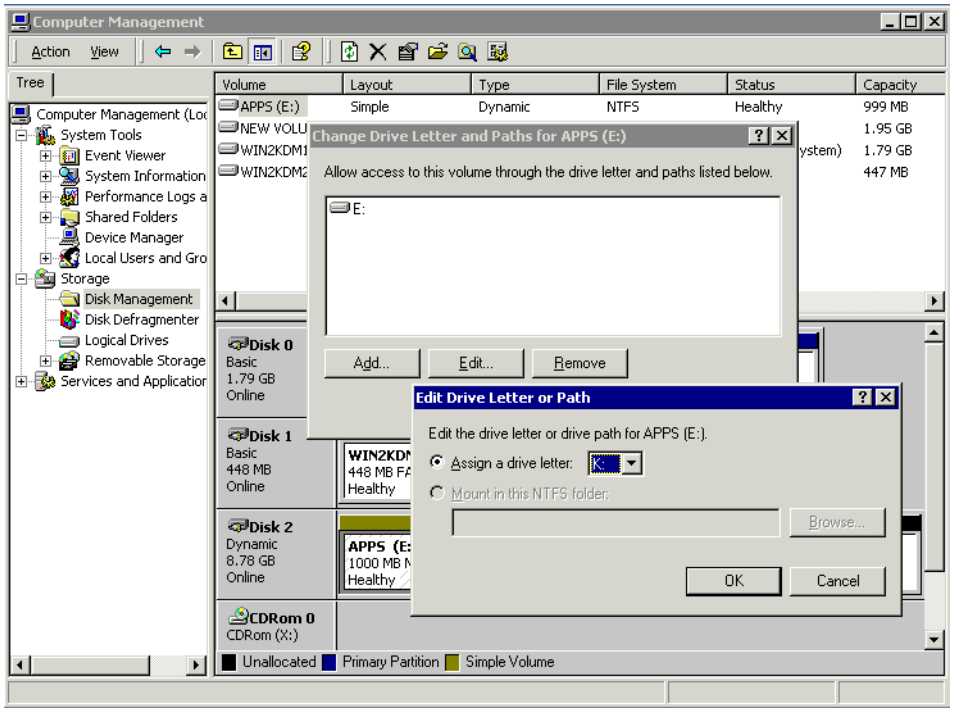

Figure 53. Changing the drive letter of a volume

7. A confirmation window appears and advises you that changing the drive letter may cause certain programs to no longer run. Click **Yes**.

The new drive letter of the volume is now reflected in the Disk Management window. If necessary, you can always change the drive letter back to the original assignment.

5.4.6 Mounting a volume

Prior to Windows 2000, the only way to reference a volume was through its assigned drive letter. Now a volume can be referenced or “pointed to” by an empty folder on another NTFS partition. This is called “mounting the volume”. For further information, see 5.2.7.2, “Mounted volumes or partitions in Windows 2000” on page 94.

Unlike drive letter assignments, a volume may be mounted more than once at the same time.

To mount a volume, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Administrative Tools->Computer Management**.
2. The Computer Management window appears. Click **Disk Management**.

3. The Disk Management window appears in the right pane.
4. Find the Windows 2000 volume that you want to mount. In this example, we mount the second volume on Disk 2. This volume is not currently mounted and does not have a drive letter assignment. Therefore, currently it is not accessible. Right-click the volume, and select **Change Drive Letter and Path...**.
5. The Change Drive Letters and Path window appears. If the volume is already mounted, you can use the **Edit** button to change the mount, or you can use the **Add** button to specify an additional mount for the volume. To remove one or more mounts for the volume, select **Remove**. Since we are adding a mount, we clicked Add.
6. The Add New Drive Letter or Path window (Figure 54) appears. Select the **Mount in this NTFS folder** radio button. Enter an empty folder on an NTFS drive that will be used to point to this partition. If you want to create a new empty folder, click **Browse**.

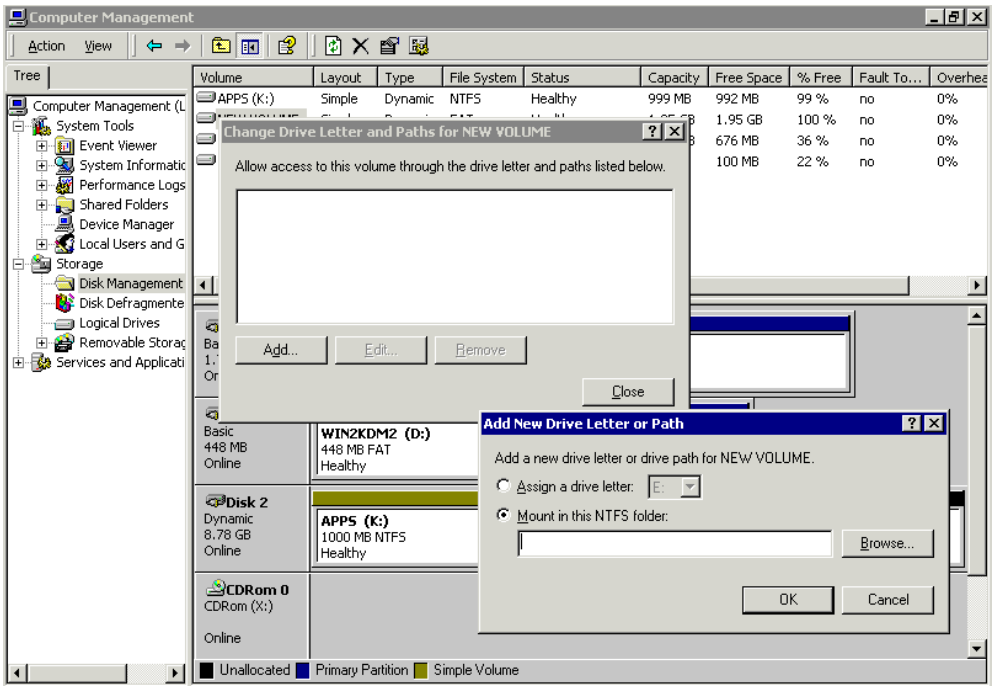

Figure 54. Mounting a volume to an NTFS folder

7. The Browse for Drive Path window appears. All NTFS volumes are displayed. Click the drive that you want to select. Click **New Folder**.
8. A new folder appears under the drive named “New Folder.” See Figure 55. Double-click the name **New Folder**; you can change the name to something more meaningful. In this example, we create an empty folder named MAKDCE. Click **OK**.

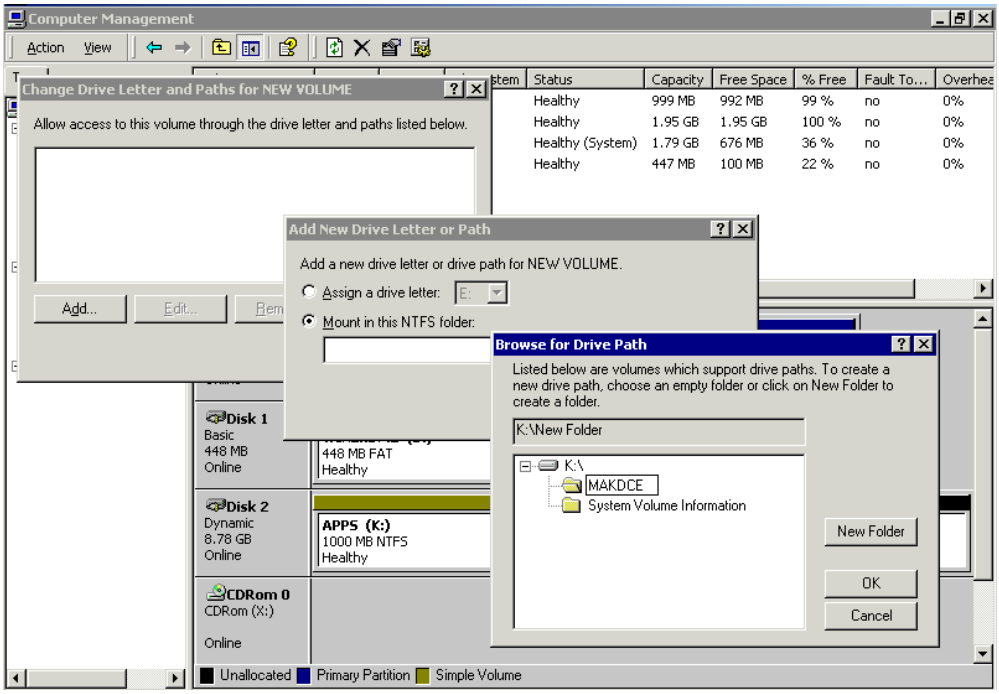

Figure 55. Creating an empty folder to mount a volume

9. The new empty folder is created on the NTFS volume that you selected. The path is automatically filled in on the Add a New Drive Letter or Path window. Click **OK**.

The volume is now successfully mounted. From this point forward, it will appear that the partition is contained within the empty folder that you created. You can tell that this is a mounted drive because the icon associated with the empty folder now automatically appears as a disk drive rather than a folder.

5.4.7 Extending a volume

You can extend a basic volume on a dynamic disk if there is unallocated space available on the same disk or another disk.

To extend a volume, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Administrative Tools->Computer Management**.
2. The Computer Management window appears. Click **Disk Management**.
3. The Disk Management window appears in the right pane. Locate the volume you want to extend. Also locate an area on a dynamic disk with sufficient unallocated space to store the extension. In this example, we extend the simple volume assigned K: on Disk 2. Right-click the unallocated space, and select **Extend Volume...**.
4. The Extend Volume Wizard is launched. Click **Next**.
5. The Select Disks window (Figure 56 on page 114) is displayed. Use the **Add** and **Remove** buttons to select the dynamic disk to store the extension. In this example, we create an extension of 5 GB on Disk 2. Click **Next**.

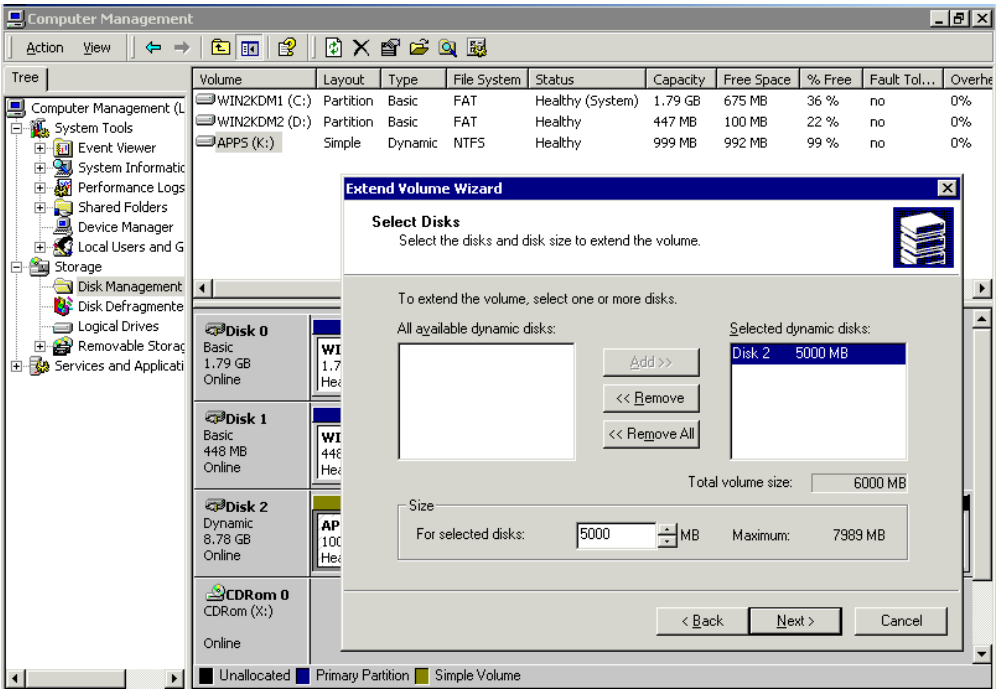

Figure 56. Extending a simple volume

6. A Completing the Wizard window appears that summarizes all of your selections. If necessary, you can click **Back** to revise your selections. Otherwise, click **Finish**.

The volume is now extended, formatted, and ready to use. It retains the same drive letter or mounts as it had before the extension.

5.4.8 Creating a spanned volume

Before you can create a spanned volume under Windows 2000, you must have an adequate amount of unallocated space on two or more dynamic disks. Refer to 5.3.1, “Creating a network server storage space” on page 96, and 5.3.2, “Linking a network server storage space” on page 97.

A spanned volume allows you to refer to the space on several disks by one drive letter or as one mounted volume.

To create a spanned volume, follow these steps:

1. On the Windows 2000 console, click **Start->Programs->Administrative Tools->Computer Management**.
2. The Computer Management window appears. Click **Disk Management**.
3. The Disk Management window appears in the right pane. Locate an area on two or more of the dynamic disks with sufficient unallocated space to store the new volume. In this example, we create a spanned volume of 3.92 GB made up of 1.92 GB on Disk 2 and 2.0 GB on Disk 3. Right-click either of the unallocated spaces, and select **Create Volume...**.
4. The create volume wizard is launched. Click **Next**.

5. The Select Volume Type window (Figure 57) is displayed. Select the type of volume that you want to create. In this example, we are creating a spanned volume. Click **Next**.

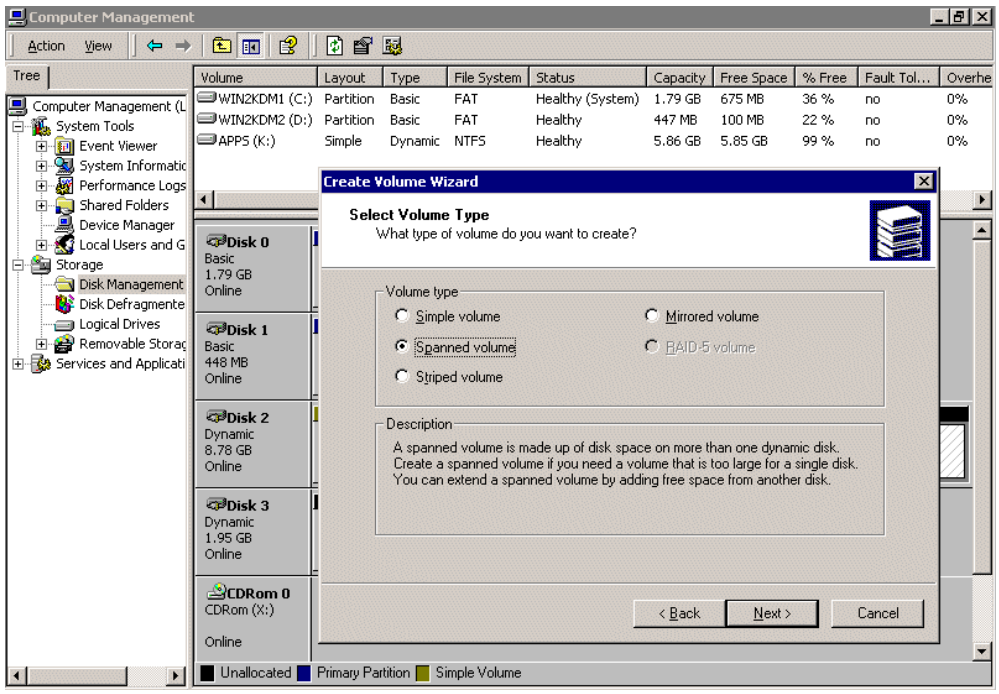

Figure 57. Creating a spanned volume (Part 1 of 3)

6. The Select Disks window (Figure 58 on page 116) is displayed. All disks with unallocated storage are displayed. Use the **Add** and **Remove** buttons to select the disk to be used to store the volume. Specify a size, in MB, for the new volume. In this example, we are creating 3.92 GB spanned volume made up of 1.92 GB on Disk 2 and 2 GB on Disk 3. Click **Next**.

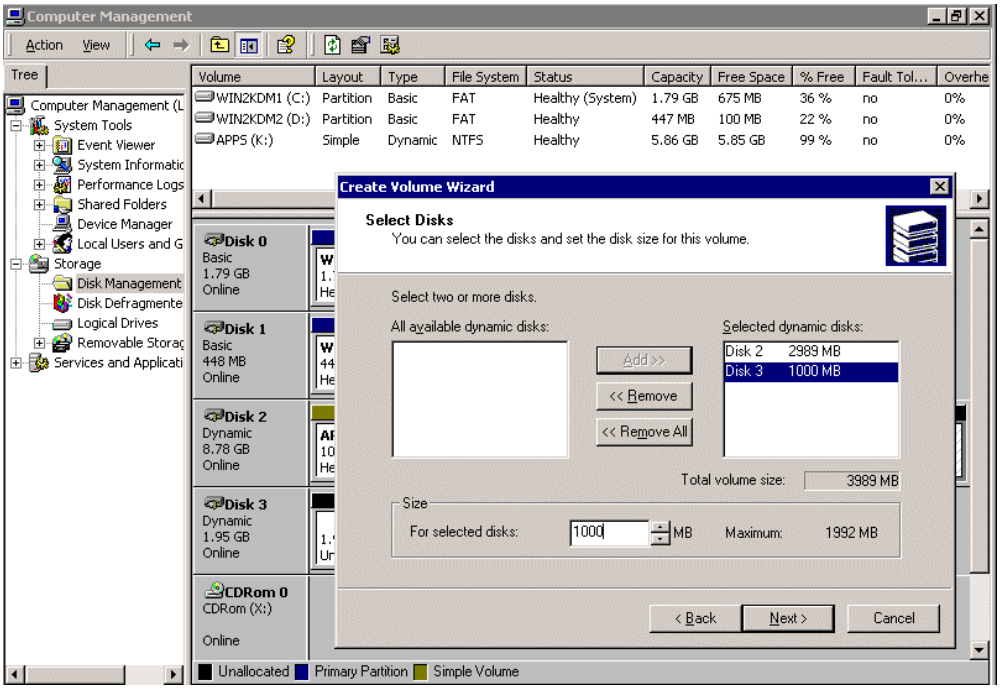

Figure 58. Creating a spanned volume (Part 2 of 3)

7. The Assign Drive Letter or Path window is displayed. By default, the next available drive letter is assigned. You can click the drop-down list to select from the available drive letters that appear. For more information on mounted drives, see 5.2.7.2, “Mounted volumes or partitions in Windows 2000” on page 94. In this example, we accepted the default of E:. Click **Next**.
8. The Format Volume window is displayed. The formats that are available depend on the size you selected for the new volume. On this display, you specify the volume format, the allocation unit size, a volume label, whether to perform a quick format, and whether to enable compression. Click **Next**.
9. A completing the wizard window appears that summarizes all of your selections. If necessary, you can click **Back** to revise your selections. Otherwise, click **Finish**.

The new spanned volume is created, formatted, and ready to use as shown in Figure 59. For Windows 2000, the spanned volume is treated as one contiguous space.

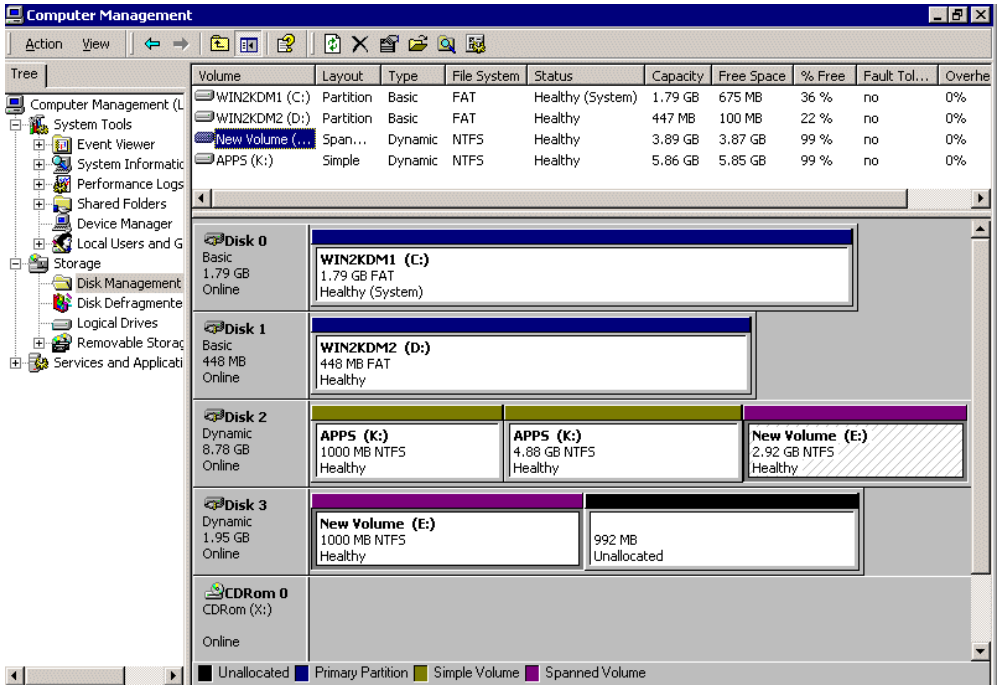

Figure 59. Creating a spanned volume (Part 3 of 3)

5.4.9 Configuring the Windows 2000 virtual storage file (Pagefile)

For a discussion of the various reasons why you may want to change the configuration of the Windows 2000 virtual storage file, see 5.2.8, “Windows 2000 virtual memory paging file (Pagefile.sys)” on page 95.

If you are *increasing* the size of a paging file or creating a new paging file on a disk, the change is effective immediately. If you are *reducing* the size of a paging file, the change is deferred until the next system reboot.

To configure the Pagefile, follow these steps:

1. Click **Start->Settings->Control Panel**.
2. Double-click **System**.
3. Select the **Advanced** tab.
4. Click the **Performance** button.
5. The Performance Options window appears as shown in Figure 60 on page 118.

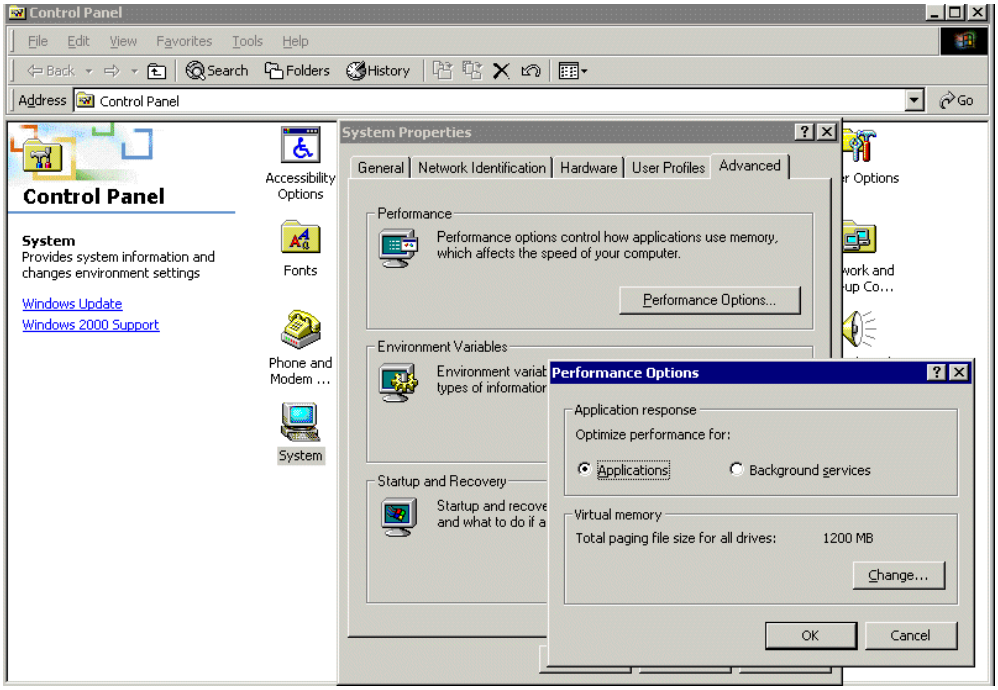

Figure 60. Configuring the Windows 2000 virtual memory file (Part 1 of 2)

6. The total size of the virtual memory page file is displayed. This is the sum of all page files on all drives.
7. Click the **Change** button.
8. The Virtual Memory window (Figure 61) appears. Each disk drive is displayed in the scroll bar at the top of the window. Click a drive, and then set the initial and maximum size of the paging file *on that drive*. You can delete a page file by setting the initial and maximum size to 0. A page file deletion or a reduction is size is not completed until the next server re-boot.

   Note that the recommended size of all of the paging files is displayed.

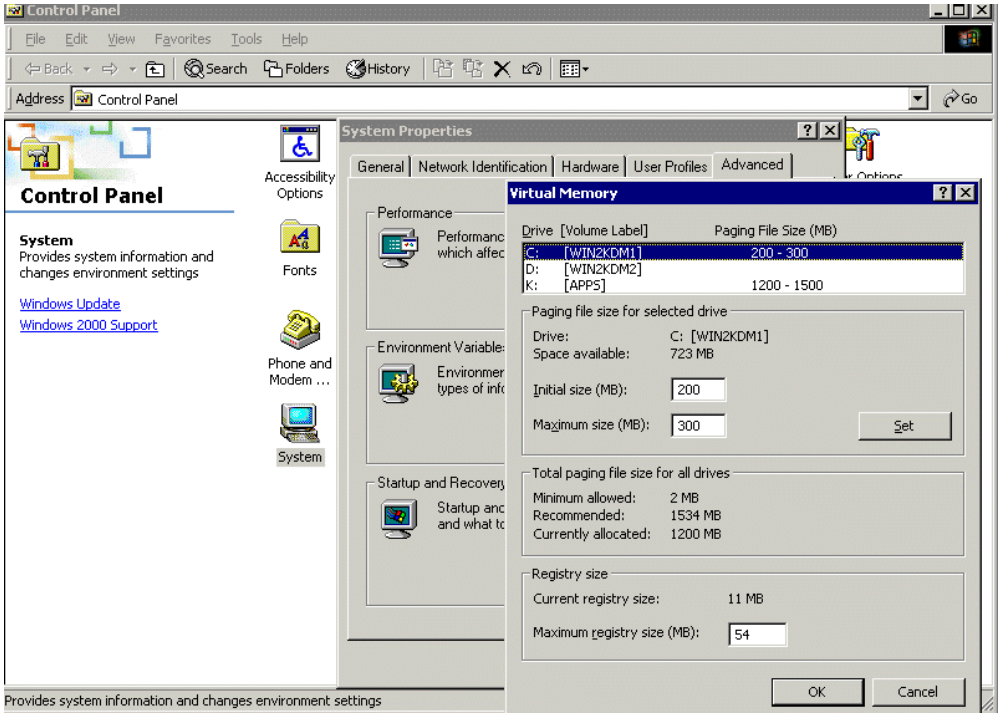

Figure 61. Configuring the Windows 2000 virtual memory file (Part 2 of 2)

9. Click **Set**.
10. You may see a warning message that indicates the size of the pagefile on the system drive is inadequate to store debugging information. If you receive this message, you should increase the size of the file, if possible.
11. Click **OK** three times.
12. If the changes you performed require a re-boot to become active, you are given the opportunity to re-boot at this time. If you click **Yes**, the Windows 2000 server is immediately re-booted. If you click **No**, the changes are deferred until the next the Windows 2000 server re-boot.

Chapter 6. User administration

One of the primary benefits of installing the Windows 2000 server on the Integrated xSeries Server is the ability to integrate the administration of users on both the iSeries and Windows 2000 servers. This chapter look at how you set up and use this integration.

6.1 Overview of user integration

The processes of enrollment and propagation allow you to administer Windows 2000 user accounts from the iSeries server. User integration also minimizes the amount of work that the administrator needs to do when managing users on the Windows 2000 server.

Enrollment is the process by which an OS/400 user or group profile is registered with the integration software by using the Change Network Server User Attributes (CHGNWSUSRA) command.

Propagation is the process by which a newly enrolled OS/400 user or group profile, or updates to profiles, are sent to either:

- The domain of which the Windows 2000 server, running on an Integrated xSeries Server in the local iSeries, is a member.
- The Windows 2000 server running on an Integrated xSeries Server in the local iSeries server, which is not part of a domain.

This chapter refers to these two propagation targets as the *domain* and *local server* respectively, or generically as the *Windows 2000 environment*.

The enrollment and propagation processes happen automatically when they are triggered by an event such as running the CHGNWSUSRA command to enroll a user or group, a user updating their password on the iSeries server, or restarting the Windows 2000 server.

Modifications to enrolled OS/400 user profiles, especially passwords, are propagated to the Windows 2000 domain or local server in real time. The synchronization of passwords is one of the main benefits of running the Windows 2000 on the Integrated xSeries Server because of the greatly reduced administration of user accounts and passwords.

6.2 OS/400 groups in Windows 2000

The following groups are created in the domain or on the local server as part of the installation of Windows 2000 on the Integrated xSeries Server (see Figure 62 on page 122). They perform functions specifically related to user propagation.

- AS400_Users
- AS400_Permanent_Users

In releases prior to Version 4 Release 5, these group names were called OS/400_Users and OS/400_Permanent_Users. The “/” character is not allowed in Windows 2000 user and group names. Therefore, a new integrated Windows 2000 server, or one upgraded from Windows NT, will automatically use the new

group names. For integrated Windows NT servers (running on releases prior to V4R5) in a Windows 2000 domain, you must run the `qconvgrp` utility to update the group names. This utility is included with the Integration for Windows Server (5769-WSV) program product, option 1, at Version 4 Release 5. It is also available in an integration service pack for previous releases. This utility may be found on the D: drive of the integrated Windows NT server. You need to run it from a Windows NT command line.

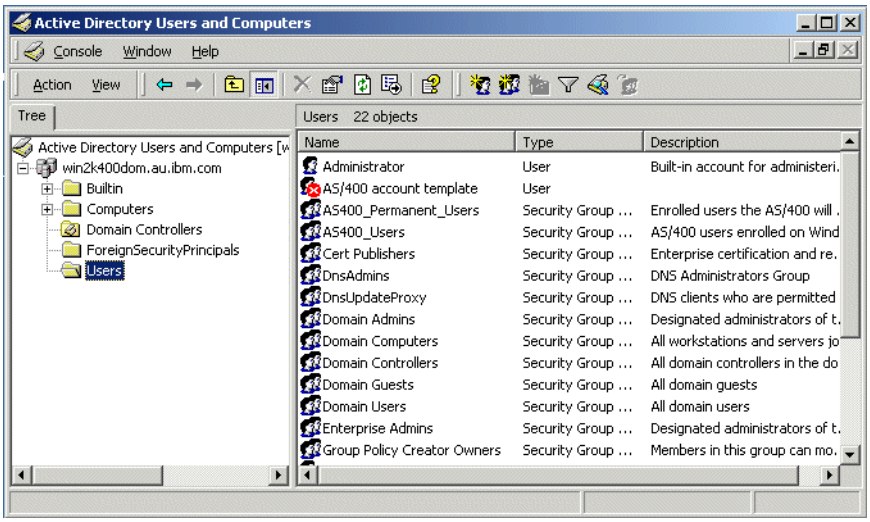

Figure 62. New OS/400 groups in a Windows 2000 domain

6.2.1 OS400_Users group

Every user propagated from OS/400 to the Windows 2000 environment is automatically added to the OS400_Users group. This group is a useful place to find out which OS/400 user profiles are enrolled. You can remove a user from this group by using Active Directory Users and Computers, in the case of a domain, or Local Users and Groups, in the case of a local server. However, the next time an update occurs for that user from the iSeries server, for example, by using the Work with Network Server Enrollment (WRKNWSENR) display and selecting option 6 next to the user, or when the server is next varied on, the user is placed back into the group by the integration function.

6.2.2 AS400_Permanent_Users group

In certain environments, it may be important to prevent an OS/400 administrator from deleting a Windows 2000 account without realizing the potential consequences. To address this situation, you can manually add the account to the OS400_Permanent_Users group. Users that are in this group cannot be deleted from the Windows 2000 environment by commands initiated from OS/400. The Windows 2000 administrator must delete them manually from this group before you can delete them from the OS/400.

If you remove a user from this group on Windows 2000, the user is not replaced in the group by the OS/400 integration function. This applies even if you use the WRKNWSENR command and select option 6 next to the user, as you might do with the OS400_Users group.

6.3 User enrollment templates

When you create a user profile in OS/400, you designate a security level (*SECOFR, *USER, *PGMR, and so on). When the user is enrolled in the Windows 2000 environment, the OS/400 security attributes are *not* carried across. The reason is that there is no direct mapping between the implementation of security in the iSeries and Windows 2000 servers. To work around this problem, you can use a *template*, which is a normal Windows 2000 user account that has the characteristics that you want given to an OS/400 user profile when the profile is propagated to Windows 2000. You can set up a number of templates, of which each correspond to a different class of user under Windows 2000. You can use any Windows 2000 user account as a template, even an existing user. Templates must be set up before you start enrollment. You can have as many templates as you want, although we recommend that you keep the number within manageable proportions. Typically, you need a template for each major type of users.

If you do not use a template when you enroll OS/400 users, each user becomes a member of the Windows 2000 *OS400_Users* group and *Users* group if you enroll locally on a Windows 2000 local server. They become members of the *OS400_Users* group and *Domain Users* group if you enroll in a Windows 2000 domain.

If you want Windows 2000 security to be part of the template that is used to create the Window 2000 user account, you must make sure that the template account is a member of groups that have the appropriate level of authority assigned to them for the users you want to enroll. Notice that the template user account does not pass on its rights and permissions to propagated users. The assignment of rights and permissions to users and groups is handled in the normal way on the Windows 2000 server by the administrator.

The enrollment of a user in the domain, or locally on a Windows 2000 server, results in a user account that is created with the characteristics of the template, in addition to some of the settings in the OS/400 profile. The following attributes of a profile in OS/400 are propagated to the corresponding Windows 2000 account in real time, either at or following enrollment (parameter names are shown in uppercase letters):

- User or group profile name: USRPRF (at enrollment only)
- Password: PASSWORD
- Password expired: PWDEXP (propagation occurs at midnight following expiration)
- Profile status: STATUS
- Text description: TEXT
- Group profile of which the user profile is a member: GRPPRF (if the group is enrolled)
- Supplemental groups of which the user profile is a member: SUPGRPPRF (if the groups are enrolled)

Templates are really only for use when Windows 2000 accounts are created. Therefore, it is most important to make sure that the templates you use are an accurate reflection of the way you want the users enrolled in Windows 2000 to be

set up. Any subsequent changes to user accounts must be made within the Windows 2000 environment, because after enrollment, the template is not used again for that user. Therefore, any changes to the template only affect users enrolled after the change. Changing an OS/400 user to use a different template after enrollment also has no effect. Notice, however, that if you add the user to a different OS/400 group (also enrolled), the Windows 2000 user account is also added to this Windows 2000 group.

Following enrollment, the user should be treated as a normal Windows 2000 account for allocation to additional groups, logon restrictions, and so on. These changes should be administered in the normal way using the Active Directory Users and Computers function on a domain controller or the Local Users and Groups function on a local server.

The OS400_Users group is maintained automatically and should not be changed. We recommend that you do not remove users from this group, although there is no harm in doing so. Remember that enrolled user accounts should not be deleted from the Windows 2000 environment unless you are really sure. This results in the loss of ownership of files on the Windows 2000 server because of the Security ID (SID) change (explained in 6.6.3, “Ending enrollment: OS/400 or Windows users, groups not deleted” on page 148).

To be safe, you can add the OS400_Permanent_Users group to the template accounts to make sure that every OS/400 user is a member of this group, and therefore, cannot be deleted accidentally from Windows 2000 by a user in OS/400.

Generally speaking, you can make any changes you want to a Windows 2000 account that has been enrolled on the iSeries server, except for those settings that are propagated across from the corresponding OS/400 user profile. Any changes on Windows 2000 to these propagated settings will simply be overwritten by OS/400 the next time propagation occurs.

6.3.1 Example of template use

Table 8 shows examples of OS/400 groups and the templates used by them when enrolling users in a Windows 2000 domain. These are used to describe what happens when you modify a user from the OS/400.

Table 8. Example of template use

OS/400 profile	Windows 2000 template	Windows 2000 groups in template
USERGRP	TEMPUSER	Domain Users
ADMNGRP	TEMPADMN	Domain Users, Administrators
Single User	TEMPHOUR	OS400_Permanent_Users

The user profile STAGG is created on the iSeries server and made a member of the OS/400 group USERGRP. Because this group is enrolled in the Windows domain, STAGG is automatically enrolled in the domain and becomes a member of the Windows 2000 groups USERGRP, OS400_Users, and Domain Users. STAGG becomes a member of USERGRP as a result of being a member of that group on the iSeries server, which has also been enrolled to the domain. STAGG becomes a member of OS400_Users because all enrolled users become

members of that group on Windows 2000. STAGG is included in the Domain Users group because it is specified in the template account TEMPUSER.

If you add STAGG to the OS/400 group ADMNGRP (which is also enrolled in the domain), the only change you would see in Windows 2000 is that STAGG is added to the group ADMNGRP, in addition to the other groups of which user STAGG is already a member. STAGG will *not* become a member of the Administrators group because the template TEMPADMN was not selected when user STAGG was first enrolled. If user STAGG is re-enrolled using the template TEMPHOUR, there are no changes made to the corresponding Windows 2000 account. Again, the only time a template can be used is when a profile is enrolled for the first time.

6.3.2 Password considerations

Because OS/400 passwords are not case-sensitive, the propagation process converts all passwords to lowercase before passing them to Windows 2000.

If the OS/400 QSECURITY system value is set to 10, the Windows 2000 accounts that are created do not require a password to sign on. All other QSECURITY levels require that a user account has a password to sign on. Refer to *OS/400 Security Reference*, SC41-5302, for more information regarding OS/400 security levels.

If you want passwords to expire after a certain amount of time, this should be set on the iSeries server. When a user next signs on to OS/400 after their password has expired, they receive a message telling them that their password has expired, and they are given the opportunity to change it. Every night at midnight, the Windows integration function checks OS/400 for expired users. This information is sent to the Windows 2000 domain or local server where the integration code sets the User must change password at next logon option (unless the Windows Password Never Expires option has been set). If expired Windows users try to sign on to the domain or local server, they are prompted to change their password. Although they can reset their password and sign on to the domain or local server, they must also change their password on the OS/400. If they don't, their Windows password will be overwritten by the (expired) OS/400 password at midnight or when the server is restarted.

This behavior is different than for OS/400 releases prior to Version 4 Release 5, where the Windows NT account was disabled by the OS/400 integration software if the OS/400 password expired. In some cases, this caused problems because Windows users often gain access to the iSeries series through an emulator under Windows. When they could not sign on to Windows, they were not able to gain access to the iSeries server to change their passwords.

Notice the following special cases:

- If the Windows Password Never Expires option has been set, you can always sign on to Windows, even when your password has expired in OS/400. This special case is discussed more, later in this section.
- If the user can sign on locally to their workstation (as opposed to the domain), the user can log on, start an emulation session on the OS/400, and change their password. Then, the user can log onto the domain or local server again because the new password has been propagated to the Windows

environment. The user should also change the local workstation password to keep it in synchronization with the domain or local server account.

If a user profile is disabled in OS/400, it is also disabled in the Windows 2000 environment and must be reset in OS/400 before the user can log on to the domain or local server again. If a disabled Windows account is enabled by the Administrator, the user is allowed to log on using that account to the domain or local server. However, when OS/400 refreshes the profile, it is once again disabled. Also, if the user password is changed on the domain or local server, it is changed back to the OS/400 value at the next propagation.

The following considerations apply when setting up user accounts in the Windows environment:

- When you set up a user on a Windows domain or local server, you normally leave the default password value set at *User must change password at next logon.* However, in an Integrated xSeries Server environment, this setting is not appropriate because the password is controlled from OS/400. You do not want the user to modify their password through Windows. If the user changes their password from the Windows side, it is overwritten by the user's OS/400 password the next time the server is restarted. Therefore, we strongly recommend that you *de-select* the **User must change password at next logon** setting in your templates. Windows users must receive their password changes from OS/400 and are not subject to any attempted changes made from the Windows side.
- We recommend that you *select* **User cannot change password** in the template account. This prevents the user from changing the password from the Windows side, therefore, causing OS/400 and Windows passwords for this user to be out of synchronization.
- We also recommend that you *select* **Password never expires** in the template account. Otherwise, Windows may expire the user's password before it expires in OS/400. If this happens, any attempt to change the password from the Windows side is either rejected (if you select User cannot change password) or overwritten by the propagation process (if the password is changed by the Windows Administrator).

Prior to Version 4 Release 4, the Windows NT *Password never expires* option was *not* honored by the OS/400 *Password expiration interval* setting in the user profile. In other words, if a user's OS/400 password expired, the user integration code would also expire the user's Windows NT password, even if the Windows NT *Password never expires* option was selected. However, with Version 4 Release 4 and later releases, it is honored, and this change has been made available for Version 4 Releases 2 and 3. This change may create a security exposure in cases where users infrequently log on to OS/400. In this case, if you select the Windows NT or 2000 *Password never expires* option, the user is not prompted to change their password until the next time they log on to the OS/400. Therefore, they may still be able to log on to the domain or local server long after their password has expired in OS/400. For users of this type, you may *not* want to select the *Password never expires* option. In this case, either OS/400 or Windows expires the user's password on the domain or local server, depending on which password expiration interval is reached first. In either case, the user must reset their password in OS/400 by either logging on to their workstation and changing it through an emulator session or by asking the OS/400 administrator to change it.

As mentioned previously, the user can now always log on to the domain or local server even if their OS/400 user profile has expired. Even if the user does not have the *Password never expires* option set in their user account, they will be prompted to change their password when they try to log on to Windows.

In summary, be careful about who has control of user profiles and from where profiles are modified. Also, use discipline when managing control of these files. It is usually more appropriate to use OS/400 for user administration whenever possible.

6.3.3 Recommended template settings

Templates should reflect as closely as possible the characteristics of the Windows 2000 accounts that you want to create. The following recommendations may help you to set up your templates:

- For iSeries server users:
  - De-select **User must change password at next logon**.
  - Select **User cannot change password**.
  - De-select **Password never expires** (refer to 6.3.2, “Password considerations” on page 125, for a discussion of this setting).
  - Select **Account is disabled**. This prevents anyone signing on to Windows 2000 with the template user account itself. This setting is overwritten when the Windows 2000 account is created (the enrolled user has a status of enabled).
- For a Windows administrator:
  - Membership of the OS400_Permanent_Users group is strongly recommended because you do not want an administrator to be deleted accidentally from OS/400.
  - Membership of the Administrators group is required if you are enrolling users on a local server. For a domain, it is Domain Admins.
  - There may be other groups of which you want this administrator to be a member.
  - The administrator may require dial-in capability for out-of-hours support.

After the Windows 2000 accounts are created, you may want to make some of the following changes to a particular user:

- Enter a description (for example, Member of Accounts Department).
- Membership of the OS400_Permanent_Users group may be beneficial.
- Membership of specialist groups may be required. Enrolled OS/400 users default to membership of the Users group if they are enrolled locally to a server, or Domain users if they are enrolled in a domain.
- Logon hours restrictions may apply.
- Workstation restrictions may apply.

6.3.4 Creating a Windows 2000 template account

Depending on whether your Windows 2000 server is part of a domain or is a local server, refer to the following section or 6.3.4.2, “Creating a Windows 2000 template account on a local server”.

6.3.4.1 Creating a Windows 2000 template account in a domain

Template accounts enable you to enroll OS/400 users and groups in a domain with a pre-defined set of characteristics.

To create a user template in a domain, follow these steps:

1. Click **Start->Programs->Administrative Tools->Active Directory Users and Computers** from the Windows 2000 server console.
2. Right-click the Users folder, and select **New->User**. The display shown in Figure 63 appears.

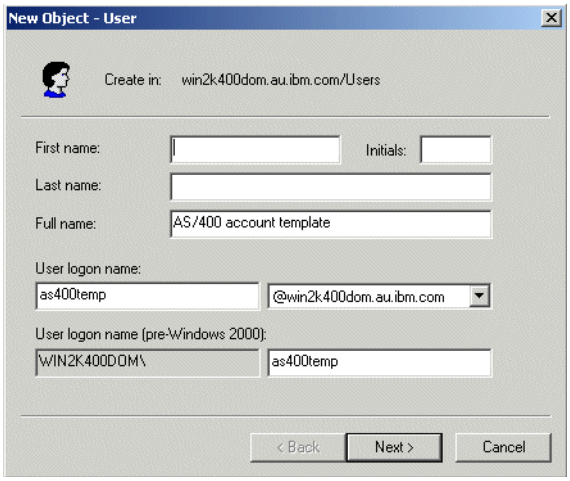

Figure 63. Creating a Windows 2000 template account in a domain (Part 1 of 2)

3. Type a distinctive name for the template, such as *tempuser* or *as400temp*, in the User logon name field.
4. Type a description of the template in the Full name field. Click **Next**. The display in Figure 64 appears.

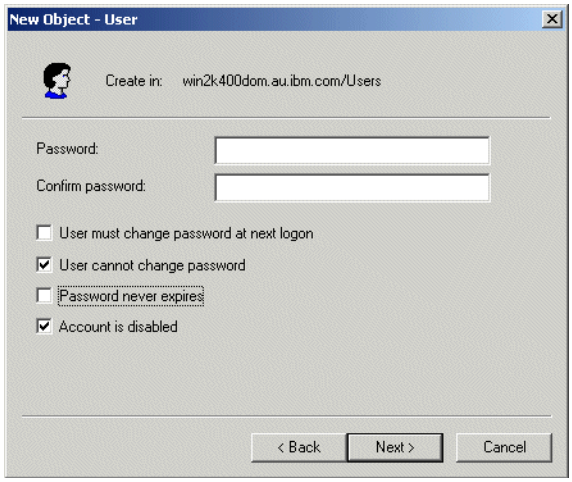

Figure 64. Creating a Windows 2000 template account in a domain (Part 2 of 2)

5. You do not need to enter a password for a template account. Select the **Account is disabled** box and other password boxes as required. Click **Next**.
6. Click **Finish** to create the account. Notice that an “x” within a red circle indicates that the account is disabled.
7. Right-click the account, and select **Properties**. Customize the template account as required.

6.3.4.2 Creating a Windows 2000 template account on a local server

Template accounts enable you to enroll OS/400 users and groups on a local server with a pre-defined set of characteristics.

To create a user template on a local server, follow these steps:

1. To create a user template on a local server, select **Start->Programs->Administrative Tools->Computer Management-> Local Users and Groups** from the Windows 2000 server console.
2. Right-click the **Users** folder, and select **New User...**. The display in Figure 65 appears.

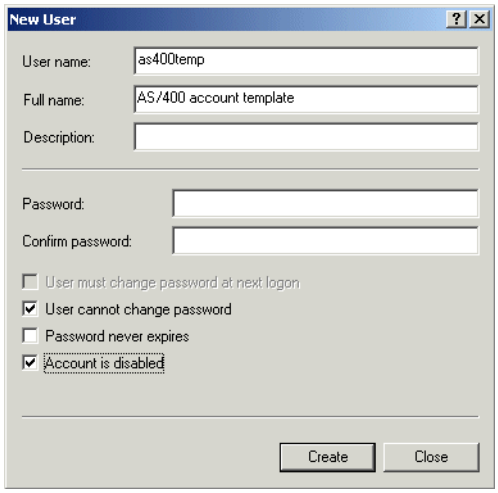

Figure 65. Creating a Windows 2000 account template on a local server

3. Type a distinctive name for the template, such as *tempuser* or *as400temp*, in the User name field.
4. Type a description of the template in the Full name field. Click **Create**. The template is created.
5. Click **Close**.

6.3.5 Specifying a home directory in a template

To allow the Windows 2000 server to manage users in the most portable way possible, a home directory must be set up for each user to store user-specific information generated by applications. To minimize the amount of work that must be done, specify home directories in the Windows 2000 template accounts so that each new profile created by the enrollment process has a home directory created for it automatically. To provide scalability, it is important not to lock home directories to a particular disk drive. Use the Universal Naming Convention (UNC) names to give portability.

To customize your template profiles to include a home directory, follow these steps:

1. Create the home directory folder on the appropriate server, and share it.
2. In a domain, click **Start->Programs->Administrative Tools->Active Directory Users and Computers** from the Windows 2000 server console.

   On a local server, click **Start->Programs->Administrative Tools-> Computer Management->Local Users and Groups**.
3. Double-click the template (model user) to display its properties.
4. Click the **Profile** tab.
5. In the Home folder segment, click **Connect**. Select a drive letter (such as Z:). Move to the To: dialogue, and enter the directory path of the home directory using a UNC name, for example: \\as400win\homedirs\%username%, as shown in Figure 66. In this example, *as400win* is the name of the server where the home directory folder resides, and *homedirs* is the name of the home directory folder.

   If you use the variable name *%username%*, instead of the logon or user name, Windows 2000 automatically substitutes the user's name in place of the variable name when each new Windows 2000 account is created. It also creates a home directory for the user.

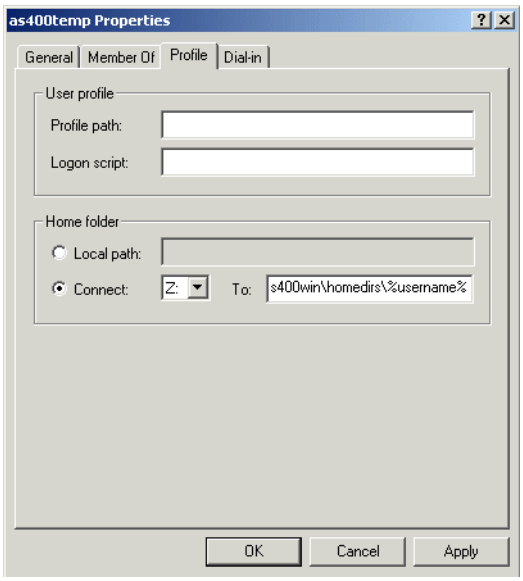

Figure 66. Specifying a home directory in a template

6. Click **OK**.

6.4 Enrolling OS/400 users and groups on Windows 2000

This section describes the options for initiating and maintaining the enrollment of OS/400 users and groups in the Windows 2000 environment.

QRETSVRSEC

You must change the default value for the Retain server security data (QRETSVRSEC) system value from 0 to 1 using the Work with System Values (WRKSYSVAL) command. If you did not do this after the installation completed, do it now. This system value controls whether OS/400 retains passwords. If this value is set to *0*, passwords are not retained. Then, enrollment is delayed until the OS/400 can access the password, for example, when the user signs onto the OS/400 or when the password is changed using the Change User Profile (CHGUSRPRF) or Change Password (CHGPWD) commands. If this value is set to 1, passwords are retained by the OS/400 and can be immediately propagated to the Windows 2000 environment. After this value is changed from 0 to 1, users must log on, or their password must be changed before the password can be retained.

If you have multiple Integrated xSeries Servers on your iSeries, each can be in a different domain. You can enroll users in all the domains as long as at least one Integrated xSeries Server in the iSeries is in each domain to which you want to enroll the new user. You cannot enroll users in a domain that is made up solely of PC-based servers, or enroll users from an iSeries server that does not have a Windows 2000 server running on an Integrated xSeries Server. Normally, if a user needs access to resources in other domains, you create a user in only one domain and use a trust relationship between domains. This makes administration easier.

6.4.1 Changing the command defaults

Before you enroll any users, you may want to change some command defaults. Most of the OS/400 commands used in this chapter have default values that are best modified for the Windows environment. You can use the Change Command Defaults (CHGCMDDFT) command to change them. A list of the commands and the defaults that we suggest you change is provided in Table 5 on page 53.

6.4.2 Domain controllers and servers

Windows 2000 servers can be set up as:

- **Domain controller**

  There can be one or more domain controllers in the domain. When a user logs into the domain, a domain controller issues the user a pass card, which enables them to gain access to network resources. The domain controller is responsible for synchronizing account information across other domain controllers in the domain.

- **Server**

  A server can be created as a member of a domain or as a member of a workgroup. If it is part of a domain, a server can keep its own (local) accounts, but is also aware of accounts in the domain. Therefore, domain users can gain access to resources on servers that are members of the domain. If the server is part of a workgroup, users in a domain cannot gain access to its resources, even if the domain and workgroup are on the same physical network.

6.4.3 Domain and server lists

When you run the Change Network Server User Attributes (CHGNWSUSRA) command, you need to enter the following information into the Windows server domain list and the Windows local server list parameters:

- **Windows server domain list**

  If you enter a domain name in the *Windows server domain list*, the OS/400 user or group you are enrolling is propagated to the *domain* you nominate. In this case, the Windows 2000 server running on the Integrated xSeries Server in the iSeries you are working on must be one of the following types:

  - A domain controller
  - A server created in the domain (it cannot be a server created in a workgroup)

- **Windows local server list**

  If you enter a server name in the Windows local server list, the OS/400 user or group you are enrolling is propagated to the server that you nominate, rather than a domain. In this case, the Windows 2000 server running on the Integrated xSeries Server in the iSeries you are working on must be one of the following types:

  – A server created in a domain. In this case, the user or group is only propagated to the server, *not* the domain.

  – A server created in a workgroup. Also, in this case, the user or group is only propagated to the server.

In both cases, we say that you are enrolling the user or group *locally* to a server.

If you specify the name of a domain controller in the *Windows local server list*, you will receive an error because you cannot enroll a user or group specifically to a Windows 2000 server that is created as a domain controller. You must always enroll in a domain.

Notice that you only need to use the *Windows server domain list* or the *Windows local server list* in the following cases:

- There are multiple Integrated xSeries Servers in the iSeries server that you are working on that are domain controllers in different domains.
- There are multiple Integrated xSeries Servers in the iSeries server that you are working on that are created as servers.
- There are multiple network server descriptions for the one Integrated xSeries Server in the iSeries server you are working on (only one of which can be active at a time). For example, you may have a separate network server description for different Windows 2000 environments, and you need to enroll the user or group information in all environments. In this case, enrollment will occur when the inactive server is varied on.

6.4.4 Setting the network server attributes

You can use the Change NWS Attributes (CHGNWSA) command to set up the default Windows 2000 domain and server lists to which you want to enroll users and groups. Afterwards, you can simply refer to these network server attributes using the `*NWSA` value. For example, you can use the (CHGNWSA) command to set up a default domain and server list, as shown in Figure 67 on page 134. As a result of running this command, the domains AS2KDOM1, AS2KDOM2, and AS2KDOM3 and the servers SERVER1, SERVER2, and SERVER3, are set as the default options for the Network Server Attributes (*NWSA) attribute. *WINDOWSNT is also set as the default server type when *WINDOWSNT is entered in the Prompt control parameter.

```
                    Change NWS Attributes (CHGNWSA)

Type choices, press Enter.

Prompt control . . . . . > *WINDOWSNT    *ALL, *BASE, *NETWARE...
Default server type  . . . . . > *WINDOWSNT    *SAME, *BASE, *NETWARE...
Windows server domain list:
  Domain . . . . . > AS2KDOM1
  User template  . . . . . > AS400DOM1
  Group type . . . . . > *GLOBAL       *GLOBAL, *LOCAL

  Domain . . . . . > AS2KDOM2
  User template  . . . . . > AS400DOM2
  Group type . . . . . > *GLOBAL       *GLOBAL, *LOCAL

  Domain . . . . . > AS2KDOM3
  User template  . . . . . > AS400DOM3
  Group type . . . . . > *GLOBAL       *GLOBAL, *LOCAL
             + for more values

Windows local server list:
  Server . . . . . > SERVER1
  User template  . . . . . > AS400SERV1

  Server . . . . . > SERVER2
  User template  . . . . . > AS400SERV2

  Server . . . . . > SERVER3
  User template  . . . . . > AS400SERV3
             + for more values
```

Figure 67. Example of setting up the default Windows domain and local server lists

Now, when you run the CHGNWSUSRA command, you can optionally specify *NWSA for the Windows server domain list and Windows local server list parameters, and automatic substitution will take place. User and group profiles are automatically enrolled on the domains and local servers specified in Figure 67. In the example shown in Figure 68, the OS/400 user JOHN is enrolled in the domains and servers defined in Figure 67.

```
                 Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . > JOHN          Name, *CURRENT
Profile type . . . . . *USER          *USER, *GROUP
Prompt control . . . . . > *WINDOWSNT    *ALL, *BASE, *NETWARE...
Default server type  . . . . . *NWSA          *SAME, *NWSA, *BASE...
Windows server domain list:
  Domain . . . . . *NWSA
  User template  . . . . . .
  Group type . . . . . .                *GLOBAL, *LOCAL
             + for more values
Windows local server list:
  Server . . . . . *NWSA
  User template  . . . . . .
             + for more values
```

*Figure 68. Example of using the Network Server Attributes (*NWSA) option (Part 1 of 2)*

Alternatively, you can enroll user JOHN to the Windows server domain list, as shown in Figure 69.

```
                  Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . . . . . . > JOHN          Name, *CURRENT
Profile type . . . . . . . . . .   *USER         *USER, *GROUP
Prompt control . . . . . . . . . > *WINDOWSNT    *ALL, *BASE, *NETWARE...
Default server type  . . . . . . > *NWSA         *SAME, *NWSA, *BASE...
Windows server domain list:
  Domain . . . . . . . . . . . . > *NWSA
  User template  . . . . . . . .
  Group type . . . . . . . . . .                 *GLOBAL, *LOCAL
               + for more values
Windows local server list:
  Server . . . . . . . . . . . .   *NONE
  User template  . . . . . . . .
               + for more values
```

*Figure 69. Example of using the Network Server Attributes (*NWSA) option (Part 2 of 2)*

Take care if you choose to enroll users or groups using *NWSA instead of specific domains or servers. If you use *NWSA, and then later change the domain or server lists in the network server attributes, you may accidentally un-enroll users from domains or servers. For example, if you remove a server from the *Windows local server list*, the integration software attempts to remove enrolled users from the deleted server the next time propagation is triggered.

6.4.5 Enrolling users or groups

Should you enroll your users singly or as part of a group?

Enrolling single user profiles requires more work. You have to run the CHGNWSUSRA command for each user. However, you have greater flexibility in terms of user customization if you choose the single user option.

Choosing to enroll group profiles automates the process. The reason is that a new user added to an OS/400 group profile that has already been enrolled is enrolled automatically. However, you must be sure that all the members of the group have the same requirements because they all pick up the same Windows 2000 template.

As a general rule, we suggest that you use groups as much as possible to take advantage of the automatic enrollment capability. However, there are always a few users who have specific needs. You can manage these as single users.

6.4.6 Enrolling an OS/400 user profile

If a new user profile is created on the iSeries server and enrollment is required, you must run the Change NWS User Attributes (CHGNWSUSRA) command for each new user. Each user can be enrolled with a completely separate template, if required, and is managed independently of all the others.

To enroll a single user to the Windows 2000 environment, follow these steps:

1. Use the Create User Profile (CRTUSRPRF) command to create an OS/400 profile for the user, if one does not already exist.
2. On an OS/400 command line, type:

   ```
   CHGNWSUSRA PMTCTL(*WINDOWSNT)
   ```

   Press F4. The Change NWS User Attributes display appears.
3. Type the name of the user you want to enroll in the User profile parameter.
4. Make sure that *USER appears in the Profile type parameter.
5. Press Enter. More fields appear following the Prompt control parameter.

   You may want to enroll the user in a Windows 2000 domain or on a local server running on the Integrated xSeries Server. You can also enroll users to both at the same time. To enroll the user in a domain, proceed with the next step. If you want to enroll the user on a local server only, skip to step 7.
6. Type the name of the domain in which you want to enroll the user in the Domain parameter of the Windows server domain list. Type *NWSA if you previously defined a server domain list using the CHGNWSA command.
7. Type the name of the local server on which you want to enroll the user in the Server parameter of the Windows local server list. Type *NWSA if you previously defined a local server list using the CHGNWSA command.
8. If you want to use a template as the basis for Windows user settings, type the name of the template in the User template parameter of the Windows server domain list or the Windows local server list, or both, as the case may be.
9. Press Enter.

Figure 70 shows an example of user TESTUSER1 being enrolled in the domain AS2KDOM using the template AS400TEMP.

```
                  Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . . . . . . > TESTUSER1     Name, *CURRENT
Profile type . . . . . . . . . .   *USER         *USER, *GROUP
Prompt control . . . . . . . . . > *WINDOWSNT    *ALL, *BASE, *NETWARE...
Default server type  . . . . . . > *NWSA         *SAME, *NWSA, *BASE...
Windows server domain list:
  Domain . . . . . . . . . . . . > AS2KDOM
  User template  . . . . . . . . > AS400TEMP
  Group type . . . . . . . . . . > *GLOBAL       *GLOBAL, *LOCAL
              + for more values
Windows local server list:
  Server . . . . . . . . . . . .   *NONE
  User template  . . . . . . . .
              + for more values
```

Figure 70. Enrolling an OS/400 user

Note: To avoid unpredictable results, do not enroll the same OS/400 user from multiple iSeries servers in the same Windows 2000 domain.

Most Windows networks that have multiple domains use a trust relationship between the domains to access resources across domain boundaries. This does

not prevent you from enrolling the same user account in multiple domains, if required. To enroll a user in more than one domain, you can specify multiple domains in the *Windows server domain list* parameter of the CHGNWSUSRA command. To do this, type a plus (+) next to the + for more values option. Enter domain information in the same way as for the first domain entry. The user profile is then propagated to all these domains whenever certain changes to the profile occur. Do not forget that, in each domain, there must be at least one Integrated xSeries Server in your iSeries for this to work.

Follow the same procedure to enroll a user on multiple local servers running on Integrated xSeries Servers.

6.4.7 Enrolling an existing Windows 2000 user

If you have a user who is already registered as a Windows 2000 user, but not an OS/400 user, and you want to have that user enrolled and managed by the iSeries server, enrollment is not allowed until the password is the same on both systems. To achieve this, we recommend that you create the user on the iSeries server with the same name and password that exists on Windows 2000, and enroll the user using the CHGNWSUSRA command. Then, manually set the password options in the user's Windows 2000 account, as recommended in 6.3.3, "Recommended template settings" on page 127, because templates are ignored when enrolling an existing Windows 2000 user.

6.4.8 Enrolling an OS/400 group profile and group members

Group members are enrolled as members of the Windows 2000 Domain local or Global group (if enrolling in a domain) or the Windows 2000 group (if enrolling on a local server) whose name corresponds to the OS/400 group profile. We do not discuss the differences between Windows 2000 group types here. If you need more information on this subject, refer to the appropriate Microsoft documentation.

To enroll an OS/400 group and its members to the Windows 2000 environment, follow these steps:

1. Use the `CRTUSRPRF` command to create the OS/400 group profile and its member profiles, if they do not already exist.

   Note: Do not use the Create Group (CRTGRP) command to create the group profile. This type of group is not compatible with the enrollment function.

2. Set the group profile's password to `*NONE` and its status to `*DISABLED` to prevent it from being used to sign on to the iSeries server.
3. On an OS/400 command line, type:

   ```
   CHGNWSUSRA PMTCTL(*WINDOWSNT)
   ```

   Press F4. The Change NWS User Attributes display appears.
4. Type the name of the group that you want to enroll in the User profile parameter.
5. Type `*GROUP` in the Profile type parameter.
6. Press Enter. More parameters appear following the Prompt control parameter.
7. Type `*ALL` in the Propagate group members parameter.

Specifying *ALL (rather than *MBRONLY) for the Propagate group members parameter ensures that the group profile name is displayed when you use the Work with NWS Enrollment (WRKNWSENR) command and press F10 to display the groups.

You may want to enroll the group and its members on a Windows 2000 domain or on a local server running on the Integrated xSeries Server. You can also enroll them on both at the same time. To enroll the group and its members on a domain, proceed with the next step. If you want to enroll the group and its members on a local server only, go to step 9.

8. Type the name of the domain in which you want to enroll the group and its members in the Domain parameter of the Windows server domain list. Type *NWSA if you previously defined a server domain list using the CHGNWSA command.
9. Type the name of the local server on which you want to enroll the group and its members in the Server parameter of the Windows local server list. Type *NWSA if you previously defined a local server list using the CHGNWSA command.
10. If you want to use a template as the basis for Windows user settings, type the name of the template in the User template parameter of the Windows server domain list or the Windows local server list, or both, as the case may be.

    You can enroll the OS/400 group as a Windows 2000 Domain local or Global group when enrolling in a domain. In this case, specify the type of group, *GLOBAL or *LOCAL, in the *Group type* parameter.

    If you are enrolling an OS/400 group profile on a local server, notice that you cannot specify a group type. The reason is that only Local groups can be created on a Windows 2000 local server.

11. Press Enter.

Figure 71 shows an example of the TESTGRP1 group being enrolled as a Windows 2000 Global group with parameters set to enroll both the group and all its users in the domain AS2KDOM. Users are enrolled using the template AS400TEMP.

```
                  Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . > TESTGRP1      Name, *CURRENT
Profile type . . . . . > *GROUP        *USER, *GROUP
Prompt control . . . . . > *WINDOWSNT  *ALL, *BASE, *NETWARE...
Propagate group members  . . . . > *ALL *SAME, *NONE, *ALL, *MBRONLY
Default server type  . . . . . > *WINDOWSNT  *SAME, *NWSA, *BASE...
Windows NT domain list:
  Domain . . . . . > AS2KDOM
  User template  . . . . . > AS400TEMP
  Group type . . . . . > *GLOBAL       *GLOBAL, *LOCAL
              + for more values
Windows NT server list:
  Server . . . . . .   *NONE
  User template  . . . . . .
              + for more values
```

Figure 71. Enrolling an OS/400 group and its members

If a group with the name TESTGRP1 has already been enrolled in the Windows 2000 environment, and you use *ALL for the Propagate group members parameter, the group is still enrolled, and the group members are added to the existing Windows 2000 group. This would only fail if the group name on the iSeries server is the same as one of the Windows 2000-supplied groups (such as Administrators or Replicators).

If a user profile is moved to a different group on the iSeries server, that change is also propagated as long as the new group is enrolled in the Windows 2000 environment.

6.4.9 Enrolling OS/400 group members only

To enroll only the members of an OS/400 group to the Windows 2000 environment without enrolling the group itself, follow these steps:

1. On an OS/400 command line, type:

   ```
   CHGNWSUSRA PMTCTL(*WINDOWSNT)
   ```

   Press F4. The Change NWS User Attributes display appears.

2. Type the name of the group whose members you want to enroll in the User profile parameter.
3. Type `*GROUP` in the Profile type parameter.
4. Press Enter. More parameters appear following the Prompt control parameter.
5. Type `*MBRONLY` in the Propagate group members parameter.

   You may want to enroll the group members in a Windows 2000 domain or on a local server running on the Integrated xSeries Server. You can also enroll the group members to both at the same time. To enroll the group members in a domain, proceed with the next step. If you want to enroll the group members on a local server only, go to step 7.

6. Type the name of the domain in which you want to enroll the group members in the Domain parameter of the Windows server domain list. Type `*NWSA` if you previously defined a server domain list using the CHGNWSA command.
7. Type the name of the local server on which you want to enroll the group members in the Server parameter of the Windows local server list. Type `*NWSA` if you previously defined a local server list using the CHGNWSA command.
8. If you want to use a template as the basis for Windows user settings, type the name of the template in the User template parameter of the Windows server domain list or the Windows local server list, or both, as the case may be.
9. Press Enter.

Only the group members are propagated to the Windows 2000 environment. The group itself is not enrolled, and the group profile does not appear in the Work with NWS User Enrollment (WRKNWSENR) display.

Figure 72 on page 140 shows an example of the members of group TESTGRP2 being enrolled in the domain AS2KDOM. Users are enrolled using the template AS400TEMP.

```
                  Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . > TESTGRP2      Name, *CURRENT
Profile type . . . . . > *GROUP        *USER, *GROUP
Prompt control . . . . . > *WINDOWSNT  *ALL, *BASE, *NETWARE...
Propagate group members  . . . . > *MBRONLY    *SAME, *NONE, *ALL, *MBRONLY
Default server type  . . . . . > *NWSA         *SAME, *NWSA, *BASE...
Windows NT domain list:
  Domain . . . . . > AS2KDOM
  User template  . . . . . > AS400TEMP
  Group type . . . . . .   *GLOBAL       *GLOBAL, *LOCAL
               + for more values
Windows NT server list:
  Server . . . . . .   *NONE
  User template  . . . . . .
               + for more values
```

Figure 72. Enrolling only the members of an OS/400 group

6.4.10 Enrolling an OS/400 group only

To enroll an OS/400 group to the Windows 2000 environment without enrolling any of its members, follow these steps:

1. On an OS/400 command line, type:

   `CHGNWSUSRA PMTCTL(*WINDOWSNT)`

   Press F4. The Change NWS User Attributes display appears.

2. Type the name of the group you want to enroll in the User profile parameter.
3. Type `*GROUP` in the Profile type parameter.
4. Press Enter. More parameters appear following the Prompt control parameter.
5. Type `*NONE` in the Propagate group members parameter.

   You may want to enroll the group on a Windows 2000 domain or on a local server running on the Integrated xSeries Server. You can also enroll the group on both at the same time. To enroll the group in a domain, continue with the next step. If you want to enroll the group on a local server only, go to step 8.

6. Type the name of the domain in which you want to enroll the group in the Domain parameter of the Windows server domain list. Type `*NWSA` if you previously defined a server domain list using the CHGNWSA command.
7. Type the name of the local server on which you want to enroll the group in the Server parameter of the Windows local server list. Type `*NWSA` if you previously defined a local server list using the CHGNWSA command.
8. Type `*NONE` in the User template parameter.
9. You can enroll the OS/400 group as a Windows 2000 Domain local or Global group when enrolling in a domain. In this case, specify the type of Windows 2000 group, `*GLOBAL` or `*LOCAL` in the Group type parameter.

   If you are enrolling an OS/400 group profile on a local server, notice that you cannot specify a group type. The reason is that only Local groups can be created on a Windows 2000 local server.

10. Press Enter.

Figure 73 shows an example of group TESTGRP3 being enrolled in the domain AS2KDOM. Notice that you cannot specify a user template.

```
                  Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . > TESTGRP3      Name, *CURRENT
Profile type . . . . . > *GROUP        *USER, *GROUP
Prompt control . . . . . > *WINDOWSNT    *ALL, *BASE, *NETWARE...
Propagate group members  . . . . > *NONE         *SAME, *NONE, *ALL, *MBRONLY
Default server type  . . . . . > *NWSA         *SAME, *NWSA, *BASE...
Windows NT domain list:
  Domain . . . . . > AS2KDOM
  User template  . . . . . *NONE
  Group type . . . . . *GLOBAL       *GLOBAL, *LOCAL
              + for more values
Windows NT server list:
  Server . . . . . *NONE
  User template  . . . . . .
              + for more values
```

Figure 73. Enrolling an OS/400 group only

6.5 Enrollment status

You can display the current status of enrolled users and groups by using the Work with NWS User Enrollment (WRKNWSENR) command. Follow these steps:

1. Type `WRKNWSENR` on an OS/400 command line, and press F4.
2. In the Profile type parameter, specify one of the following values:
   - Type `*USER` if you want to check the enrollment status of users (an example is shown in Figure 74 on page 142).
   - Type `*GROUP` if you want to check the enrollment status of groups (an example is shown in Figure 75 on page 142).
3. Type `*WINDOWSNT` in the Server type parameter.
4. Press Enter.

You can display the groups or the users as the primary option, depending on whether you specify the Profile type parameter as *USER or *GROUP. Press F10 to toggle between displaying users, groups, or users *and* groups.

```
                        Work with NWS User Enrollment
                                                                 System:   SYSTEM1
Type options, press Enter.
  2=Change user profile   5=Display user profile   6=Retry entry
  14=Change network user attributes   15=Display network user attributes
  16=Display error details

     Entry                          Enrollment  Error
Opt    Profile           Type       status      code     Text
     AS2KDOM             *WNTDMN
       TESTUSER1         *USER      *CURRENT             Windows 2000 test user
       TESTUSER2         *USER      *CURRENT             Windows 2000 test user
       TESTUSER3         *USER      *CURRENT             Windows 2000 test user
       TESTUSER4         *USER      *CURRENT             Windows 2000 test user
       TESTUSER5         *USER      *CURRENT             Windows 2000 test user
       TESTUSER6         *USER      *CURRENT             Windows 2000 test user
```

Figure 74. User enrollment status by user (press F10 to see groups)

```
                        Work with NWS User Enrollment
                                                                 System:   SYSTEM1
Type options, press Enter.
  2=Change user profile   5=Display user profile   6=Retry entry
  14=Change network user attributes   15=Display network user attributes
  16=Display error details

     Entry                          Enrollment  Error
Opt    Profile           Type       status      code     Text
     AS2KDOM             *WNTDMN
       TESTGRP1          *GROUP     *CURRENT             Windows 2000 test grou
         TESTUSER3       *USER      *CURRENT             Windows 2000 test user
         TESTUSER4       *USER      *CURRENT             Windows 2000 test user
       TESTGRP2          *GROUP     *MBRONLY             Windows 2000 test grou
         TESTUSER5       *USER      *CURRENT             Windows 2000 test user
         TESTUSER6       *USER      *CURRENT             Windows 2000 test user
       TESTGRP3          *GROUP     *CURRENT             Windows 2000 test grou
```

Figure 75. User enrollment status by group (press F10 to see users)

From Windows 2000 Active Directory Users and Groups (domain controller) or Local Users and Groups (local server), you see a window similar to the example in Figure 76.

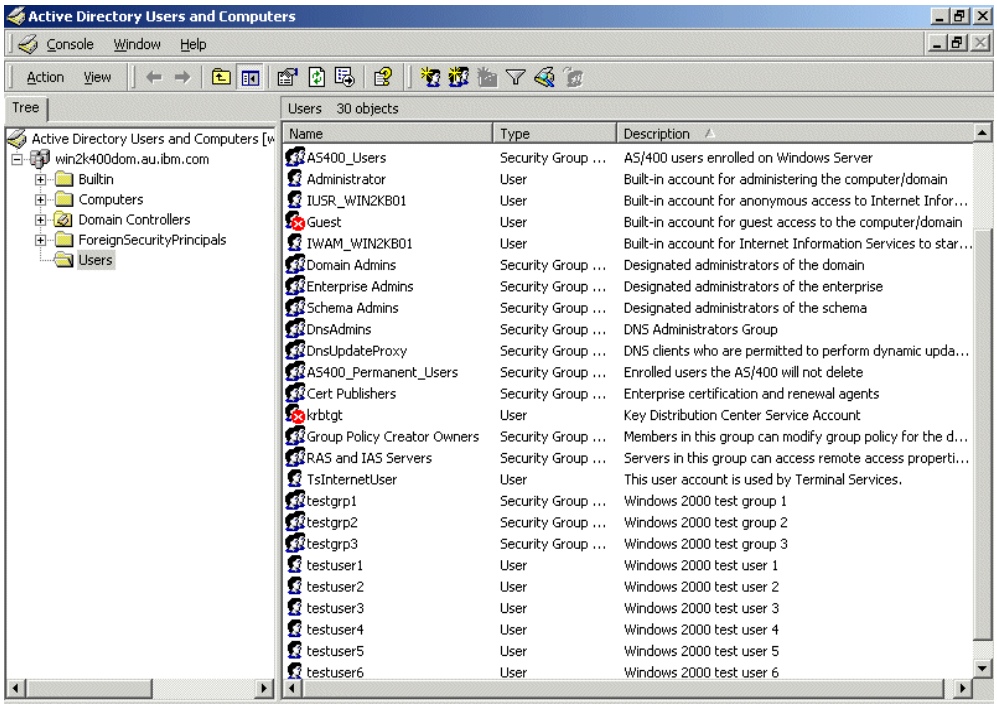

Figure 76. Enrolled users and groups from the Windows 2000 side

In the Work with NWS User Enrollment (WRKNWSENR) display, each user has a status code that shows whether enrollment successfully completed. The full meaning of these indicators is provided in the help text of the display. Appropriate actions (where necessary) are also recommended. The indicators are explained in Table 9.

Table 9. WRKNWSENR status codes

Enrollment status	Description
*CURRENT	Update was successful.
*UPDPND	Update has not yet completed.
*DLTPND	Deletion has not yet completed.
*UPDRCYPND	Update has had a recoverable error and will retry.
*DLTRCYPND	Deletion has had a recoverable error and will retry.
*UPDFAIL	Update has had an unrecoverable error.
*DLTFAIL	Deletion has had an unrecoverable error.
*MBRONLY	Only the group members are enrolled.

6.5.1 When propagation takes place

The time when propagation occurs varies according to how the user is defined and how enrollment has been implemented.

For a single user profile, propagation does not happen until the profile is enrolled using the CHGNWSUSRA command. There is no other way to start propagation for a single user from the iSeries server to the Windows 2000 environment.

Group enrollment is started the same way. However, after the group has been enrolled, you can add a user to that OS/400 group, and the user is automatically enrolled on the iSeries server and propagated to the Windows 2000 environment.

When a network server description is varied on, propagation occurs for all users enrolled on Windows 2000 Integrated xSeries Servers in the domain and on local servers. Any changes made to the following parameters through Windows 2000 since the last update from the iSeries server are overwritten in Windows 2000 by the OS/400 values as follows (parameter names are shown in uppercase):

- User or group profile name: USRPRF (at enrollment only)
- Password: PASSWORD
- Password expired: PWDEXP (propagation occurs at midnight following expiration)
- Profile status: STATUS
- Text description: TEXT
- Group profile of which the user profile is a member: GRPPRF (if the group is enrolled)
- Supplemental groups of which the user profile is a member: SUPGRPPRF (if the groups are enrolled)

If the integrated Windows 2000 server is active, the changes occur immediately. If the integrated Windows 2000 server is varied off or shut down, the changes occur the next time the server is activated. The WRKNWSENR command shows a status of *UPDPND for the enrolled OS/400 user profiles until the server becomes available. As soon as the server is available, any outstanding updates are propagated immediately. Any errors resulting from the propagation are reported on the WRKNWSENR display with an error code. Type `16` next to the relevant user to show the error, and display instructions for resolving the problem. When an error occurs, you normally must perform some action, either on the iSeries server or the Windows 2000 server to resolve the problem. Type `6` next to the user on the Work with NWS User Enrollment (WRKNWSENR) display to retry propagation.

If you want to reset a user account in the Windows 2000 environment, you can also select option 6 on the Work with NWS User Enrollment (WRKNWSENR) display to force propagation at any time. For example, a password may have been changed by the Windows 2000 user. However, the iSeries does not overwrite it until a change is made on the iSeries server or the network server description is varied off and then on again. You can select option 6 to force sending of the OS/400 password to the Windows 2000 environment.

6.6 Ending enrollment

We recommend that you establish a standard method for ending enrollment of users in your organization. To do this, you need to understand what each of the alternative methods does and which method best fits your environment (you may decide to use more than one). Regardless of the method you choose, you must be careful about the users that are enrolled in the AS400_Permanent_Users group in the Windows 2000 environment. These users cannot be removed from the Windows 2000 environment by an OS/400 administrator.

The way in which user accounts are handled within the Windows 2000 environment is different than the way in which the iSeries server handles user profiles. On the iSeries server, you cannot delete a user that still owns files without specifying that the owned files are to be deleted or that the ownership of those files be transferred to another user. Windows 2000 allows you to delete a user that owns files without either deleting those files or changing their ownership. However, if a user account is deleted from Windows 2000 and then re-created with exactly the same account name, it does not have the same authority to files as the original account. When a Windows 2000 user account is created, a security identification code (SID) is generated and used to identify the files accessible by that account. When a new account is created, a different SID is generated, even if the user account name is the same as before. This prevents the new user from owning the files owned by a previous user with the same name.

If you simply delete an enrolled user from the Windows 2000 environment, the user account is removed from the domain or local server, but not from the iSeries server. Because the user profile is still enrolled, it is re-propagated to the Windows 2000 domain or local server at the next opportunity (normally the next time the Integrated xSeries Server is varied on).

6.6.1 Ending enrollment: OS/400 user or group is deleted

You can end enrollment for a user or group on the iSeries server by deleting the OS/400 user or group profile. In this case, the profile is deleted from the iSeries server and from the domain and local server, as the case may be. You can use the Delete User Profile (DLTUSRPRF) command to perform the following tasks:

- **Delete a user**

  This ends enrollment for the user and deletes the user from the iSeries server, Windows 2000 domain, and local server.

- **Delete the group or groups of which the user is a member**

  This ends enrollment for the group and all its members and removes them from the Windows 2000 domain and local server. However, if the group has any members that were added from the Windows 2000 side, rather than enrolled from the iSeries server, the group is not deleted from the Windows 2000 domain or local server. The only members that the Windows 2000 group can still have are users not enrolled from the iSeries server.

Notice that deleting a Windows 2000 account from the iSeries server fails if the user is a member of the AS400_Permanent_Users group. In this case, the enrollment status of the user (as shown in the Work with NWS User Enrollment (WRKNWSENR) display) is *DLTFAIL. To remove the *DLTFAIL status, use one of the following methods:

- Remove the user manually from the AS400_Permanent_Users group on Windows 2000. Then select option `6` on the Work with NWS User Enrollment (WRKNWSENR) display to retry the deletion operation.
- Select option `4` on the Work with NWS User Enrollment (WRKNWSENR) display to remove the *DLTFAIL entry (the user is not deleted from the Windows 2000 environment).

6.6.2 Ending enrollment: OS/400 users and groups not deleted

You can end enrollment for a user or group on the iSeries server without deleting the OS/400 user or group profile. In this case, the profile remains on the iSeries server, but is deleted from the Windows 2000 environment. You can do this in the following ways:

- Use the `CHGNWSUSRA` command to end enrollment for a user. This does not work if the user is a member of an OS/400 group that is enrolled.

  Refer to 6.6.2.1, “Using CHGNWSUSRA to end enrollment for an OS/400 user”, for a description of how to do this.

- Use the `CHGNWSUSRA` command to end enrollment for a group. This ends enrollment for the group and all its members who were enrolled through that group. It also removes the group and its members from the Windows 2000 environment. However, if the group has any members that were added from the Windows 2000 side, rather than enrolled from the iSeries server, the group is not deleted from the Windows 2000 domain or local server. The only members that the Windows 2000 group can still contain are users not enrolled from the iSeries server.

  Refer to 6.6.2.2, “Using CHGNWSUSRA to end enrollment for an OS/400 group”, for a description of how to do this.

- Use the `CHGUSRPRF` command to change the user profile and remove the user from the enrolled group of which it is a member.

Notice that deleting a Windows 2000 account from the iSeries server fails if the user is a member of the AS400_Permanent_Users group. In this case, the enrollment status of the user (as shown in the Work with NWS User Enrollment (WRKNWSENR) display) is *DLTFAIL. To remove the *DLTFAIL status, use one of the following methods:

- Remove the user manually from the AS400_Permanent_Users group on Windows 2000. Then select option `6` on the Work with NWS User Enrollment (WRKNWSENR) display to retry the deletion operation.
- Select option `4` on the Work with NWS User Enrollment (WRKNWSENR) display to remove the *DLTFAIL entry (the user is not deleted from the Windows 2000 environment).

6.6.2.1 Using CHGNWSUSRA to end enrollment for an OS/400 user

To end enrollment for a user in the Windows 2000 environment, follow these steps:

1. On an OS/400 command line, type:

   ```
   CHGNWSUSRA PMTCTL(*WINDOWSNT)
   ```

2. Press F4. The Change NWS User Attributes display appears.
3. Type the name of the user for whom you want to end enrollment in the User profile parameter.
4. Make sure that the Profile type parameter shows `*USER`.
5. Press Enter. More parameters appear following the Prompt control parameter.
6. Place the cursor to the left of the Domain parameter of the Windows server domain list.

7. Type a < (less than) sign to the left of the domains from which you want to remove a user. If the Windows server domain list has only one domain, type *NONE in the Domain parameter instead. You can also type *NONE to remove a user from all domains in which the user is enrolled.

   Note: If the list has only one entry, typing the < (less than) sign to the left of that entry causes *SAME to be entered. The result is that the user is *not* removed from the domain.

8. Place the cursor in the Server parameter of the Windows local server list.
9. Type a < (less than) sign to the left of those local servers from which you want to remove a user. If the Windows local server list has only one server, type *NONE in the Server parameter instead. You can also type *NONE to remove a user from all local servers on which the user is enrolled.

   Note: If the list has only one entry, typing < to the left of that entry causes *SAME to be entered. The result is that the user is *not* removed from the server.

10. Press Enter. The user is removed from the domains and local servers you specified.

Figure 77 shows enrollment being ended for the user TESTUSER1 by entering *NONE in the Domain and Server parameters.

```
                  Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . > TESTUSER1     Name, *CURRENT
Profile type . . . . . .   *USER       *USER, *GROUP
Prompt control . . . . . > *WINDOWSNT  *ALL, *BASE, *NETWARE...
Default server type  . . . . .   *NWSA       *SAME, *NWSA, *BASE...
Windows server domain list:
  Domain . . . . . > *NONE
  User template  . . . . . .
  Group type . . . . . .              *GLOBAL, *LOCAL
             + for more values
Windows local server list:
  Server . . . . . .   *NONE
  User template  . . . . . .
             + for more values
```

Figure 77. Ending enrollment for a user

6.6.2.2 Using CHGNWSUSRA to end enrollment for an OS/400 group

To end enrollment for a group in the Windows 2000 environment, follow these steps:

1. On an OS/400 command line, type:

   ```
   CHGNWSUSRA PMTCTL(*WINDOWSNT)
   ```

2. Press F4. The Change NWS User Attributes display appears.
3. Type the name of the group for which you want to end enrollment in the User profile parameter.
4. Make sure that the Profile type parameter shows *GROUP.
5. Press Enter. More parameters appear following the Prompt control parameter.

6. Place the cursor to the left of the Domain parameter of the Windows server domain list.
7. Type a < (less than) sign to the left of those domains from which you want to remove the group. If the Windows server domain list has only one domain, type *NONE in the Domain parameter instead. You can also type *NONE to remove a group from all domains in which the group is enrolled.

   Note: If the list has only one entry, typing the < (less than) sign to the left of that entry causes *SAME to be entered. The result is that the group is *not* removed from the domain.
8. Place the cursor in the Server parameter of the Windows local server list.
9. Type a < (less than) sign to the left of the local servers from which you want to remove a group. If the Windows local server list has only one server, type *NONE in the Server parameter instead. You can also type *NONE to remove a group from all local servers on which the group is enrolled.

   Note: If the list has only one entry, typing the < (less than) sign to the left of that entry causes *SAME to be entered. The result is that the group is *not* removed from the server.
10. Press Enter. The group is removed from the domains and local servers you specified.

An example of ending enrollment for a group and all its users is shown in Figure 78.

```
                  Change NWS User Attributes (CHGNWSUSRA)

Type choices, press Enter.

User profile . . . . . > TESTGRP1      Name, *CURRENT
Profile type . . . . . > *GROUP        *USER, *GROUP
Prompt control . . . . . > *WINDOWSNT  *ALL, *BASE, *NETWARE...
Propagate group members  . . . . > *ALL  *SAME, *NONE, *ALL, *MBRONLY
Default server type  . . . . . *NWSA   *SAME, *NWSA, *BASE...
Windows server domain list:
  Domain . . . . . > *NONE
  User template  . . . . . .
  Group type . . . . . .               *GLOBAL, *LOCAL
             + for more values
Windows local server list:
  Server . . . . . *NONE
  User template  . . . . . .
             + for more values
```

Figure 78. Ending enrollment for a group and all its users

6.6.3 Ending enrollment: OS/400 or Windows users, groups not deleted

You may want to end enrollment for OS/400 users or groups without deleting any users from the iSeries server or Windows 2000 environment. This makes it possible to add these users to groups on the iSeries server and change passwords on the iSeries server without these updates ever appearing in the Windows 2000 environment. However, this approach can result in more user administration because you now have to maintain OS/400 and Windows users separately.

To end enrollment without deleting any users, follow these steps:

1. Add the Windows 2000 user accounts that you do not want to delete to the AS400_Permanent_Users group in the domain or local server.
2. End enrollment for these users on the iSeries server using the Change NWS User Attributes (CHGNWSUSRA) command.
3. If you check the Work with NWS User Enrollment (WRKNWSENR) display, you can see that the user profiles have an enrollment status of *DLTFAIL and an error code of 270. This indicates that propagation of the change was not successful (because the users are members of the AS400_Permanent_Users group). However, enrollment has indeed ended for these users.
4. Select option 4 on the Work with NWS User Enrollment (WRKNWSENR) display to remove the user enrollment entries in error from the list.

6.7 Miscellaneous tasks

This section covers miscellaneous user administration tasks that you may need to perform from time to time, such as changing a user's name and changing the domain name.

6.7.1 Changing a user's name

If one of your users, BSmith for example, gets married and changes her name to BJohnson, how do you handle this change?

We suggest that you use the following method, but there are other ways to do it:

1. User BSmith was initially created as a member of USERGRP and propagated to the Windows 2000 environment using the CHGNWSUSRA command.
2. User BSmith gets married and changes her last name to Johnson.
3. On Windows 2000, rename BSmith to BJohnson (this is a simple change under Windows 2000).
4. Create a new user profile on the iSeries server called BJohnson, copied from BSmith. Change BJohnson's password to be the same as BSmith's (because this is not copied from one profile to another). The password used for the new user, BJohnson, on the iSeries server must be the same as the password used for the corresponding Windows 2000 account. Ensure that BJohnson is part of USERGRP on the iSeries server.
5. Enroll BJohnson as an existing Windows 2000 user. This is explained in 6.4.7, "Enrolling an existing Windows 2000 user" on page 137.
6. Delete user BSmith from the iSeries server to transfer object ownership to BJohnson. Because BJohnson does not inherit BSmith's authorities to objects on the iSeries server, they must be transferred.

6.7.2 Changing the domain name

Although this is an unusual operation, you may at some point decide to change the name of the Windows 2000 domain. If you do this, there are some important considerations you need to understand.

The OS/400 integration software uses the enrollments created by the Change NWS User Attributes (CHGNWSUSRA) command to determine the domain name

to which user profile changes are sent. If you change the name of the domain (which you have to do from Windows 2000), the iSeries server is not aware of the change, and user enrollment remains set to the old domain name.

When the iSeries server tries to perform an update on a user who is enrolled in the old domain, it simply reports that it is unable to find the domain controller and leaves the user in an *UPDPND or *DLTPND status according to the operation that was attempted.

To enroll users in the new domain, you need to use the CHGNWSUSRA command and enter the new domain name for the group or user that you want to move. This can be done directly from the Work with NWS User Enrollment (WRKNWSENR) display using option 14.

Chapter 7. Backup and restore

This chapter looks at backup and restore of the Windows 2000 on the Integrated xSeries Server environment from both the iSeries and Windows 2000 perspectives. More specifically, this chapter concentrates on the iSeries point of view, because backup and restore on Windows 2000 is largely specific to the backup application you use. These processes are well documented in the Windows 2000 and application manuals.

Note: It is important that you understand the concepts that are involved before you plan your backup strategy. Therefore, read the entire chapter before you start working on your plan.

If you have a PC background, we encourage you to review your previous backup strategy and planning in light of what you read in this chapter. Windows 2000 running on the Integrated xSeries Server effectively acts as a guest operating system on the iSeries server. Therefore, there is more flexibility and new techniques that you can use to back up your Windows 2000 files. You may be able to back up your Windows 2000 files more quickly and efficiently than if Windows 2000 were running on a PC.

This chapter compares the various methods of saving and restoring Windows 2000 data and provides recommendations about the way we think the backups should be done. It also covers performance, automating the backup and restore process, and provides sample backup schedules. One of the major advantages of running Windows 2000 on the Integrated xSeries Server is the ability to include Windows 2000 backups in an iSeries backup procedure. This allows you to take advantage of the high speed tape drives and powerful software support that the iSeries server offers.

Never under estimate the importance of backup. No matter how much it costs, it almost always costs less to your business than trying to manually recover or recreate lost data. Always test your backups to make sure that you can restore them successfully.

We recommend that you read *Backup and Recovery,* SC41-5304, which describes backup and restore on the iSeries server in detail.

7.1 Overview of backup and restore

Because the Integrated xSeries Server environment is a combination of two operating systems (Windows 2000 and OS/400), there are several options for saving data from which you can choose. The types of backup you can perform, and, therefore, the options you have for restoring data are different, depending on whether you are looking at backup from a Windows 2000 or iSeries perspective. You may choose to manage your backups using OS/400 functions, using Windows 2000 functions, or a combination of both. There is no obvious choice as to which of the two options is the better system for controlling your backup strategy. It depends on what you are backing up, how much you are backing up, how much time you have to perform the backup, and how you want to restore the data. Both the Windows 2000 and iSeries servers have their own strengths and limitations, so understand what each system does well and plan your strategy around those strengths.

7.1.1 Backup from a server-centric perspective

The backup of Windows 2000 files can be performed from either the iSeries or Windows 2000 side. We term this *iSeries-centric* and *Windows 2000-centric* as shown in Figure 79.

We recommend that you use a combination of iSeries and Windows 2000 backup functions to obtain the best overall save and restore strategy that satisfies your requirements.

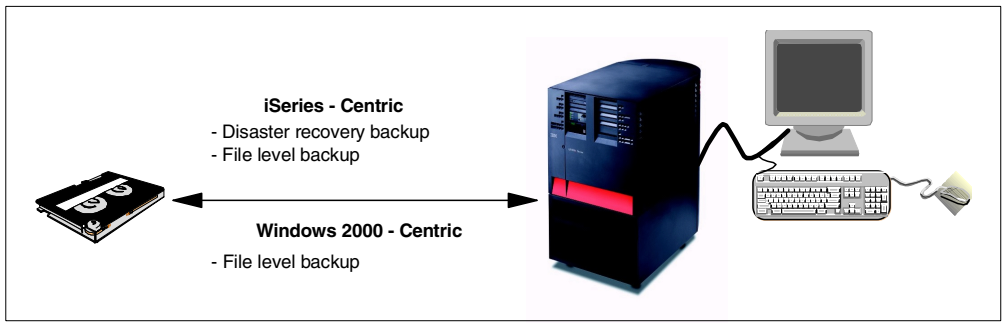

Figure 79. Backup from a server-centric perspective

7.1.1.1 iSeries-centric backup

In general terms, backup from the iSeries side is often used for disaster recovery purposes. However, at V4R5, you can also back up Windows 2000 files at a file level.

There are two basic methods that can be used to back up and restore Windows 2000 files from the iSeries side:

- **Disaster recovery backup**: This method backs up files at a storage space level using an OS/400 Integrated File System (IFS) save command. It is fast and enables you to incorporate a backup of Windows 2000 files into an unattended backup of the iSeries server. However, you cannot restore individual Windows 2000 files using this method.

  Because you can back up all Windows NT and 2000 drives, including the system drive, as a complete unit, it is quick and easy to recover a failed server by simply restoring the storage spaces. This is a major advantage of using iSeries disaster recovery backup to perform a complete save your Windows server, versus trying to use a Windows backup application to do this.

- **File-level backup**: File-level backup can be further divided into the following methods:

  – *Using the Integrated File System (IFS)*: This method, new with V4R5, uses an OS/400 IFS save command. It is not as fast as saving data at a storage space level, but enables you to incorporate a backup of the Windows 2000 files into an unattended backup of the iSeries. You can also restore individual Windows 2000 files using this method.

  – *Using Tivoli Storage Manager (TSM) - iSeries Server*: Tivoli Storage Manager (TSM) is a cross-platform family of products that integrates network backup and archive with storage management and disaster recovery planning functions. It is a sophisticated, powerful, and high performance product that can be used to save files from a Windows 2000 server to a tape drive attached to the iSeries server.

7.1.1.2 Windows 2000-centric backup

Backup from the Windows 2000 side provides file-level save and restore capability using native Windows 2000 backup applications. iSeries tape drives or PC tape drives can be used by Windows 2000 backup applications to provide fast, reliable saves of Windows 2000 files.

This method may suit customers migrating from PC-based Windows 2000 servers, who prefer to back up their Windows 2000 files using a Windows 2000-based application. It enables the use of an iSeries tape drive or a PC tape drive attached to another Windows 2000 server in the network. However, this type of backup is difficult to incorporate into an unattended backup from the iSeries side. This is because Windows 2000 cannot share a tape cartridge formatted for use by the iSeries. There are also restrictions on the use of iSeries auto cartridge loaders, and tape libraries are not supported.

7.1.2 Disaster recovery versus file-level backup and restore

Backup and restore in the Integrated xSeries Server environment can also be viewed from the disaster recovery and file-level perspectives. This section summarizes these methods as they apply to Windows 2000 running on the Integrated xSeries Server. They are covered in greater detail later in this chapter.

7.1.2.1 Disaster recovery backup and restore

Disaster recovery backup and restore can only be performed from the iSeries side, not from Windows 2000. The objective of a disaster recovery backup is to recover the entire Windows 2000 environment as fast as possible. Such a situation might arise after a fire or flood, when the system has been totally destroyed. In this case, you are more concerned with the speed of restoring the Windows 2000 environment as a whole, rather than restoring individual files.

With a disaster recovery backup, you save the storage spaces that contain the Windows 2000 boot files, installation image, system files, applications, and user files. In this case, you cannot restore individual files. As part of a disaster recovery backup, you may also want to save the iSeries configuration objects, product libraries, and message queue. Because a storage space is backed up (and restored) as a single, complete entity (or “black hole”), this is true disaster recovery.

Prior to V4R5, the Windows NT system drive could be created as either a user storage space or system storage space. In V4R5, you can only create the Windows NT or 2000 system drive as a user storage space. Therefore, in this chapter, we are only concerned with the system drive created as a user storage space. For information on saving system storage spaces, refer to *AS/400 - Implementing Windows NT on the Integrated Netfinity Server,* SG24-2164.

You should plan to make a complete backup of your Windows 2000 environment so that it can be restored from scratch if necessary. Make sure you have a plan to restore on a different iSeries server, possibly at a different site. This should enable the server to be up and running fairly quickly, depending on the volume of data to be restored.

iSeries disaster recovery backup and restore are described in detail in the following sections:

- Section 7.3, “Disaster recovery backup from the iSeries side” on page 167
- Section 7.5, “Disaster recovery restore from the iSeries side” on page 186

7.1.2.2 File-level backup and restore

The objective of a file-level backup is to allow you to restore one or more individual files or directories, without having to restore a complete Windows 2000 disk volume to recover a single file. Often this is a result of a user accidentally deleting a file.

You can perform a file-level backup from either the iSeries or Windows 2000 server as follows:

- **iSeries server:** From OS/400, you can back up Windows 2000 files and directories at a file level using an IFS save command or using Tivoli Storage Manager (TSM).

  OS/400 file-level backup and restore are described in detail in the following sections:

  – Section 7.4, “File-level backup from the iSeries side” on page 174
  – Section 7.6, “File-level restore from the iSeries side” on page 191

- **Windows 2000:** From Windows 2000, you can back up files using a Windows 2000 backup application to an iSeries tape drive that has been allocated to the Windows NT Server or to a PC-based Windows 2000 server that has a tape drive connected to it.

  Although Windows documentation often talks about “disaster recovery” backup, we need to draw a distinction between disaster recovery as it applies to OS/400 storage spaces and disaster recovery in the Windows context. From the Windows point of view, a disaster recovery backup is a backup of a complete disk volume or volumes as opposed to backing up selected files. However, Windows backup applications still back up at a file level, and you can still restore individual files from a Windows “disaster recovery backup”. In the context of this chapter, we regard all Windows 2000 backup operations as occurring at the file level.

  Windows 2000 file-level backup and restore are described in detail in 7.7, “Backup and restore from the Windows 2000 side” on page 196.

7.1.3 Staged backup

With a staged backup, you first back up data to disk and then (optionally) save this intermediate backup to tape as shown in Figure 80.

Because saving to disk is always faster than backing up direct to tape, it can be very useful, even mandatory, when the backup window is small. A backup window is defined as the time that is available to perform a backup of the system. This usually corresponds to the length of time that the system can be made unavailable to users. As soon as the backup to disk has been completed, the system can be made available to users. The disk backup can then be saved to tape at a later stage.

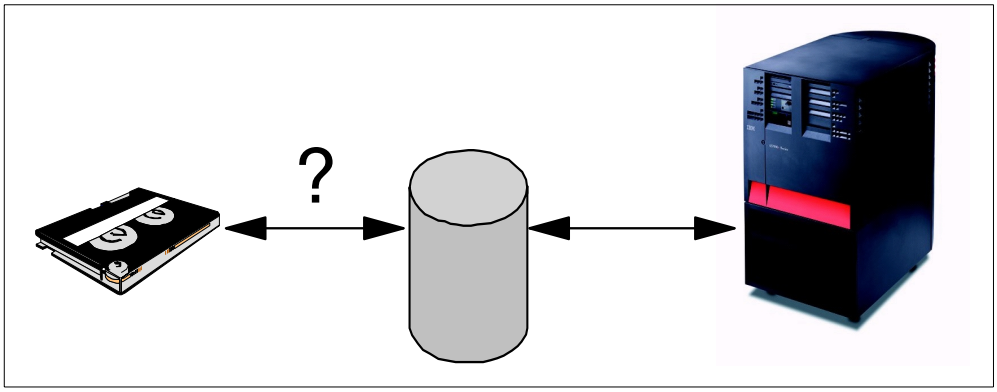

Figure 80. Staged backup

Saving to disk on the iSeries server is usually accomplished by using an object called a save file. A save file acts as a common receptacle for saving several types of objects such as libraries, files, and storage spaces. You can use the same OS/400 commands to save to a save file as you would use to save to tape. Instead of specifying a tape device name, you specify *SAVF. You are also prompted for the name of the save file and the library where it is stored.

Because you are backing up to disk, you can also restore from disk. This method provides a very fast method of restoring data, especially since you don't need to waste time locating and mounting a tape.

The downside of backing up to disk is the cost of the additional disk required. However, the cost will vary greatly depending on whether you subsequently back up the data to tape and delete the disk backup or leave the disk backup in place for fast retrievals.

Staged backup can be performed from both the iSeries and Windows 2000 as follows:

- **iSeries server**: Storage spaces can be saved to disk by either creating a straight copy of the storage space or by saving to a save file.

  With V4R5, Windows 2000 files can also be saved to save files.

- **Windows 2000**: Files can be saved to disk through the Windows 2000 interface using Windows 2000 applications. Some Windows 2000 applications, such as Arcserve, provide a similar capability as is provided by OS/400 save files, in that you can back up multiple files to a single file on disk. This backup could be performed to a non-Windows 2000 file system in the IFS using AS/400 NetServer.

7.1.4 Windows 2000 installation scenarios

To properly understand how to back up Windows 2000, you need to look at the ways it can be installed. There are three possible installation scenarios for Windows 2000 in an Integrated xSeries Server environment at V4R5:

- Install Windows 2000 on a 700 MHz Integrated xSeries Server residing in an iSeries server Model 270 or 8xx.

  Drive C: is your Windows 2000 system drive, and drive D: is the installation code image.

- Install Windows 2000 on a 333 MHz Integrated xSeries Server residing in an iSeries server pre-Model 270 or 8xx.

  Drive C: is your Windows 2000 system drive, and drive D: is the installation code image.

- Install Windows NT on a 333 MHz Integrated xSeries Server residing in a pre-Model 270 or 8xx iSeries server and upgrade the server to V4R5 and Windows 2000.

  Drive E: is your Windows 2000 system drive, drive D: is the installation code image, and drive C: is the DOS boot drive. The V4R4 drive structure is maintained.

The third installation scenario results in a slightly different backup regime, because, to back up the complete environment, you need to save different objects than those that are saved in the first two scenarios.

Note

In this chapter, unless specifically noted, we assume that the C: drive contains the Windows 2000 system and the D: drive contains the installation code image.

7.1.5 Planning a backup strategy

This chapter does not attempt to help you define your backup strategy in detail. Nor does it cover how to back up the iSeries server as a whole. Both of these topics are well documented elsewhere. We recommend that you consult the manual *Backup and Recovery*, SC41-5304.

The objective of this section is to provide guidance to help you understand the special requirements of the Windows 2000 on Integrated xSeries Server environment and provide input to your overall backup strategy.

As part of your backup strategy, you should also have a backup schedule. Refer to 7.10.1, “Recommended backup schedule” on page 216, for suggestions.

7.1.5.1 General considerations

Here are some general points that you should consider when formulating a backup strategy:

- Before you decide how you are going to take a backup of your system, you must first decide how you want to restore it, that is, at a storage-space level, file level, or both.
- Next you need to decide whether you are going to use an iSeries or Windows 2000-centric approach or a combination of both. Keep in mind that backing up data at a storage space level can only be initiated from the iSeries server.
- Importantly, you need to calculate how much data to back up and how frequently. Many of the system objects (for example, the network server description) do not change from one year to the next. It is pointless to back up these objects every day. Conversely, you may need to back up user files daily.

- Once you decide how much data to back up and how often, you can decide whether you need to take the staged approach and back up some of your data to disk.
- One of the most obvious differences between a PC-based server and an Integrated xSeries Server is that the latter does not have a diskette drive. This means that you cannot use a BOOT diskette or an Emergency Repair Diskette with an Integrated xSeries Server. In this chapter, we describe other ways in which you can quickly recover your Windows 2000 system.
- If you are restoring your Windows 2000 environment to a different iSeries server, or you want to bring up your server on another Integrated xSeries Server in the same iSeries, remember to check the hardware resource name of the Integrated xSeries Server on the new system. The resource name is probably different, and you would need to modify the network server description accordingly.

  You may also need to make sure that the type and position of the LAN cards match in both servers.
- Before you start to back up Windows 2000 files, the network server description must be in the correct state, depending on the type of backup you are performing:
  - To perform a disaster recovery backup, the network server description must be varied off.
  - To perform a file-level backup, the network server description must be varied on.
- If all else fails, you can re-install the server. There are three options for this:
  - The easy option is to restore the C: and D: drives from backup. This is a unique capability of the iSeries server, which is made possible because Windows 2000 is effectively acting as a guest operating system on the iSeries.
  - If the D: drive is still intact, and you can boot the server into console mode, you can re-install by re-running the Windows 2000 installation command.
  - The more extreme method is to delete the entire server from the iSeries, and go back to the start of the installation process. Most of the time, though, this should not be necessary.

7.1.5.2 Backup tips

As you read this chapter, you will come to your own conclusions about the options that are most suited to your own environment. Here, we provide some tips for a range of situations that we hope will assist you in confirming your own ideas or in coming to a decision:

- If possible, do not store user data on the Windows 2000 system (C:) drive.
- Try to keep application software on a separate drive or drives. Applications rarely change and do not require frequent backups, so you can eliminate these storage spaces from your daily routine.
- Try to keep static data and frequently modified data on separate drives. Static data (for example, reference such material as iSeries User Guides) changes infrequently and only needs backing up when it changes, where frequently modified data needs to be saved regularly.

- Always back up the system objects on the iSeries as soon as you are satisfied that the server is installed and configured correctly.
- Make frequent backups of the Windows 2000 system (C:) drive. This is where the Windows 2000 operating system is stored and where the registry (including the domain database) is kept (if the Windows 2000 server is a domain controller). As a precaution, you may also want to use a Windows 2000 utility to back up the registry separately, in addition to backing up the C: drive. The fastest way to save the C: drive is to use a disaster recovery backup.
- Ensure that all the system component of the Windows 2000 server are included in your periodic, complete iSeries backup.
- If you have already implemented a backup strategy using a Windows 2000 application, you may want to continue using the backup procedures you already have in place. However, it is worthwhile investigating whether using the backup functions available from the iSeries side will complement or even improve your current procedures.
- If you are new to Windows 2000, you probably have an iSeries backup strategy that is well established. We advise you to review that strategy to verify that the Windows 2000 components are included. Make sure you also implement a file-level backup strategy for your Windows 2000 server. There are several options including IFS save, Tivoli Storage Manager (TSM), Windows 2000 Backup Program, Computer Associates Arcserve, Veritas Backup Exec, and so on. You need to review these to see which suits your needs best. We recommend that you use TSM for larger installations and either the IFS save or a Windows 2000 backup application for smaller shops.
- If you need disk protection (RAID-5 or mirroring), implement this at the iSeries level, and do not use any form of Windows 2000 protection. Using Windows 2000 RAID-5 or mirroring will adversely affect performance and add no additional protection whatsoever.

Specific recommendations for backup and restore are described in 7.10, “Backup technique positioning and recommendations” on page 215.

7.2 Enabling tape support

There is no PC tape drive supplied with the Integrated xSeries Server. Windows 2000 running on the Integrated xSeries Server can use the iSeries tape drive for backup purposes. However, both the iSeries and Windows 2000 cannot use the iSeries tape drive concurrently; it must be allocated to one server or the other. When using a Windows 2000 backup application, you can also use a tape drive attached to a PC server somewhere in the network. More likely, you may want to use an iSeries tape drive, which tends to be faster and more reliable than most PC tape drives. If you have multiple Integrated xSeries Servers in the same iSeries server, they can all access the same tape drive (although not at the same time), so you only need one tape drive for multiple Windows 2000 servers.

The way Windows 2000 handles backup is different than Windows NT. Backup on Windows 2000 is media-oriented rather than device-oriented. It centers on the concept of “media pools”. We do not attempt to explain the new backup functions of Windows 2000. In addition to reading this section, you should consult the Windows 2000 documentation for additional information.

To allocate an iSeries tape drive for use by the Windows 2000 server, the iSeries tape drive must be logically detached from (varied off) the iSeries. Then, it must be assigned (locked) to the Windows 2000 server so that Windows 2000 thinks it has one or more physical tape drives attached. When this is done, the Windows 2000 server can use the iSeries tape drives as if they were normal PC tape devices. Be aware that, to make an iSeries tape drive available to Windows 2000, there are additional steps you need to perform.

The iSeries supports a wide range of tape drives. The Windows 2000 server has the appropriate SCSI driver for the iSeries tape drive (supplied with the OS/400 integration software), so it can use any of the supported iSeries devices. If you have multiple tape drives on your iSeries, each one can be allocated separately. It is possible to have tape drives dedicated to the iSeries and to Windows 2000. Notice that you can restrict which tape drives can be allocated to Windows 2000. Device restrictions are achieved by specifying the devices that are *not* to be made available to the Windows 2000 server. Devices to be restricted can be identified at two points:

- During installation (using the INSWNTSVR command) by listing the devices in the Restrict device resources (RSTDEVRSC) parameter.
- After installation by using the CHGNWSD command and listing the devices in the Restrict device resources (RSTDEVRSC) parameter. Notice that the network server description (NWSD) must be varied off for the change to be made.

7.2.1 iSeries tape drives

Most iSeries tape drives are supported, but some older models cannot be used. The latest information about which tape devices can be used from Windows 2000 running on the Integrated xSeries Server can be found in Informational APAR II11119, which can be viewed on the Web at:

`http://www.as400.ibm.com/windowsintegration`

Select **Service Information->Informational APARs**.

7.2.1.1 Supported tape drives

The following tape drives are supported for use by Windows 2000 running on the Integrated xSeries Server (the drive model is 001 unless otherwise specified):

- 1349, 1350, 1360, 1378, 1379, 1380
- 3570-B00, -B01, -B02, -B0A, -B11, -B12, -B1A
- 3570-C00, -C01, -C02, -C0A, -C11, -C12, -C1A
- 3590-B11, -B1A, -B21, -B2A, -E11, -E1A
- 4482, 4483, 4486
- 4582, 4583, 4586
- 6341, 6342, 6343, 6344, 6346, 6347, 6348, 6349
- 6366, 6367, 6368, 6369, 6378, 6379
- 6380, 6381, 6382, 6383, 6384, 6385, 6386
- 6390
- 6480, 6481, 6482, 6483, 6484, 6485, 6486
- 6490
- 7207-122
- 7208-002, -012, -222, -232, -234, -342
- 9999

7.2.1.2 Unsupported tape drives

The following tape drives are not supported for use by Windows 2000 running on the Integrated xSeries Server:

- Quarter-inch cartridge (QIC) tape drives other than those listed previously
- All ½-inch reel tape drives (for example, 2440, 3422, 3430, 9347, 9348)
- 3480, 3490, 3490e

7.2.2 Supported Windows 2000 backup applications

The Windows 2000 Backup program is a standard utility shipped with Windows 2000 that provides functions to back up system and non-system files to tape or disk.

There are numerous other backup programs on the market that offer a wider range of functions than the standard Microsoft application. In addition to the Windows 2000 Backup program, there are two other applications that have been tested for use with Windows 2000 running on the Integrated xSeries Server. They are:

- Veritas Backup Exec 8.0 and previous versions
- Computer Associates Arcserve 6.6x and previous versions

For further details regarding supported backup applications, refer to Informational APAR II11119, which can be viewed on the Web at:
`http://www.as400.ibm.com/windowsintegration`

Select **Service Information->Informational APARs**.

Because a particular backup application is not “supported” does not mean that it will not work. The supported applications are those that have been tested and certified to work in an Integrated xSeries Server environment.

7.2.3 Restrictions on using iSeries tape drives

There are two restrictions on the use of iSeries tape drives by Windows 2000 backup applications:

- Although most iSeries tape drives can be used by either Windows 2000 or OS/400, each operating system requires a different media format. For a tape cartridge to be used by Windows 2000 in an iSeries tape drive, it must be formatted as non-labeled. Therefore, it is not possible to use the same tape cartridge to save data using a Windows 2000 backup application and OS/400 backup commands.
- iSeries tape drives, such as the 3570 and 3590, support Auto Cartridge Loader (ACL) and Auto Cartridge Facilities (ACF). When performing a backup using a Windows 2000 backup application, such as Arcserve, tape cartridges must be loaded manually because there is no support for the ACL. In terms of an unattended backup, this means that all the Windows 2000 files that you want to back up must fit on one tape cartridge.

  Similarly, there is no tape library support when using a Windows 2000 backup application. Tape libraries are not supported as libraries, but may be supported as single devices.

There are two possible circumventions for these limitations:

- If you have two or more tape drives, you can use one for iSeries backup and one for Windows 2000 backup. However, the limitation of only being able to

use one tape cartridge for your Windows 2000 files still exists, unless there is an operator available to manually change cartridges.

- You can use AS/400 NetServer and a backup utility, such as BXTOOLS (from Mensk Technologies), to save Windows 2000 files to a directory in the OS/400 Integrated File System (IFS). You can then back up the IFS directory to tape using OS/400 backup commands. Refer to 7.7.4.1, “Backing up Windows 2000 files to the IFS” on page 199, for more information on BXTOOLS.

7.2.4 Installing the tape driver

The IBM iSeries Tape Drive device driver must be installed before applications running on Windows 2000 can use an iSeries tape drive. Windows should automatically install the driver for you. To verify that the driver is installed, follow these steps:

1. Sign on to Windows 2000 as Administrator.
2. Click **Start->Programs->Administrative Tools->Computer Management**.
3. Click the **Device Manager** icon in the left-hand pane.
4. Double-click **Tape drives** in the right-hand pane. You should see an entry for the type and model of the tape drive installed in your iSeries, as shown in Figure 81.

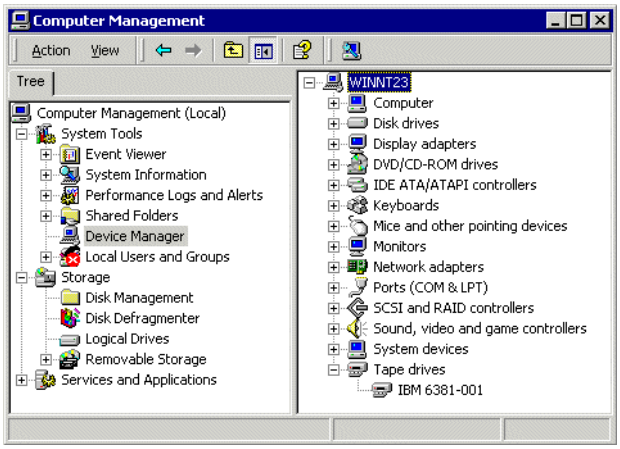

Figure 81. Installed iSeries tape drive

If your iSeries tape drive appears in the window, you can now proceed to 7.2.6, “Allocating a tape drive to Windows 2000 from the iSeries server” on page 163, to make it available to Windows 2000 backup applications.

If the tape drive on your iSeries does not appear under Tape drives, or if the Tape drives icon does not appear at all, proceed to the following section to install it manually.

7.2.4.1 Installing the iSeries tape drive device driver

To install the iSeries tape drive device driver, follow these steps:

1. On the Windows 2000 task bar, click **Start->Settings->Control Panel**.
2. Double-click **Add/Remove Hardware**.
3. On the Add/Remove Hardware Wizard welcome panel, click **Next**.

4. On the Choose a Hardware Task panel, select **Add/Troubleshoot a device**. Click **Next**. Windows tries to find any uninstalled plug and play devices.
5. On the Choose a Hardware Device panel, select **Add a new device**. Click **Next**.
6. On the Find New Hardware panel, select **No, I want to select the hardware from a list**. Click **Next**.
7. On the Hardware Type panel, scroll to the bottom of the list, and select **Tape Drives**. Click **Next**.
8. On the Select a Device Driver panel, select **IBM iSeries Tape Drive**. Click **Next**.
9. On the Start Hardware Installation panel, click **Next**.
10. On the Completing the Add/Remove Hardware Wizard panel, you should see the following message: *The following hardware was installed: IBM iSeries Tape Drive*. Click **Finish**.
11. To confirm that the tape drive has installed correctly, click **Start->Programs-> Administrative Tools->Computer Management**.
12. Click the **Device Manager** icon in the left-hand pane.
13. Double-click **Tape drives** in the right-hand pane. You should see an entry under Tape drives for your tape device as shown in Figure 81 on page 161. The entry should show a tape device type and model, for example 6381-001. Assuming your tape drive appears in the window, you can now use it. Proceed to the next section.

Tape device driver

If you see an entry titled *IBM iSeries Tape drives*, you *must* update the tape device driver before you continue.

To update the tape device driver, follow these steps:

1. Expand **Other devices** in the Computer Management panel. You should see an entry with the correct tape drive type and model number, for example 6381-001.
2. Right-click the device, and select **Properties**.
3. Select the **Driver** tab.
4. Click the **Update Driver** button.
5. On the Upgrade Device Driver Wizard welcome panel, click **Next**.
6. Click the **Display a list of.....** radio button. Click **Next**.
7. You should see an entry for **IBM iSeries Tape Drive**. Select it, and click **Next**.
8. Click **Next.**
9. Click **Finish**.
10. Click **Close** on the Properties panel. A new entry should appear in the Device Manager panel under Tape drives, showing the correct type and model of tape drive you have in your iSeries.

11. Uninstall the entry titled **IBM iSeries Tape Drive**, if you haven't done so already. Now proceed to the next section.

7.2.5 Formatting a tape

A tape may be formatted for use by the iSeries *or* Windows 2000, but not both. The formats are mutually exclusive and therefore, the iSeries and Windows 2000 servers cannot share the same tape. To format a tape that Windows 2000 can recognize, use the OS/400 Initialize Tape command (INZTAP), for example:

```
INZTAP DEV(TAP01) NEWVOL(*NONE) NEWOWNID(*BLANK) VOL(*MOUNTED) CHECK(*NO)
   DENSITY(*DEVTYPE) CODE(*EBCDIC)
```

Notice that `DENSITY(*DEVTYPE)` gives the best performance. However, if you receive an error with this setting when trying to initialize the tape, try using `DENSITY(*CTGTYPE)`. If you still receive an error, the tape cartridge is incompatible with your tape drive.

This command produces a non-labeled tape that can be used by Windows 2000 backup applications. Do not format or reformat tapes using Windows 2000 applications. Format all tapes for use by Windows 2000 using the `INZTAP` command.

7.2.6 Allocating a tape drive to Windows 2000 from the iSeries server

To use an iSeries tape drive from a Windows 2000 backup application, you must vary it off from an OS/400 session and then lock it to Windows 2000 using the server console. In addition, you must restart the Windows 2000 service for the backup application you are using. You must do this before you run any backups.

To lock the tape drive to a Windows 2000 server, you must have Administrator or Backup Operator authority.

To transfer control of the iSeries tape drive to a Windows 2000 server from the iSeries, follow these steps:

1. Using the following command, vary off the tape device from an OS/400 session:

   ```
   WRKCFGSTS *DEV *TAP
   ```

   On the Work with Configuration Status (WRKCFGSTS) display, find the tape device. Type `2` next to the device, and press Enter.

   Notice that some tape devices report in under more than one device description. Tape libraries (3570, 3590, and so on) report in as devices (TAPxx), as well as tape libraries (tapemlbxx), where *xx* is a sequence number. OS/400 Integration for Windows Server does not support tape libraries. Therefore, if your device has a tape library description, you must vary off both the tape device and tape library before locking the device on the Windows 2000 server console.

2. Lock the device on the Windows 2000 console. This is done from the iSeries Devices application located at **Start->Programs->iSeries Windows Server-> iSeries Devices**.

   Figure 82 on page 164 shows an example of the iSeries Devices panel.

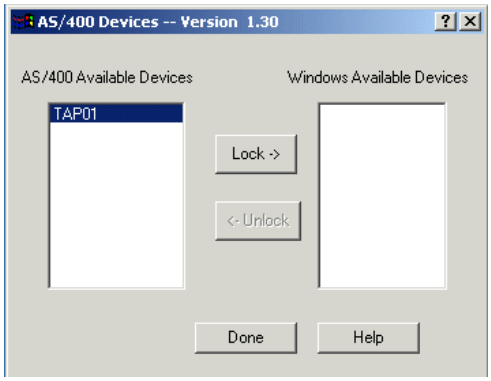

Figure 82. Locking an iSeries tape device to Windows 2000

3. Select the tape device in the left pane of the window, and click **Lock**. This moves the device from the left side to the right side and allocates it for exclusive use by the Integrated xSeries Server. It must be locked before Windows 2000 can access the drive.
4. Click **Done** to close the iSeries Devices window.
5. Insert a tape cartridge that has been formatted for Windows 2000.

7.2.6.1 Restarting Windows 2000 services

Unlike Windows NT, with Windows 2000, you need to restart a Windows 2000 service before you can use the tape drive. Depending on the backup application you are using, you need to restart one of the following services:

- **Windows 2000 Backup program**: Removable storage service
- **Computer Associates Arcserve**: Consult the manufacturer's documentation
- **Veritas Backup Exec**: Consult the manufacturer's documentation

Follow these steps:

1. Click **Start->Programs->Administrative Tools->Computer Management->Services and Applications->Services**.
2. Find the service applicable to your backup application and right-click it. Click **Restart**.

An example of restarting the Windows 2000 Backup program service is shown in Figure 83.

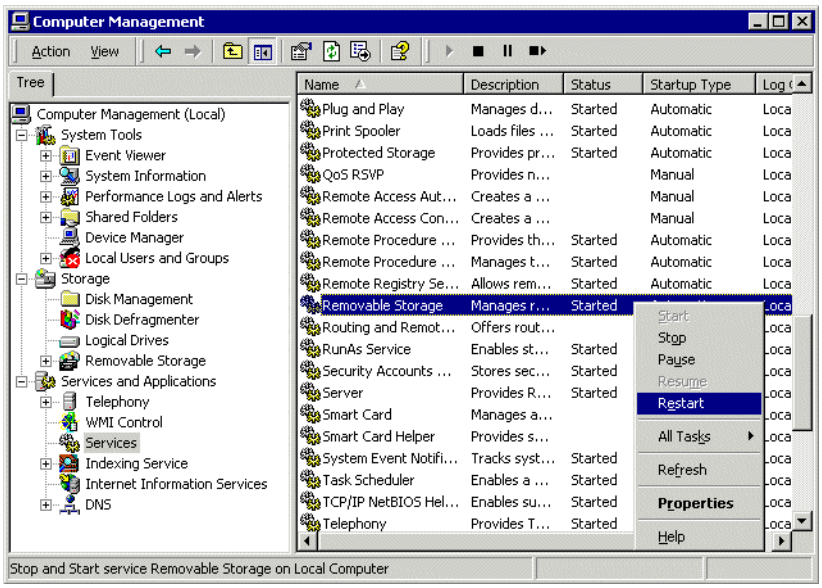

Figure 83. Restarting the Windows 2000 Backup program service

After the tape drive is logically connected to the Windows 2000 server, you can use it in the same way as you would use a PC-attached tape device. Using one of the supported backup utilities, you can direct your Windows 2000 backups to the iSeries tape drive.

If you shut down Windows 2000, or the Windows 2000 server fails before you unlock the tape drive, it unlocks automatically. However, it is still in a varied off state on the iSeries server.

7.2.7 Allocating a tape drive to the iSeries server from Windows 2000

To unlock the tape drive from a Windows 2000 server, you must either be the person who originally locked the drive or have Administrator or Backup Operator authority.

To transfer control of the iSeries tape drive from a Windows 2000 server to the iSeries, follow these steps:

1. On the Windows 2000 server console, select **Start->Programs->iSeries Windows Server->iSeries Devices**.
2. In the Windows **Available Devices** list, click **TAP01** or the tape drive that you allocated to Windows 2000.
3. Click **Unlock** to make the tape drive available to the iSeries server.
4. Click **Done**.
5. On the OS/400 command line, type:

   ```
   WRKCFGSTS *DEV *TAP
   ```

   Press Enter. The Work with Configuration Status display appears.
6. In the Opt column next to TAP01, type `1` to vary on the tape drive. Press Enter.
7. Insert a tape cartridge that has been formatted for the iSeries server.

7.2.8 Controlling tape devices in a batch environment

You may want to run a Windows 2000 backup application from the iSeries. In this case, you need to pass commands to Windows 2000 using a command line (also called *batch*) interface. You need to be able to lock the iSeries tape drive to Windows 2000 using a command line interface and initiate the backup application from this interface. Therefore, your backup application must support such an interface.

It is possible to lock and unlock shared tape drives from a command line interface on Windows 2000 using the AS400DEV command. It can be run from a Windows 2000 batch file or command line prompt. The AS400DEV command can also be used to automate a backup routine from the iSeries side using the Submit Network Server Command (SBMNWSCMD) command. An example is described in 7.8.1.2, "Automating file-level backup on the iSeries server" on page 204. The following options are available with the AS400DEV command:

- **/help**: Displays help information and the version number of the AS400DEV command
- **/all**: Displays all sharable devices
- **/as400**: Displays iSeries tape devices not locked to the local Integrated xSeries Server
- **/windows**: Displays iSeries tape devices locked to the local Integrated xSeries Server
- **/lock device_name**: Locks the tape device specified to the Integrated xSeries Server
- **/unlock device_name**: Unlocks the tape device specified from the Integrated xSeries Server

The following example locks the tape device TAP01 to Windows 2000, assuming that the device is varied off on the iSeries:

```
as400dev /lock tap01
```

Remember, with Windows 2000, you also need to restart a Windows 2000 service before you can use the tape drive. Depending on the backup application you are using, you need to restart one of the following services:

- **Windows 2000 Backup program**: Removable storage service
- **Computer Associates Arcserve**: Consult the manufacturer's documentation
- **Veritas Backup Exec**: Consult the manufacturer's documentation

To do this, you need to run a command from a Windows 2000 command line or batch file or use the SBMNWSCMD command from the iSeries server. Consult the Microsoft documentation to find out how to do this.

7.3 Disaster recovery backup from the iSeries side

Object types

Before you continue reading this section, make sure you are familiar with the types and names of objects that are created on both the iSeries and Windows 2000 when running a Windows 2000 server on the Integrated xSeries Server. Details of these objects are provided in Chapter 11, “OS/400 components of the Windows 2000 server” on page 263.

You can perform a disaster recovery backup from the iSeries side to save all components of the Windows 2000 on an Integrated xSeries Server environment. This type of backup is useful when you need to restore an object such as the network server description, the Windows 2000 system (C:) drive, or a complete user drive.

Note: You cannot restore individual Windows 2000 files from a disaster recovery backup.

To ensure the stability of the server, be careful if you save any one of the components of a Windows 2000 server without saving the others. For example, save the user storage spaces and the network server description at the same time. To Windows 2000, these components operate as a unit to create the full system and should be treated as such. Failure to do this may result in discrepancies in the registry and NTFS permissions.

Network server description

You must vary *off* the network server description before you perform a disaster recovery backup.

To position disaster recovery backup against other methods of backup, see 7.10, “Backup technique positioning and recommendations” on page 215.

You perform a disaster recovery backup of the Windows 2000 on Integrated xSeries Server environment by running OS/400 Control Language (CL) commands. These CL commands can either be run individually, from the OS/400 SAVE menu or in CL programs. Section 7.8, “Automating backup and restore” on page 200, shows you how to use CL programs to automate your backup operations.

The Windows 2000 system files are a special case, because if any of them become damaged or are accidentally deleted, you may not be able to boot the server. Therefore, they require special consideration and should be backed up on a regular basis. Refer to 7.3.2, “Special considerations for Windows 2000 system files” on page 169, for more information.

7.3.1 Disaster recovery backup types

When you perform a disaster recovery backup of the Windows 2000 in an Integrated xSeries Server environment, you can break it down into three logical

groupings of objects. Each grouping should be saved as part of the same backup operation to maintain synchronization between the various components.

- **Non-Windows 2000 part of the environment:** The non-Windows 2000 part of the environment includes:

  - Communications objects
  - QNTAP library
  - NTAP directories
  - Server message queue

  You may want to save this group of objects after you have:

  - Finished installing Windows 2000 on the Integrated xSeries Server
  - Applied service packs to the OS/400 Integration for Windows NT code
  - Made changes to the communication objects

- **Windows 2000 system drives:** The Windows 2000 system drives includes:

  - Windows 2000 system (C:) drive
  - Installation image (D:) drive

  You may want to save this group of objects after you have:

  - Finished installing Windows 2000 on the Integrated xSeries Server
  - Made changes to the Windows 2000 operating system and registry
  - Installed a new OS/400 Integration for Windows Server Service Pack

- **Windows 2000 application code:** The Windows 2000 application code drives includes:

  - Windows 2000 system (C:) drive
  - Other drives where Windows 2000 applications are installed

  You may want to save this group of objects after you have installed a new application on the Windows 2000 server.

- **Windows 2000 user data:** The Windows 2000 user data comprises the drive or drives where your user data is stored.

  You may want to perform this type of save on a regular (say daily or weekly) basis so that you have a backup of all updates to user files. Remember that this is a backup at a user storage space level; you cannot restore individual files from this backup.

  Save all user storage spaces in the one backup operation to maintain synchronization between files on different Windows 2000 drives.

- **Complete Windows 2000 environment:** This is a combination of the second, third, and fourth types above.

  You may want to save all of the Windows 2000 server drives (storage spaces) to recover the server in the case of a catastrophic Windows 2000 failure (where you cannot recover the server).

- **Complete Windows 2000 on Integrated xSeries Server environment:** This is a combination of the first four types above.

  You may want to save the complete environment to restore the server on another iSeries server after a disaster where you cannot recover the iSeries.

7.3.2 Special considerations for Windows 2000 system files

The Windows 2000 operating system and installation image are located on the C: and D: drives respectively. The user storage spaces that contain these drives reside in the /QFPNWSSTG directory of the IFS.

Because of the way in which Windows 2000 is implemented on the Integrated xSeries Server, you can save these drives on the iSeries and restore them if files on the C: or D: drives become damaged or deleted, for example:

- If your BOOT.INI file is deleted, you can restore the C: drive to recover it.
- If the \i386 directory on the D: drive is deleted, you can replace it by restoring the D: drive.
- If the Windows 2000 registry becomes corrupted, you can restore the C: drive to recover it.

This function effectively replaces the need to use the BOOT disk, RDISK, and REGISTRY backup options that you may normally consider with a PC-based Windows 2000 server.

We recommend that you save the C: and D: drives frequently. The C: drive should be saved daily if possible because it contains the registry. When you restore the C: drive, you need to be aware that the registry may be back level. It is a good idea to take frequent backups of this drive to ensure that you never restore a version of the registry that is too old to be useful. There are also other ways of backing up the registry with Windows 2000 that you can use in addition to this process. We recommend that you save the system drive to a save file stored on the iSeries server. If you use compression, this does not take a large amount of disk space. Saving to disk gives you the ability to restore the system drive quickly and get your Windows 2000 server up and running again with a minimum of disruption.

Section 7.8.2.1, “Automating disaster recovery restore” on page 206, shows an example of a CL program to restore a Windows 2000 system drive.

7.3.3 Disaster recovery tips

You should note the following points when performing a disaster recovery backup:

- You can restore a storage space over the top of an existing storage space without deleting it first.
- You can back up (SAV command) or copy (CRTNWSSTG command) a storage space regardless of whether it is linked to a network server description.
- If you back up a storage space (SAV command) while it is linked, it will restore in a linked condition.

  If you back up a storage space (SAV command) while it is unlinked, it will restore in an unlinked condition.
- When you save or restore a storage space, you should see a completion message of `3 objects saved` or `3 objects restored`. The objects are:
  - The storage space directory object (same name as the storage space)
  - QFPCLTSTG1 is a stream file object that contains the data
  - QFPCONTROL is a stream file object that contains header information

7.3.4 Disaster recovery backup methods

When you perform a disaster recovery backup, there are three methods you can use:

- **Save to tape**: Saving to tape is the most common form of backup. Table 10 lists the CL commands you can use.
- **Save to disk**: Saving to disk has the advantage of being very fast, and the data is easily accessible. Table 10 lists the CL commands you can use.
- **Copy to disk**: Copying a user storage space to disk is a special case. This method uses the Create Network Server Storage (CRTNWSSTG) command, which is described in 7.3.6, "Backup using the CRTNWSSTG command" on page 172.

Saving and restoring to and from disk can be used as part of a staged backup strategy. See 7.1.3, "Staged backup" on page 154, for more information on staged backups.

7.3.5 Performing a disaster recovery backup

Each component of the Windows 2000 server on the Integrated xSeries Server environment can be backed up individually to tape or save files as shown in Table 10. Replace the *underlined* values with the values that are appropriate for your system as follows:

- The object names used in the table are for a sample network server description called AS400WIN. Replace these with your own object names.
- Replace the device names in the table as follows:
  - **Saving to tape**: Replace *TAP01* with the tape device name you are using (if not *TAP01*).

    You can use the Data compression (DTACPR) and Data compaction (COMPACT) parameters on the save commands to store more data on a tape cartridge, depending on the type of tape drive you are using.
  - **Saving to a save file**:
    - Replace *library* with the name of the library containing the save file.
    - Replace *save-file* with the name of the save file you want to use.

    Notice that, before you save to a save file, you must create the save file in a library by using the Create Save File (CRTSAVF) command, for example:

    ```
    CRTSAVF FILE(MYLIB/SAVE1)
    ```

    You must use a different save file for each save operation.

    You can use the Data compression (DTACPR) parameter on the save commands to save disk storage space. Compressing the data provides better performance and results in a shorter save time. When you save to a save file, you must manually select compression because the command default is *DEV. *DEV does not compress a save file.

Table 10. Disaster recovery backup to tape and save files

Object description	Object name	Object type	Save command examples
Network Server Description	QSYS/*AS400WIN*	Configuration definitions	SAVCFG DEV(*TAP01*) [1] SAVCFG DEV(*SAVF) SAVF(library/save-file) DTACPR(*YES) [1]
Line descriptions [2]	QSYS/*AS400WIN00-02*	Configuration definitions	SAVCFG DEV(*TAP01*) [1] SAVCFG DEV(*SAVF) SAVF(library/save-file) DTACPR(*YES) [1]
Windows 2000 system drive (C: drive) [4]	/QFPNWSSTG/*AS400WIN1*	User storage space	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QFPNWSSTG/*AS400WIN1*') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QFPNWSSTG/AS400WIN1') DTACPR(*YES)
Windows 2000 installation code (D: drive) [5]	/QFPNWSSTG/*AS400WIN2*	User storage space	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QFPNWSSTG/*AS400WIN2*') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QFPNWSSTG/AS400WIN2') DTACPR(*YES)
Integration code (5769-WSV)	QSYS/QNTAP [3]	Library	SAVLIB LIB(QNTAP) DEV(*TAP01*) SAVLIB LIB(QNTAP) DEV(*SAVF) SAVF(library/save-file) DTACPR(*YES)
Windows 2000 server messages	*QGPL*/*AS400WIN*	Message queue	SAVOBJ OBJ(*AS400WIN*) LIB(*QGPL*) DEV(*TAP01*) OBJTYPE(*MSGQ) SAVOBJ OBJ(AS400WIN) LIB(QGPL) DEV(*SAVF) OBJTYPE(*MSGQ) SAVF(library/save-file) DTACPR(*YES)
Integration code (5769-WSV)	/QIBM/ProdData/NTAP[3]	IFS dirs	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QIBM/PRODDATA/NTAP') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QIBM/PRODDATA/NTAP') DTACPR(*YES)
User data and applications in System ASP	/QFPNWSSTG/*AS400WIN3*	IFS dirs (user storage spaces)	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QFPNWSSTG/*AS400WIN3*') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QFPNWSSTG/AS400WIN3') DTACPR(*YES)

Object description	Object name	Object type	Save command examples
User data and applications in User ASP nn, where *nn* is from 2 to 16	/QFPNWSSTG/*AS400WIN3*	IFS dirs (user storage spaces)	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QFPNWSSTG/*AS400WIN3*') ('dev/QASPnn/AS400WIN3.UDFS') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QFPNWSSTG/AS400WIN3') ('dev/QASPnn/AS400WIN3.UDFS') DTACPR(*YES)

1. SAVCFG saves all configuration objects on the system. You cannot save individual lines or network server descriptions.
2. The new 700 MHz Integrated xSeries Server and the 333 MHz iSeries installed in a migration tower do not support the external host LAN, corresponding to lines with a 01 or 02 suffix. The external host LAN lines are only supported on a Windows 2000 server, migrated from Windows NT installed on a pre-V4R5 release, running on a 333 MHz Integrated Netfinity Server installed in pre-270 or 8xx hardware.
3. You can also back up the NTAP directory and the QNTAP library by running the SAVLICPGM command to save the OS/400 Integration for Windows Server Program Product (5769-WSV).
4. If you migrated your Windows 2000 server, running on a 333 MHz Integrated Netfinity Server, from Windows NT installed on a release prior to V4R5, your system drive will be drive E:, and the user storage space suffix will be “2”.
5. If you migrated your Windows 2000 server, running on a 333 MHz Integrated Netfinity Server, from Windows NT installed on a release prior to V4R5, your installation drive will also be drive D:, but the user storage space suffix will be “1”.

7.3.6 Backup using the CRTNWSSTG command

You can back up a user storage space by copying it to disk using the Create Network Server Storage (CRTNWSSTG) command. This command makes a copy of a user storage space and saves it under another name. If you have a problem with the primary storage space, you can simply unlink it from the network server description and link the backup. Here is an example of a command to copy a storage space named AS400WIN4 to AS400WIN4B:

```
CRTNWSSTG NWSSTG(AS400WIN4B) FROMNWSSTG(AS400WIN4)
```

To run this command, the network server description must be varied off. However, you do not need to unlink the storage space to copy it.

7.3.7 Backup using the OS/400 SAVE menu

When you perform a disaster recovery backup of the Windows 2000 on Integrated xSeries Server environment to tape, you can also use the OS/400 SAVE menu (GO SAVE). The commands provided on the iSeries for saving the system are available on the second panel of the SAVE menu as shown in Figure 84. The help text provides full details of the options and components of the system that are saved with each.

```
Save System and User Data
  21. Entire system
  22. System data only
  23. All user data
```

Figure 84. SAVE menu options

When you perform a full iSeries backup, any Integrated xSeries Server components that you have on that iSeries are automatically backed up by default. We recommend that you review your backup requirements for the Windows 2000 server with the person in your organization who is responsible for backing up the iSeries server, to make sure that the system backup includes the Windows 2000 components. Many organizations modify the default iSeries backup options to suit their own requirements. Verify that your organization has not removed the commands that back up the Windows 2000 server.

Every component of the Windows 2000 server on the Integrated xSeries Server environment can be backed up using an option from the OS/400 SAVE menu as shown in Table 11. The *underlined* object names used in the table are for a sample network server description called AS400WIN.

Table 11. Disaster recovery backup using an option from the OS/400 SAVE menu

Object description	Object name	Object type	SAVE Menu options
Network Server Description	QSYS/*AS400WIN*	Configuration definitions	GO SAVE Option 21, 22, or 23
Line descriptions [1]	QSYS/*AS400WIN00-02*	Configuration definitions	GO SAVE Option 21, 22, or 23
Integration code (5769-WSV)	QSYS/QNTAP	Library	GO SAVE Option 21, or 22
Integration code (5769-WSV)	/QIBM/ProdData/NTAP	IFS dirs	GO SAVE Option 21 or 22
Windows 2000 server messages	*QGPL/AS400WIN*	Message queue	GO SAVE Option 21 or 23
Windows 2000 system drive (C: drive) [2]	/QFPNWSSTG/*AS400WIN1*	IFS dir (user storage space)	GO SAVE Option 21 or 23
Windows 2000 installation code (D: drive) [3]	/QFPNWSSTG/*AS400WIN2*	IFS dir (user storage space)	GO SAVE Option 21 or 23
User data and applications in System ASP or User ASP	/QFPNWSSTG/*AS400WIN3*	IFS dirs (user storage spaces)	GO SAVE Option 21 or 23

1. The new 700 MHz Integrated xSeries Server and the 333 MHz Integrated Netfinity Server installed in a migration tower do not support the external host LAN, corresponding to lines with a 01 or 02 suffix. The external host LAN lines are only supported on a Windows 2000 server, migrated from Windows NT installed on a pre-V4R5 release, running on a 333 MHz Integrated Netfinity Server installed in pre-270 or 8xx hardware.
2. If you migrated your Windows 2000 server from Windows NT, your system drive will be drive E:, and the user storage space suffix will be “2”.
3. If you migrated your Windows 2000 server from Windows NT, your installation drive will also be drive D:, but the user storage space suffix will be “2”.

7.4 File-level backup from the iSeries side

Object types

Before you continue reading this section, make sure you are familiar with the types and names of objects that are created on both the iSeries and Windows 2000 when running a Windows 2000 server on the Integrated xSeries Server. Details of these objects are provided in Chapter 11, “OS/400 components of the Windows 2000 server” on page 263.

You can perform a file-level backup of a Windows 2000 (or Windows NT) Server running on the Integrated xSeries Server from the iSeries side using the QNTC file system. This type of backup is useful when you need to restore a specific Windows server file after it is corrupted or accidentally deleted.

Network server description

You must vary *on* the network server description before you perform a file-level backup.

Starting with V4R5, the QNTC file system now supports the Integrated File System (IFS) Save Object (SAV) and Restore Object (RST) commands. This means that Windows server files can now be saved and restored at a file level from the iSeries side, using CL commands. Notice that this is a true file backup, because NTFS attributes are preserved for both save and restore operations.

File-level save and restore through the QNTC file system supports the following file types:

- File Allocation Table (FAT)
- FAT32
- NTFS

This capability is supported for Windows NT (including Terminal Server Edition) and Windows 2000, but it will not be made available for releases prior to V4R5.

You can automate file-level backups by including the appropriate CL commands in your backup procedure. Refer to 7.8, “Automating backup and restore” on page 200, for more information on how to do this.

Using file-level backup, you can save the following types of Windows data:

- Files
- Directories
- Shares
- Windows registry

File-level backup through the QNTC file system supports the following new Windows 2000 file types:

- Encrypted files
- Sparse files
- Reparse points

When you perform a file-level backup through QNTC, there are two methods you can use:

- **Save to tape**: Saving to tape is the most common form of backup.
- **Save to disk**: Saving to disk has the advantage of being faster than tape, and the data is easily accessible.

You can also perform a file-level backup of the Windows 2000 server from the iSeries side by using an application such as Tivoli Storage Manager - AS/400 Server V3.1.2 (TSM). For more information on TSM, refer to 7.4.7, “Backup using Tivoli Storage Manager” on page 184.

QNTC setup

Before you use the QNTC file system to save and restore individual Windows files, you need to do some setup work. Refer to Chapter 13, “QNTC file system” on page 333, for a description of how to do this.

QNTC is an IFS file system that is specifically designed to provide access to directory shares residing on Windows computers in the network. It was first implemented in Version 4 Release 3, but the ability to manage files through the QNTC file system was not previously included the IFS Save Object (SAV) and Restore Object (RST) commands. This support has now been added in V4R5.

Notice that file-level backup and restore capability is only available for Windows NT and 2000 servers running on Integrated xSeries Servers, not PCs. Also, you must perform the backup on the iSeries server in which the Integrated xSeries Server is installed.

File-level backup and restore through the QNTC file system occurs across the internal LAN.

Also called NetClient, QNTC is an implementation of the Server Message Block (SMB) protocol. Where NetServer (also an implementation of the SMB protocol) enables the iSeries to appear to a Windows network as a peer resource server for file and print, NetClient enables the iSeries to act as a peer network client to a Windows network. You can think of NetClient as a form of Windows Network Neighborhood for the iSeries.

To make files available through the QNTC file system, the directories on the Windows 2000 server that contain the files you want to save must first be shared. Once the files are shared, you can use the Work Link (WRKLNK) command from a green screen, or the Operations Navigator or NetServer GUI interfaces, to access the individual Windows 2000 files through the QNTC directory.

NetClient allows you to access individual Windows files that reside in the Windows domain of which the server running on the Integrated xSeries Server is a member.

NetServer must be configured and started before you can use NetClient. Also, the NetServer must be in the same domain as the Windows 2000 server.

For a detailed description of the QNTC file system, refer to Chapter 13, “QNTC file system” on page 333.

Note

To save and restore files to and from the QNTC file system, special code to run on the Windows NT or 2000 server is supplied as part of 5769-WSV (Integration for Windows Server). This code only runs on Windows NT and 2000 servers installed on the Integrated xSeries Server. Therefore, SAV and RST support for QNTC is only available for Windows NT and 2000 servers installed on the Integrated xSeries Server. You cannot use this capability to back up PC servers in the network.

In terms of backup and restore, the significance of SAV and RST support for the QNTC file system is that you now have an alternative method to Tivoli Storage Manager (TSM) for saving Windows NT and 2000 files, at a file level, from the iSeries side. SAV and RST support for QNTC is a technique that is easy to use and integrates well into an existing backup strategy. However, it does not provide the same level of performance or control as TSM.

For a comparison of the performance of various backup methods, refer to 7.9, “Backup and restore performance” on page 209.

7.4.1 Positioning file-level backup through QNTC

File-level backup through the QNTC file system is not intended to provide the same level of performance as either TSM or one of the supported Windows 2000 backup applications, such as Computer Associates Arcserve or Veritas Backup Exec. Therefore, be careful about using this method as your primary means of backup.

File-level backup through the QNTC file system has the major advantage that you can use it to integrate a file-level backup of Windows 2000 on the Integrated xSeries Server into your OS/400 backup procedure. There are no limitations with tape drives or tape media because this is a native OS/400 backup.

If you decide to use file-level backup through QNTC, make sure that you only back up the minimum number of files, that is, those files that are volatile (change on a regular basis). Test your backup procedure before going into production to ensure that your backup window is large enough to accommodate the save. If you are having trouble fitting your backup into the time available, you can try techniques such as incremental or differential backups. Refer to 7.4.3, “Incremental versus differential backups”.

To position file-level backup using the QNTC file system against other methods of backup, refer to 7.10, “Backup technique positioning and recommendations” on page 215.

7.4.2 Backing up special files

You should be aware of how the following objects are backed up:

- Active files
- Windows registry
- Encrypted files

7.4.2.1 Backing up active files

As long as they can be read, active (open) files are backed up along with other files. Therefore, you can back up the Windows 2000 server while it is in use. In fact, there is no simple way to make the server unavailable to users without bringing it down. However, to perform a file-level backup, the server must be up. You should, if possible, try to get all users off the system before starting your backup. Otherwise, you may encounter data synchronization problems if you need to restore a file that was saved while it was being updated.

7.4.2.2 Backing up the Windows registry

The Windows registry is saved using the special share name $REGISTRY.

When you save the registry, temporary files totalling up to 5 MB are stored in the Windows path. These temporary files can be used by the Windows hive recovery function.

7.4.2.3 Backing up encrypted files

Windows 2000 disk volumes can contain encrypted files. Windows 2000 keeps track of encrypted files on a particular volume by maintaining a System Volume Information (SVI) file. When you back up an encrypted file, the SVI file is not saved. If you try to back up a Windows 2000 disk volume containing encrypted files, you will receive an error stating that the SVI file was not saved. This is a normal condition and does not affect the restore of the volume because Windows 2000 automatically rebuilds the SVI file when an encrypted file is restored.

7.4.3 Incremental versus differential backups

We assume that you have a backup strategy in place. As part of this strategy, you would normally perform a complete disaster recovery backup of the Windows 2000 server's storage spaces on a regular basis. In addition, you need to back up all your volatile files (normally user data) on a regular basis (usually every day). You need to perform a file-level backup so that you can restore individual files if they are deleted or corrupted. In this case, the recommended method is to save all your volatile files once per week. Then, every day, only save those files that changed since the last complete save. In this case, you need to decide whether you will perform your daily file-level saves incrementally or differentially.

7.4.3.1 Incremental backups

An incremental backup is where you save only those objects that changed since the last save of the object (complete file-level backup or previous incremental backup). For this type of backup, you would specify CHGPERIOD(*LASTSAVE) and UPDHST(*YES). Refer to 7.4.5, "SAV command parameters" on page 181, for a description of the CHGPERIOD and UPDHST parameters of the SAV command.

For example, if you perform a complete file-level backup every Sunday (specifying UPDHST(*YES)), you could perform an incremental backup on Monday through Saturday to save only those objects that changed since the previous day's backup. This means that, should you need to recover the system on Friday, you would need to restore the full backup from the previous Sunday, plus all incremental backups since then. On the other hand, because you are only saving the files that changed since the previous day's backup, the backups are faster than a differential backup.

7.4.3.2 Differential backups

A differential backup is where you save all those objects that changed since the last complete backup. For this type of backup, you would specify CHGPERIOD(*LASTSAVE) and UPDHST(*NO). Refer to 7.4.5, “SAV command parameters” on page 181, for a description of the CHGPERIOD and UPDHST parameters of the SAV command.

For example, if you perform a full file-level backup every Sunday (specifying UPDHST(*YES)), you could perform a cumulative backup on Monday through Saturday to save all those objects that have changed since the last full system backup. This means that, should you need to recover the system on Friday, you would need to restore the full backup from the previous Sunday, plus only the cumulative backup you performed on Thursday. On the other hand, because you are saving all files that changed since the last full system save, the backups are progressively slower than an incremental backup.

7.4.4 Preparing for a file-level save

You must complete the following tasks before you attempt a file-level save through the QNTC file system:

1. Set up the QNTC file system
2. Set up an OS/400 profile
3. Create shares on the Windows 2000 server
4. Add members to QAZLCSAVL
5. Omit files from the backup
6. Check the Windows server
7. Check the iSeries server

These tasks are described in the following sections.

7.4.4.1 Setting up the QNTC file system

Refer to Chapter 13, “QNTC file system” on page 333, to make sure that the QNTC file system is set up correctly. Notice that NetServer is a prerequisite for QNTC, and the NetServer must be in the same domain as Windows 2000 running on the Integrated xSeries Server.

7.4.4.2 Creating shares on the Windows 2000 server

In order for files and directories to be accessible and visible within the QNTC file system (and to other Windows computers on the network), you need to create a share over each directory that contains the data you want to save. To create shares on a Windows server, follow these steps:

1. Right-click **Start**, and select **Explore**.
2. Right-click the directory you want to share, and select **Sharing...**.
3. Click the **Share this folder** radio button.
4. Enter a **Share name** or accept the default. Share names cannot be longer than 12 characters, but can include embedded blanks.
5. Set the **User limit** radio buttons to restrict the number of users that can access this share, according to your requirements.
6. Click the **Permissions** button if you need to restrict the level of access to this share. Notice that the permissions you set need to be compatible with the authority you invest in the user profile that you use for the file-level backup.

For example, if the backup user profile is added to the Administrator's group on the Windows server, the permissions should be set to include the Administrator's group and to allow *full control*.

7. Click **OK** to create the share.

Notice that you cannot use the system shares C$ and D$ to back up files through QNTC.

7.4.4.3 Adding members to QAZLCSAVL

The QAZLCSAVL file in QUSRSYS enables you to specify the shares to be backed up.

You need to add a member to the file for each Windows 2000 server running on an Integrated xSeries Server from which you want to save files. The member takes its name from the network server description (NWSD).

You need to add a member for every server that you want backed up, regardless of whether the server name is referenced in the SAV command. You need to add an entry in a member for every share that you want backed up, regardless of whether the share name is referenced in the SAV command. For example, if you want to back up a share called `share1` on a server called `server1`, you would need to add a member to file QAZLCSAVL with the same name as the NWSD for `server1` and an entry in the member for `share1`. You could then back up `share1` using either of the following SAV commands:

```
SAV /QNTC/server1/share1
SAV /QNTC/server1
```

In both cases, the system searches for the member corresponding to `server1` in the QAZLCSAVL file to determine which shares to back up.

You could also use the following command to save `share1`:

```
SAV /QNTC/*
```

In this case, the system compiles a list of all shares specified in all members in the QAZLCSAVL file. If there are multiple members in QAZLCSAVL, corresponding to multiple Integrated xSeries Servers installed in the iSeries, all shares specified in all members are saved.

Windows server names

When a Windows NT or 2000 server is created on the Integrated xSeries Server, it picks up the name of the network server description, by default, and uses it for its own name. Because the NWSD is a maximum of eight characters, some customers may want to change the name of the Windows server.

We recommend that you do not change the name of your Windows server. However, if you do, the iSeries can still resolve it to a member in QAZLCSAVL and perform the backup.

The QAZLCSAVL file is created with code page 500 when the Integration for Windows Server licensed program product (5769-WSV) is installed. Therefore, when you specify share names in QAZLCSAVL, be sure to use characters from this code page.

To add a member to the QAZLCSAVL file, follow these steps:

1. On the OS/400 command line, enter:

   ```
   ADDPFM FILE(QUSRSYS/QAZLCSAVL)MBR(nwsd-name )
   TEXT('description')
   EXPDATE(*NONE) SHARE(*NO) SRCTYPE(*NONE)
   ```

   Here, *nwsd-name* is the name of your network server description.

2. Use an SEU or the Edit File (EDTF) command to add entries to the member that you just created, for example:

   ```
   EDTF FILE(QUSRSYS/QAZLCSAVL) MBR(nwsd-name)
   ```

Remember to use characters for your share names from code page 500.

In the file member, list all the shares that you want to save on a separate line. For example, if you defined *share1, share2, share3, share4,* and *share5* on the server with NWSD name AS400WIN, you would create a member in QAZLCSAVL called AS400WIN, with the following records:

```
0001.00 share1
0002.00 share2
0003.00 share3
0004.00 share4
0005.00 share5
```

If you specify multiple share names that include the same directory on the Windows 2000 server, OS/400 saves the data multiple times if you save those shares.

7.4.4.4 Omitting files from the backup

You can exclude certain files that you do not want to save from the backup.

Enter the list of files you do not want to save in the Windows 2000 registry key:

```
HKLM\SYSTEM\CurrentControlSet\Control\BackupRestore\FilesNotToBackup
```

You can include `/s` for subdirectories, as well as wildcards (*).

You can also use the *OMIT keyword on the SAV command to omit objects from the save. *OMIT can also be used to exclude the registry from the backup.

7.4.4.5 Setting up a backup profile

To perform a file-level backup using QNTC, the user profile and password that you use to run the backup must be the same on both the iSeries and Windows 2000 servers. In addition, your Windows 2000 account must be a member of the Administrator's group.

7.4.4.6 Checking the Windows server

Complete the following tasks before you begin backing up any files:

1. Windows 2000 provides no way to stop users from signing on and accessing data on the server while the SAV command is running. Consequently, you should back up Windows server files when you expect few users to access the system. A note telling users to avoid accessing the server is a good precaution.

2. Verify that the Windows 2000 server running on the Integrated xSeries Server is active and that the TCP/IP internal LAN connection to the iSeries is working.
3. The AS/400 Remote Command service must be running on Windows 2000. To verify, click **Start->Settings->Control Panel->Administrative Tools-> Services**. The service should have a status of *Started.*

7.4.4.7 Checking the iSeries server

You must back up your Windows server files either before you put the system into a restricted state to back up the remaining OS/400 files or after you complete restricted state operations. Ensure that the QSYSWRK and QSERVER subsystems are active and that TCP/IP has been started (the internal LAN must be functioning correctly).

7.4.5 SAV command parameters

For a complete description of the SAV command, refer to *Backup and Recovery*, SC41-5304, and *CL Reference*, SC41-5722. A brief description of the parameters that are relevant to this chapter follows:

- **Object (OBJ)** field: Specify the path to the data you want to save in the form:

  `'QNTC/server-name/share-name/file-name'`

  Here, *server-name, share-name*, and *file-name* are optional.

  You can also use the wildcard character (*).

- **Directory subtree (SUBTREE)** parameter: Specify whether you want to save subtrees (directories) under a share. The default is to save all directories.
- **Change period (CHGPERIOD)** parameter: Specify the period during which you want to save changed files.

  If you specify CHGPERIOD(*LASTSAVE), you save any object that has changed since any save operation was performed for that object with UPDHST(*YES) specified. You can also specify a range of dates and times.

  The CHGPERIOD and UPDHST parameters are normally used together.

- **Update history (UPDHST)** parameter: Specify whether the system should update the object information with the time and day of the most recent backup.

  The UPDHST parameter value controls updating of the system save history and PC save history as follows:

  - ***NO**: The save history is not updated. The PC archive attribute and the OS/400 archive attribute are not changed.
  - ***YES**: The save history is updated. The PC archive attribute and the OS/400 archive attribute are set to “off”.
  - ***SYS**: The system save history is updated. The OS/400 archive attribute is set to “off”.
  - ***PC**: The PC save history is updated. The PC archive attribute is set to “off”.

  Every IFS object has both an OS/400 and PC (Windows) archive attribute, denoted by *SYS and *PC respectively. This means that you can independently set the archive bit for OS/400 and Windows backup applications.

Notice that for OS/400 SAVE menu options 21, 22, and 23, the default is UPDHST(*YES).

7.4.6 Using the SAV command

Objects in the QNTC file system can be backed up to tape or save files as shown in Table 12. *Objects* are defined shares, directories, and files.

Replace the *underlined* values with the values that are appropriate for your system as follows:

- The server name used in the table is for a sample Windows server called AS400WIN. Replace this with your own server name.
- “share1 and share2” are sample share names. Replace them with valid share names.
- “dir1” is a sample directory name. Replace this with a valid directory name.
- “file1 and file2” are sample file names. Replace them with valid file names.
- Replace the device names in the table as follows:
  - **Saving to tape**: Replace *TAP01* with the tape device name you are using (if not *TAP01*).

    You can use the Data compression (DTACPR) and Data compaction (COMPACT) parameters on the save commands to store more data on a tape cartridge, depending on the type of tape drive you are using.
  - **Saving to a save file**
    - Replace *library* with the name of the library containing the save file.
    - Replace *save-file* with the name of the save file you want to use.

    Notice that, before saving to a save file, you must create the save file in a library using the Create Save File (CRTSAVF) command, for example:

    ```
    CRTSAVF FILE(MYLIB/SAVE1)
    ```

    You must use a different save file for each save operation.

    You can use the Data compression (DTACPR) parameter on the save command to save disk storage space. Compressing the data provides better performance and results in a shorter save time. When you save to a save file, you must manually select compression because the command default is *DEV. *DEV does not compress a save file.

Table 12. File-level backup using the QNTC file system to tape and save files

Save type	Save command examples
Save all objects for all unresolved shares [1] for server AS400WIN.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/*') SUBTREE(*ALL) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/*') SUBTREE(*ALL) DTACPR(*YES)
Save all objects for all unresolved shares [1] for all unresolved servers [2].	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*') SUBTREE(*ALL) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/*') SUBTREE(*ALL) DTACPR(*YES)

Save type	Save command examples
Save all objects for all unresolved shares [1] for server AS400WIN that changed since any save operation was performed on these object with UPDHST(*YES) specified.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/*') SUBTREE(*ALL) CHGPERIOD(*LASTSAVE) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/*') CHGPERIOD(*LASTSAVE) DTACPR(*YES)
Save all objects for all unresolved shares [1] for server AS400WIN that changed since any save operation was performed on these object with UPDHST(*YES) specified. This is an example of an incremental backup.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/*') SUBTREE(*ALL) CHGPERIOD(*LASTSAVE) UPDHST(*YES) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/*') CHGPERIOD(*LASTSAVE) UPDHST(*YES) DTACPR(*YES)
Save all objects for all unresolved shares [1] for server AS400WIN that changed since any save operation was performed on these object with UPDHST(*YES) specified. This is an example of a differential backup.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/*') SUBTREE(*ALL) CHGPERIOD(*LASTSAVE) UPDHST(*NO) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/*') CHGPERIOD(*LASTSAVE) UPDHST(*NO) DTACPR(*YES)
Save all objects for all unresolved shares [1] for server AS400WIN that changed during the period between 15 April 2000 and 22 April 2000. [3]	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/*') SUBTREE(*ALL) CHGPERIOD('04/15/00' '00:00:00' '04/22/00' '23:59:59')[3] UPDHST(*YES) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/*') CHGPERIOD('04/15/00' '00:00:00' '04/22/00' '23:59:59')[3] UPDHST(*YES) DTACPR(*YES)
Save all objects for share *share1.* In this case, the directory over which the share is built *is* saved (and restored).	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1') SUBTREE(*ALL) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1') SUBTREE(*ALL) DTACPR(*YES)
Save all objects for share *share1.* In this case, the directory over which the share is built *is not* saved (or restored).	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/*') SUBTREE(*ALL) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/*') SUBTREE(*ALL) DTACPR(*YES)
Save all objects for share *share2.* In this case, the directory over which the share is built *is not* saved (or restored).	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/share2/*') SUBTREE(*ALL) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/share2/*') SUBTREE(*ALL) DTACPR(*YES)
Save all objects for directory *dir1.* In this case, the directory *is* saved (and restored).	SAV DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QNTC/*AS400WIN*/share1/dir1*') SUBTREE(*ALL) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/dir1*') SUBTREE(*ALL) DTACPR(*YES)
Save all objects for directory *dir1.* In this case, the directory *is not* saved (or restored).	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/dir1/*') SUBTREE(*ALL) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/dir1/*') SUBTREE(*ALL) DTACPR(*YES)
Save all files for share *share1* that start with *abc.* In this case, the directory over which the share is built *is not* saved (or restored).	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/abc*') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/abc*') DTACPR(*YES)

Save type	Save command examples
Save the file *file1.ext*.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/file1.ext') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/file1.ext') DTACPR(*YES)
Save the file *file1.ext* in User ASP nn, where *nn* is from 2 to 16.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/*share1*/*file1.ext*') ('dev/QASPnn/AS400WIN/share1/file1.ext.UDFS') SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/file1.ext') ('dev/QASPnn/AS400WIN/share1/file1.ext.UDFS') DTACPR(*YES)
Save the files *file1.ext* and *file2.ext*.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ(('/QNTC/*AS400WIN*/share1/file1.ext') ('/QNTC/*AS400WIN*/share2/file2.ext')) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ(('/QNTC/AS400WIN/share1/file1.ext') ('/QNTC/*AS400WIN*/share2/file2.ext')) DTACPR(*YES)
Save all subdirectories and shares (no files) of *share1*, including *share1*.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1') SUBTREE(*DIR) SAV DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1') SUBTREE(*DIR) DTACPR(*YES)
Save the Windows 2000 registry.	SAV DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/$REGISTRY') SAV DEV('/QSYS.LIB/*library*.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/$REGISTRY') DTACPR(*YES)

1. When there are no share names specifically identified in the OBJ parameter of the SAV command, the system looks in the file QAZLCSAVL for a member with a name corresponding to the name of the network server description specified in the OBJ parameter. The share names are resolved from the entries in the member.
2. When there are no network server description names specifically identified in the OBJ parameter of the SAV command, the system resolves the network server description names from the names of the members in file QAZLCSAVL. The share names are resolved from the entries in the members.
3. The date format you specify must correspond to the setting of the QDATFMT system value. In this example, QDATFMT is set to MDY.

7.4.7 Backup using Tivoli Storage Manager

Tivoli Storage Manager (TSM) is a cross-platform family of products that integrate network backup and archive with storage management and disaster recovery planning functions. This section briefly discusses the OS/400 version of this product, Tivoli Storage Manager - AS/400 Server V3.1.2 (TSM). It is the successor to ADSTAR Distributed Storage Manager/400.

Tivoli Storage Manager is a sophisticated, powerful, and high performance product that can be used to save files from a Windows 2000 server to a tape drive attached to the iSeries. Because it is a chargeable product that requires specific skills to use, it is more suited to larger installations with multiple Windows 2000 servers. It could be described as an industrial strength data management environment.

The product is not described in detail here. You can find more information about Tivoli Storage Manager at the Tivoli Web site:
`http://www.tivoli.com/products/index/storage_mgr/`

If you are interested in finding out more information about the OS/400 version of Tivoli Storage Manager, we recommend the following IBM redbooks:

- *Tivoli Storage Management Concepts*, SG24-4877
- *A Practical Guide to Implementing TSM on AS/400*, SG24-5472

To position file-level backup using TSM against other methods of backup, see 7.10, “Backup technique positioning and recommendations” on page 215.

TSM addresses such problems as:

- Integrating the management of data stored on different computing platforms, from small PCs and midrange systems to large enterprise host systems
- Controlling the explosion of data without adding more and more hardware and storage resources
- Centralizing and automating the administration and operation of a decentralized environment to reduce the costs of data management and storage resources
- Recovering from a major disaster when a whole site loses its data, for example, because of a fire or an earthquake

To bring the pieces together, TSM provides the following distributed data management functions:

- **Data protection**
  - *Operational backup and restore of data*: The backup process creates a copy of the data to protect against the operational loss or destruction of each file. The customer defines how often to back up (frequency) and how many copies (versions) to be held. The restore process places the backup copy of the file back into a customer-designated system following the loss of a file.
  - *Disaster recovery*: All activities to organize, manage, and automate the recovery process from a major loss of IT infrastructure and data across the enterprise. This includes processes to move data offsite into a secure vault location, to rebuild IT infrastructure, and to reload data successfully and in an acceptable time frame.
- **Efficient use of storage**
  - *Vital record retention archive and retrieval*: The archive process creates a copy of a file or a set of files representing an end point of a process for long term storage. Files can remain on the local storage media or be deleted. The customer controls how long (retention period) an archive copy is to be retained. The retrieval process locates the copies within the archival storage and places them back into a customer-designated system or workstation.
  - *Hierarchical data management*: This process provides automatic and transparent movement of operational data from user system disk space to a central storage repository. If the user accesses this data, it is dynamically and transparently restored to the client storage.

TSM implements these storage management functions in one single client-server solution, covering more than 30 operating platforms. The solution is network based, which means that the functions are available to the whole network environment. All the functions can be automated to run in a 24 x 7 lights-out environment. Administration costs are minimized by centralization of all the management of TSM components.

7.4.7.1 TSM architecture

TSM is implemented as a classic client server application, consisting of a TSM server part and different TSM clients. All of the storage media used to store TSM managed data is connected to the TSM server, known as the *storage repository*.

There are three major components of TSM:

- **TSM server**: The TSM server is the place where all the TSM managed data is stored. A wide range of systems can act as the server, including the iSeries server. The TSM server intelligently stores and manages data from TSM clients on disk, tape, or optical devices according to the defined requirements.
- **TSM backup client**: The TSM backup client is the system to be backed up. It collects the data and sends it to the TSM server. The TSM client can run on different systems including laptops, PCs, workstations, server systems, or the TSM server system itself. For an Integrated xSeries Server, it is a Windows 2000 server. The clients back up their data to the server, including data from databases and applications, and for Windows 2000, from the registry.
- **TSM administrative client**: For decentralized administration of the TSM server and the entire data management environment, TSM provides different administration interfaces, also called *administrative clients*. Depending on the client platform and the TSM server version you want administer, command line interfaces, graphical user interfaces, or Web interfaces are available.

7.5 Disaster recovery restore from the iSeries side

Object types

Before you continue reading this section, make sure you are familiar with the types and names of objects that are created on both the iSeries and Windows 2000 when running a Windows 2000 server on the Integrated xSeries Server. Details of these objects are provided in Chapter 11, “OS/400 components of the Windows 2000 server” on page 263.

Restoring an object or objects from backup is generally a matter of reversing the process you used to save them.

You can perform a disaster recovery restore from the iSeries side to restore all components of the Windows 2000 on Integrated xSeries Server environment. This type of restore is useful when you need to recover an object such as the network server description, the Windows 2000 system (C:) drive, or a complete user drive. An important point to note is that you *cannot restore* individual Windows 2000 files from a disaster recovery backup.

When you perform a disaster recovery restore, there are three methods you can use:

- **Restore from tape**: Restoring from tape is the most common form of restore. Table 13 on page 190 lists the CL commands you can use.
- **Restore from disk**: Restoring from disk has the advantage of being very fast, and the data is easily accessible. Table 13 on page 190 lists the CL commands you can use.
- **Copy from disk**: Copying a user storage space from disk is a special case. This method uses the CRTNWSSTG command and is described in 7.3.6, “Backup using the CRTNWSSTG command” on page 172. Notice that you use the same command to “restore” a storage space using CRTNWSSTG as you would to “save” it. In both cases, you simply make a copy of the storage space.

Saving and restoring to and from disk can be used as part of a staged backup strategy. See 7.1.3, “Staged backup” on page 154, for more information on staged backups.

To ensure the stability of the server, be careful if you restore any one of the components of a Windows 2000 server without restoring the others. For example, restore the user storage spaces and the network server description at the same time. For Windows 2000, these components operate as a unit to create the full system and should be treated this way. Failure to do this may result in discrepancies in the registry and NTFS permissions.

Network server description

You must vary *off* the network server description before you perform a disaster recovery restore.

You perform a disaster recovery restore of the Windows 2000 on the Integrated xSeries Server environment by running CL commands. You need to have saved the environment using one of the options described in 7.3, “Disaster recovery backup from the iSeries side” on page 167.

7.5.1 Disaster recovery restore special cases

There are a number of situations that you should pay particular attention to when you perform a disaster recovery restore:

- Restoring configuration objects
- Restoring user storage spaces, including the C: drive
- Relinking user storage spaces
- Restoring IFS directories other than user storage spaces
- Recreating TCP/IP interfaces

They are described in the following sections.

7.5.1.1 Restoring configuration objects

If you are restoring configuration objects (using the Restore Configuration (RSTCFG) command), you *must* run this command before you restore any of the Windows 2000 system drives. When the RSTCFG command runs and tries to restore the configuration objects for the system drives (not their contents, but the objects), it runs a similar process to the INSWNTSVR command, which initializes the storage spaces on the iSeries. If a storage space already exists when the

RSTCFG command is run, the restore of the object fails, and the restore of the network server description also fails.

7.5.1.2 Restoring user storage spaces, including the C: drive

There may be occasions when you want to recover a complete Windows 2000 drive, rather than individual files. Because Windows 2000 running on the Integrated xSeries Server is effectively running as a guest operating system, you can restore user storage spaces from backup, rather than rebuilding or reinstalling the server.

The Windows 2000 system (C:) drive is important because it contains the operating system and registry. It is quite possible that this drive may become corrupted because of a faulty application or driver. If you have an unrecoverable Windows 2000 system failure that does not allow you to boot the server, you can simply restore a backup of the C: drive on the iSeries and restart the server. You can think of this capability as a “hot spare system drive”.

To restore a user storage space (including the system drive) from a backup, follow these steps:

1. Vary off the Windows 2000 server by using the Vary Configuration (VRYCFG) command. Enter *YES in the Forced vary off (FRCVRYOFF) parameter.
2. Unlink the user storage space, which represents the Windows 2000 drive you are restoring, by using the Remove Server Storage Link (RMVNWSSTGL) command. You can also unlink it from the WRKNWSSTG menu.
3. Delete the user storage space using the Delete NWS Storage Space (DLTNWSSTG) command. You can also delete it from the WRKNWSSTG menu.
4. Use the Restore Object (RST) command to restore the system drive from your backup, as shown in Table 13 on page 190.
5. Relink the storage space to the network server description using the Add Server Storage Link (ADDNWSSTGL) command. You can also link it from the WRKNWSSTG menu.
6. Vary on the network server description using the VRYCFG command.

There is an example of a CL program to automate this process in 7.8.2, “Automating restore on the iSeries server” on page 206.

You may want to restore other Windows 2000 drives to maintain synchronization between Windows 2000 system files, applications, and data.

After you restore the Integrated xSeries Server, you need to check when it was saved. At this point, you can restore any incremental backups you took since that time using the QNTC file system, Windows 2000 backup application, Tivoli Storage Manager, or other file-level backup method.

7.5.1.3 Relinking user storage spaces

To set the iSeries server to automatically relink restored user storage spaces to the appropriate network server description, restore the network server *before* you restore the storage spaces. If they were linked when they were saved, they should be automatically relinked when they are restored.

If you need to relink user storage spaces manually to the network server description, use the WRKNWSSTG command (option 10) or Add Server Storage Link

(ADDNWSSTGL) command. In this case, you must specify a specific drive sequence number (for example, 3 for C:, 4 for D:, 5 for E:, etc.), *not* *CALC. Otherwise, you may encounter errors. Here is an example of using the ADDNWSSTGL command:

```
ADDNWSSTGL NWSSTG(storage_space) NWSD(network_server) DRVSEQNBR(n)
```

The drive sequence number *n* can be from 3 to 16.

7.5.1.4 Restoring IFS directories other than user storage spaces

If you are restoring the contents of an integrated file system directory (such as /QIBM/ProdData/NTAP), the directory must already exist before you attempt the installation. You can use the Create Directory (MD) command to do this. You need to create each directory separately, for example:

```
MD DIR('/QIBM')
MD DIR('/QIBM/ProdData')
MD DIR('/QIBM/ProdData/NTAP')
```

7.5.1.5 Recreating TCP/IP interfaces

After you restore a Windows 2000 environment, verify that the TCP/IP interface for the internal LAN is configured. If you run the Configure TCP/IP (CFGTCP) command and then select option 1, you should see an interface with the same name as your network server description with 00 appended and an IP address of the form 192.168.x.y. If you do not see this interface, you need to create it. You can determine the IP address of the interface by running the Work with Network Server Descriptions (WRKNWSD) command and entering 5 to display the network server's configuration. Press Enter until you see a screen that contains the TCP/IP port configuration. Notice that the IP addresses shown correspond to the Windows 2000 side of the network server. You cannot use these addresses to define TCP/IP interfaces on the iSeries server. However, to calculate the IP address of the iSeries side of the internal LAN, you simply subtract 1 from the last byte of the address shown against *INTERNAL. For example, if the Internet address for the *INTERNAL Port is 192.168.3.4, you need to create a TCP/IP interface for the internal LAN line description (ending in 00) using the address 192.168.3.3.

If you have a Windows 2000 server running on a 333 MHz Integrated xSeries Server that was migrated from Windows NT (installed on a release prior to V4R5), you may also need to recreate TCP/IP interfaces for the external LAN line or lines.

7.5.2 Performing a disaster recovery restore

Each of the components of the Windows 2000 server on the Integrated xSeries Server environment can be restored individually from tape or save files as shown in Table 13 on page 190. Replace the *underlined* values with the values that are appropriate for your system as follows:

- The object names used in the table are for a sample network server description called AS400WIN. Replace these with your own server name.
- Replace the device names in the table as follows:
  - **Restoring from tap**e: Replace *TAP01* with the tape device name you are using (if not *TAP01*).

– Restoring from a save file

- Replace *library* with the name of the library containing the save file.
- Replace *save-file* with the name of the save file you want to use.

Table 13. Disaster recovery restore from tape and save files

Object description	Object name	Object type	Restore command examples
Network Server Description	QSYS/*AS400WIN*	Configuration definitions	RSTCFG OBJ(*AS400WIN**) DEV(*TAP01*) [1] RSTCFG OBJ(*AS400WIN**) DEV(*SAVF) SAVF(library/save-file) [1]
Line descriptions [2]	QSYS/*AS400WIN00 - 02*	Configuration definitions	RSTCFG OBJ(*AS400WIN**) DEV(*TAP01*) [1] RSTCFG OBJ(*AS400WIN**) DEV(*SAVF) SAVF(library/save-file) [1]
Windows 2000 system drive (C: drive) [5]	/QFPNWSSTG/*AS400WIN1*	User storage space	RST DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QFPNWSSTG/AS400WIN1') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QFPNWSSTG/AS400WIN1')
Windows 2000 installation code (D: drive) [6]	/QFPNWSSTG/*AS400WIN2*	User storage space	RST DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QFPNWSSTG/AS400WIN2') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QFPNWSSTG/AS400WIN2')
Integration code (5769-SS1 option 29)	QSYS/QNTAP [3]	Library	RSTLIB LIB(QNTAP) DEV(*TAP01*) RSTLIB SAVLIB(QNTAP) DEV(*SAVF) SAVF(library/save-file)
Windows 2000 server messages	*QGPL/AS400WIN*	Message queue	RSTOBJ OBJ(*AS400WIN*) LIB(*QGPL*) DEV(*TAP01*) OBJTYPE(*MSGQ) RSTOBJ OBJ(AS400WIN) SAVLIB(QGPL) DEV(*SAVF) OBJTYPE(*MSGQ) SAVF(library/save-file)
Integration code (5769-SS1 option 29)	/QIBM/ProdData/NTAP [3]	IFS dirs [4]	RST DEV('QSYS.LIB/*TAP01*.DEVD') OBJ('/QIBM/PRODDATA/NTAP') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QIBM/PRODDATA/NTAP')
User data and applications in System ASP	/QFPNWSSTG/*AS400WIN3*	IFS dirs (user storage spaces) [4]	RST DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QFPNWSSTG/AS400WIN3') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QFPNWSSTG/AS400WIN3')
User data and applications in User ASP nn, where *nn* is from 2 to 16	/QFPNWSSTG/*AS400WIN3*	IFS dirs (user storage spaces) [4]	RST DEV('QSYS.LIB/*TAP01*.DEVD') OBJ('/QFPNWSSTG/*AS400WIN3'*) ('dev/QASPnn/AS400WIN3.UDFS') RST DEV('QSYS.LIB/*library*.LIB/save-file.FILE') OBJ('/QFPNWSSTG/*AS400WIN3'*) ('dev/QASPnn/AS400WIN3.UDFS')

Object description	Object name	Object type	Restore command examples

1. RSTCFG allows you to restore individual lines or network server descriptions by specifying an individual or generic name for the configuration objects.
2. The new 700 MHz Integrated xSeries Server and the 333 MHz Integrated Netfinity Server installed in a migration tower do not support the external host LAN, corresponding to lines with a 01 or 02 suffix. The external host LAN lines are only supported on a Windows 2000 server, migrated from Windows NT installed on a pre-V4R5 release, running on a 333 MHz Integrated Netfinity Server installed in pre-270 or 8xx hardware.
3. You can also restore the NTAP directory and the QNTAP library by running the RSTLICPGM command to install the OS/400 Integration for Windows Server Program Product (5769-WSV).
4. If you are restoring the contents of an IFS directory, the directory must exist before you run the RST command. For example, the /QIBM/ProdData/NTAP directory must exist before you try to restore files to it. You can create a directory in the IFS using the Create Directory (MD) command.
5. If you migrated your Windows 2000 server, running on a 333 MHz Integrated Netfinity Server, from Windows NT installed on a release prior to V4R5, your system drive will be drive E:, and the user storage space suffix will be “2”.
6. If you migrated your Windows 2000 server, running on a 333 MHz Integrated Netfinity Server, from Windows NT installed on a release prior to V4R5, your installation drive will also be drive D:, but the user storage space suffix will be “1”.

Refer to the sample CL program in Figure 89 on page 208 for an example of how to restore a complete Windows 2000 server on the Integrated xSeries Server environment.

7.5.3 Restore using the OS/400 RESTORE menu

When you perform a disaster recovery restore of the Windows 2000 server on the Integrated xSeries Server environment from tape, you can also use the OS/400 RESTORE menu (GO RESTORE). However, you would not normally restore components of the Windows 2000 server on the Integrated xSeries Server environment using options from the RESTORE menu. You would more likely use the CL commands described in Table 13 to restore individual components saved using options from the SAVE menu (Figure 84 on page 172).

7.6 File-level restore from the iSeries side

Object types

Before you continue reading this section, make sure you are familiar with the types and names of objects that are created on both the iSeries and Windows 2000 when running a Windows 2000 server on the Integrated xSeries Server. Details of these objects are provided in Chapter 11, “OS/400 components of the Windows 2000 server” on page 263.

Restoring an object or objects from backup is generally a matter of reversing the process you used to save them. You must use the same application to perform a file-level restore as you used to do the file-level backup.

You can perform a file-level restore of a Windows 2000 (or NT) server running on the Integrated xSeries Server from the iSeries side using the QNTC file system. To restore a file using the QNTC file system, the file must have been saved through the QNTC file system using the Save Object (SAV) command. This type

of restore is useful for when you need to recover a specific Windows file after it is corrupted or accidentally deleted.

With V4R5, the QNTC file system now supports the IFS Save Object (SAV) and Restore Object (RST) commands. This means that Windows 2000 files can now be saved and restored, at a file level, from the iSeries side using CL commands.

When you perform a file-level restore through QNTC, there are two methods you can use:

- Restore from tape
- Restore from disk

The method you choose to restore will depend on how the data was saved.

For a detailed description of the QNTC file system, see Chapter 13, “QNTC file system” on page 333.

Network server description

You must vary *on* the network server description before you perform a file-level restore.

As with file-level backup, you can perform a file-level restore of the Windows 2000 server by using an OS/400 application such as Tivoli Storage Manager - AS/400 Server V3.1.2. Refer to 7.4.7, “Backup using Tivoli Storage Manager” on page 184, for more information.

7.6.1 File-level restore special cases

You should be aware of how the following objects are restored:

- Restoring active files
- Restoring the Windows registry

They are described in the following sections.

7.6.1.1 Restoring active files

As long as they can be read, active (open) files are backed up along with other files. When they are restored, a numeric identifier is appended. For example, the *c:\share1\file1.ext* file is restored as *c:\share1\file1.extnnn*, where *nnn* is an integer. An error is returned to OS/400 that the restore completed, but the *c:\share1\file1.ext* file will not be active until the next reboot of the Windows 2000 server. When the server is rebooted, the *c:\share1\file1.extnnn* file is copied over the existing file (without the numeric suffix).

7.6.1.2 Restoring the Windows registry

The Windows registry is restored using the special share name $REGISTRY. Refer to the example shown in Table 14 on page 194.

Before you restore the registry, make sure you restore all objects (files, directories, and shares). After you restore the registry temporary files, you must reboot the Windows 2000 server before the new registry becomes active.

7.6.2 Preparing for a file-level restore

You must complete the following tasks before you attempt a file-level restore through the QNTC file system:

1. Set up the QNTC file system.
2. Omit files from the restore.
3. Set up an OS/400 profile.
4. Check the Windows server.
5. Check the iSeries server.

They are described in the following sections.

7.6.2.1 Setting up the QNTC file system

Refer to Chapter 13, “QNTC file system” on page 333, to make sure that the QNTC file system is set up correctly. Notice that NetServer is a prerequisite for QNTC, and NetServer must be in the same domain as the Windows 2000 server running on the Integrated xSeries Server.

7.6.2.2 Omitting files from the restore

You can exclude certain files that you do not want to restore from the backup by using the *OMIT keyword on the SAV command. You can also use *OMIT to exclude the registry from the restore.

7.6.2.3 Setting up a restore profile

To perform a file-level restore using QNTC, the user profile and password that you use to run the restore must be the same on both the iSeries and Windows 2000 servers. In addition, your Windows 2000 account must be a member of the Administrator’s group.

You must enroll the user profile you want to use for file-level backup and restore it on the iSeries, using the Change Network User Attributes (CHGNWSUSRA) command. This command propagates the OS/400 profile to Windows 2000. Notice that you will need to set up a user account template on Windows 2000 first, to make sure that the user profile you enroll will become a member of the Administrator’s group when the profile is propagated. To find out how to create a template and enrol a user profile for propagation, refer to Chapter 6, “User administration” on page 121.

7.6.2.4 Checking the Windows server

Complete the following tasks before you restore any files:

1. Windows 2000 provides no way to stop users from signing on and accessing data on the server while the RST command is running. Consequently, you should restore Windows server files when you expect few users to access the system. A note telling users to avoid accessing the server would be a good precaution.
2. Verify that the Windows 2000 server running on the Integrated xSeries Server is active and that the TCP/IP internal LAN connection with the iSeries is working.
3. The iSeries Remote Command service must be running on Windows 2000. To verify, click **Start->Settings->Control Panel->Administrative Tools-> Services**. The service should be *Started.*

7.6.2.5 Checking the iSeries server

You must restore your Windows server files either before you put the system into restricted state to restore other OS/400 files or after you complete restricted state operations. Ensure that the QSYSWRK and QSERVER subsystems are active and that TCP/IP has been started. The internal LAN must be functioning correctly.

7.6.3 RST command parameters

For a complete description of the RST command, refer to *Backup and Recovery*, SC41-5304, and *CL Reference*, SC41-5722. A brief description of the relevant parameters follows:

- **Object (OBJ)** field: Specify the path to the data you want to restore in the form:

  `'QNTC/server-name/share-name/file-name'`

  You can also use the wildcard character (*).

- **Directory subtree (SUBTREE)** parameter: Specify whether you want to restore subtrees (directories) under a share. The default is to restore all directories.

7.6.4 Using the RST command

Objects in the QNTC file system can be restored from tape or save files as shown in Table 14. *Objects* are defined as all lower level shares, directories, and files.

Replace the *underlined* values with the values that are appropriate for your system as follows:

- The server name used in the table is for a sample Windows server called AS400WIN. Replace this with your own server name.
- “share1 and share2” are sample share names. Replace them with valid share names.
- “dir1” is a sample directory name. Replace this with a valid directory name.
- “file1 and file2” are sample file names. Replace them with valid file names.
- Replace the device names in the table as follows:
  - **Restoring from tape**: Replace *TAP01* with the tape device name you are using (if not *TAP01*).
  - **Restoring from a save file**
    - Replace *library* with the name of the library that contains the save file.
    - Replace *save-file* with the name of the save file you want to use.

Table 14. File-level restore from tape and save files

Restore type	Restore command examples

Restore all objects for all unresolved shares [1] for server AS400WIN.	`RST DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QNTC/AS400WIN/*') SUBTREE(*ALL)`
	
	`RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/*') SUBTREE(*ALL)`

Restore all objects for all unresolved shares for all unresolved servers [2].	`RST DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QNTC/*') SUBTREE(*ALL)`
	
	`RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/*') SUBTREE(*ALL)`

Restore type	Restore command examples
Restore all objects for share *share1.* In this case, the directory over which the share is built *is* restored.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1') SUBTREE(*ALL) RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1') SUBTREE(*ALL)
Restore all objects for share *share1.* In this case, the directory over which the share is built *is not* restored.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/*') SUBTREE(*ALL) RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/*') SUBTREE(*ALL)
Restore all objects for share *share2.* In this case, the directory over which the share is built *is not* restored.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/share2/*') SUBTREE(*ALL) RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/share2/*') SUBTREE(*ALL)
Restore all objects for directory *dir1.* In this case, the directory *is* restored.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/dir1*') SUBTREE(*ALL) RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/dir1*') SUBTREE(*ALL)
Restore all objects for directory *dir1.* In this case, the directory *is not* restored.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/dir1/*') SUBTREE(*ALL) RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/dir1/*') SUBTREE(*ALL)
Restore all files for share *share1* which start with *abc.* In this case, the directory over which the share is built *is not* restored.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/abc*') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/abc*')
Restore the file *file1.ext.*	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1/file1.ext') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/file1.ext')
Restore the file *file1.ext* in User ASP nn, where *nn* is from 2 to 16.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/*share1*/*file1.ext*') ('dev/QASPnn/AS400WIN/share1/file1.ext.UDFS') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1/file1.ext') ('dev/QASPnn/AS400WIN/share1/file1.ext.UDFS')
Restore the files *file1.ext* and *file2.ext.*	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ(('/QNTC/*AS400WIN*/share1/file1.ext') ('/QNTC/*AS400WIN*/share2/file2.ext')) RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ(('/QNTC/AS400WIN/share1/file1.ext') ('/QNTC/*AS400WIN*/share2/file2.ext'))
Restore all subdirectories and shares (no files) of *share1*, including *share1*.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/share1') SUBTREE(*DIR) RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/share1') SUBTREE(*DIR)

Restore type	Restore command examples
Restore the Windows 2000 registry.	RST DEV('/QSYS.LIB/*TAP01*.DEVD') OBJ('/QNTC/*AS400WIN*/$REGISTRY') RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') OBJ('/QNTC/AS400WIN/$REGISTRY')

1. When there are no share names specifically identified in the OBJ parameter of the RST command, the system looks in the file QAZLCSAVL for a member with a name corresponding to the name of the network server description specified in the OBJ parameter. The share names are resolved from the entries in the member.
2. When there are no network server description names specifically identified in the OBJ parameter of the RST command, the system resolves the network server description names from the names of the members in file QAZLCSAVL. The share names are resolved from the entries in the members.

7.7 Backup and restore from the Windows 2000 side

This section briefly discusses the ways in which a Windows 2000 server can be backed up from the Windows 2000 side. Because backing up and restoring from the Windows 2000 side using a Windows 2000 backup application is not specific to the iSeries server, we do not cover this topic in detail. Your main source of information is the documentation from Microsoft and other backup application vendors. Instead, this section describes unique features of the Windows 2000 on Integrated xSeries Server environment and how you can use these features when you back up or restore the server.

To position file-level backup using Windows 2000 applications against other methods of restore, see 7.10, “Backup technique positioning and recommendations” on page 215.

7.7.1 Windows 2000 recovery options

To clarify the differences between a PC-based Windows 2000 server and an Integrated xSeries Server, you first need to look at some Windows 2000 backup-related functions. The following list is not intended to be complete, but it is a set of tasks with which most administrators are familiar:

- **Boot disk**: Microsoft recommends that you create a BOOT diskette to allow you to boot the server in the event of missing or corrupted files. It may then be possible to edit damaged files or replace missing ones.

  The Integrated xSeries Server does not provide access to a diskette drive. Therefore, you cannot use this technique.

- **Boot to PC-DOS**: By default, Windows 2000 provides a boot menu option called “Boot to PC-DOS”. If you chose to format your system drive as FAT, this option enables you to boot to DOS and repair or replace files on the system drive. If you formatted your system drive as NTFS, you cannot use DOS to access the system drive.

- **Last Known Good configuration**: There are two control sets containing configuration information:

  – *Default*: This is the configuration saved at the time the system is shut down. It contains any changes made to the configuration since the user last signed on.

  – *Last Known Good*: This is the configuration saved at the last successful sign on. At this point, it is the same as the default, but the default changes

when changes are made to the configuration. Last Known Good does not change until a successful logon has been achieved.

- **Recovery Console**: The Recovery Console is a text-mode command interpreter that is separate from the Windows 2000 command prompt and allows the system administrator to gain access to the hard disk of a computer running Windows 2000, regardless of the file format used. Recovery Console can be used for basic troubleshooting and system maintenance.

  Since starting Windows 2000 is not a prerequisite for using the Recovery Console, it can help you recover when your Windows 2000-based computer does not start properly or at all. The Recovery Console allows you to obtain limited access to NTFS, file allocation table (FAT), FAT16, and FAT32 volumes without starting the graphical interface. The Recovery Console allows administrators and support technicians to start and stop services, repair the master boot record (MBR) and boot sector, and to format volumes. The Recovery Console prevents unauthorized access to volumes by requiring the user to enter the system administrator password.

  The Recovery Console is currently not supported for the Windows 2000 server running on the Integrated xSeries Server.

- **Emergency Repair Disk (ERD)**: If your system does not start, and using safe mode or the Recovery Console has not helped, you can try using the Emergency Repair Disk (ERD) option of backup. Backup includes a wizard to help you create an ERD. If a system failure occurs, you can start the system using the Windows 2000 Setup CD or the Windows 2000 Setup floppy disks, which can be created by running Makeboot.exe from the Bootdisk folder on the Windows 2000 Setup CD. Then use the Emergency Repair Process to restore core system files. The ERD allows you to make only basic system repairs, such as to the system files, boot sector, and startup environment. The ERD does not back up data, programs, or the registry.

  The Integrated xSeries Server does not provide access to a diskette drive. Therefore, you cannot use this technique.

There are a number of additional recovery options accessible from the Advanced Options Menu. Select F8 on the boot menu display to see these options.

7.7.2 Windows 2000 backup applications

The following applications have been tested to back up Windows 2000 running on the Integrated xSeries Server (including backing up to disk):

- Windows 2000 Backup program
- Veritas Backup Exec 8.0 and previous versions
- Computer Associates Arcserve 6.6x and previous versions

For further details regarding supported backup applications, refer to Informational APAR II11119, which can be viewed on the Web at:
`http://www.as400.ibm.com/windowsintegration`

Select **Service Information->Informational APARs**.

Notice that the Windows 2000 registry requires special treatment in terms of backup. The supported backup applications have special functions that allow you to back up and restore the registry. You need to consult the documentation for each individual application for more information.

7.7.3 Tape drives used by Windows 2000 backup applications

Windows 2000 backup applications can either back up to an iSeries tape drive or a PC tape drive.

7.7.3.1 Backing up to an iSeries tape drive

iSeries tape drives can be used by backup applications running on the Windows 2000 server. The Windows 2000 tape device driver is supplied with the Integration for Windows Server licensed program product (5769-WSV).

Notice that, because the iSeries tape drive appears to the Windows 2000 server as a PC tape drive, you can back up other Windows 2000 servers to the iSeries tape drive. In other words, you can use the iSeries tape device as if it were a PC tape drive.

To set up and use an iSeries tape drive from Windows 2000, refer to 7.2, “Enabling tape support” on page 158.

7.7.3.2 Backing up to a PC tape drive

If a network of Windows 2000 servers is already installed, it is likely that you have a PC tape drive on one or more of your PC servers. The Integrated xSeries Server appears in the Windows 2000 domain the same as any other Windows 2000 server. Therefore, you can back up the Windows 2000 server on the Integrated xSeries Server files to a tape drive connected to another server, the same as you would in a PC-based network.

7.7.4 Saving Windows 2000 files in OS/400 IFS

There are two common methods you can use to gain direct access to the integrated file system (IFS) on the iSeries server:

- AS/400 NetServer
- OS/400 Client Access Express

Because both of these applications use TCP/IP to communicate, you can set up a connection between the Windows 2000 server and the iSeries across the internal LAN. The internal LAN provides a reliable, secure connection that enables Windows 2000 applications to communicate with the iSeries using TCP/IP. Using NetServer or Client Access Express, you can map a Windows drive to a directory in the IFS, and therefore, make the iSeries disk storage directly accessible to Windows 2000.

You can save Windows 2000 files in an IFS directory using many different applications. Notice, however, that there is a distinction between backing up a file and simply copying it.

File attributes

AS/400 NetServer and OS/400 Client Access Express can be used to *copy* Windows 2000 files to the IFS. However, they are not true Windows 2000 backup tools because they do not preserve NTFS attributes. They simply provide a mechanism to copy files from one system to another. NTFS attributes, such as permissions, auditing, and ownership, are lost.

To overcome this problem, you need to use a backup utility that can save the files, together with their attributes, to a network drive. One such application is BXTOOLS from Mensk Technologies. Refer to the following section for more information.

The two ways you can save files in the IFS are:

- Backing up Windows 2000 files to the IFS
- Copying Windows 2000 files to the IFS

These two methods are covered in the following sections.

7.7.4.1 Backing up Windows 2000 files to the IFS

You can back up Windows 2000 files to the IFS using the following methods:

- **Supported backup applications**: For a list of tested backup applications, see 7.7.2, “Windows 2000 backup applications” on page 197.
- **Untested backup applications**: There are a number of untested applications that you can use to back up files to disk and preserve NTFS attributes in the process. An example is BXTOOLS from Mensk technologies.

  BXTOOLS is a product that allows you to back up selected Windows 2000 files to a single file, which can then be copied to a NetServer or Client Access network drive. Because the files now reside in an IFS directory, you can use the SAV and RST commands to save them to tape as part of an iSeries unattended backup. You can also leave the files on disk for fast recovery.

  You can find more details regarding BXTOOLS on the Web at:
  `http://www.mensk.com`

7.7.4.2 Copying Windows 2000 files to the IFS

Copying a Windows 2000 file preserves the data in the file, but, in the case of NTFS files, not its attributes. You can copy Windows 2000 files to the IFS using the following methods:

- **AS/400 NetServer**: In Integrated xSeries Server, a new product was introduced called AS/400 NetServer. NetServer uses Server Message Block (SMB) architecture to allow OS/400 IFS to be visible to SMB clients on the network. This function is described in Chapter 14, “AS/400 NetServer” on page 345.

  NetServer can be used to copy files from a Windows 2000 server into the OS/400 IFS. If the files are accidentally deleted from the server, it is a simple and fast process to copy them back (without their NTFS attributes).

- **OS/400 Client Access Express**: You can install OS/400 Client Access Express onto a Windows 2000 server running on the Integrated xSeries Server. After Client Access is installed and running, you can use it to provide

access to the OS/400 IFS to copy files and directories there. Notice that you can also use Client Access for Windows 95/NT for this purpose, but we recommend Client Access Express because of its superior performance and function.

In both cases, you need to have enough iSeries disk storage available to store the copied files, and you also need the correct level of authority to the target IFS directory.

7.7.5 Restoring from the Windows 2000 side

Restoring objects to a Windows 2000 server running on the Integrated xSeries Server is usually a simple reversal of the backup process you used to save them. Your main source of information is the documentation from Microsoft and other backup application vendors.

7.8 Automating backup and restore

Backup is one of the key areas that many people want to control from the iSeries server. Therefore, when we talk about automation, we are really looking at automating backup and restore-related functions from the iSeries side. Typically, most people want to automate backup by running unattended backups overnight when the system is not being used. This chapter provides some examples of how you can write a CL program to perform a backup or restore task.

Notice that in this chapter, we only consider the scenarios where Windows 2000 is installed from scratch on either a 700 MHz Integrated xSeries Server or a 333 MHz Integrated Netfinity Server. We do not consider the case where a Windows NT server, installed on a release prior to V4R5, has been upgraded to Windows 2000, because this scenario has the old drive structure (C:, D:, and E:), which adds complexity to the CL programs.

7.8.1 Automating backup on the iSeries server

Whether you want to perform a disaster recovery or file-level backup of your Windows 2000 server on the Integrated xSeries Server environment, you can incorporate the backup into your unattended backup program by including the appropriate CL commands. This means that you can back up both your iSeries and Windows 2000 environments unattended, as part of a single backup procedure.

Because you do not need to use a tape formatted as non-labeled (as you do with a Windows 2000 backup application), you can save OS/400 objects and individual Windows 2000 files on the same tape. This also enables you to use fast Auto Cartridge Loader (ACL)-capable tape drives, such as the 3570 and 3590. You cannot use the ACL capability to back up Windows 2000 files using a Windows 2000 backup application.

Depending on whether you are performing a disaster recovery or file-level backup, you need to vary off (disaster recovery) or on (file level) the network server description. Notice that if you vary off a network server that has an iSeries TCP/IP (external host LAN only) interface defined on at least one of the Integrated xSeries Server physical LAN ports, you are forced to reply to an inquiry message on the QSYSOPR message queue. The message (CPA2614)

reads: `Network server (network-server-name) cannot be varied off at this time. (C G).`

You must respond whether you want the vary off to continue (G) or to be canceled (C). You can use one of the following methods to avoid responding to this message:

- Specify `FRCVRYOFF(*YES)` on the Vary Configuration (VRYCFG) command to avoid this inquiry message. This is the preferred option.
- You can end the *external* iSeries TCP/IP interfaces using the End TCP/IP Interface (`ENDTCPIFC`) command before you vary off the NWSD. You do not need to end the interface for the internal LAN.
- Set up a Reply List entry for message ID CPA2614 to automatically issue a reply to this inquiry message.

If your external LAN lines are defined, you need to use one of these options to vary off the network server cleanly if you want to perform an unattended backup of user storage spaces from a CL program.

You can automate backup on the iSeries server either at a disaster recovery or file level as follows:

- **Automating disaster recovery backup**: You can automate disaster recovery backup by using CL programs. This is described in 7.8.1.1, “Automating disaster recovery backup on the iSeries server” on page 201.
- **Automating file-level backup**: You can also automate file-level backup by using CL programs. This is described in 7.8.1.2, “Automating file-level backup on the iSeries server” on page 204.

7.8.1.1 Automating disaster recovery backup on the iSeries server

Network server description

You must vary *off* the network server description before you perform a disaster recovery backup.

You can automate disaster recovery backup on the iSeries by including the CL commands that correspond to the save operations you want to perform, in your backup program. The CL commands that you can use are listed in Table 10 on page 171. This enables you to perform the following types of disaster recovery backup unattended:

- Windows 2000 system drives
- Windows 2000 user storage spaces
- The complete Windows 2000 environment

Each of these scenarios is described in the following sections.

To back up the complete Windows 2000 environment as an automatic process, you can also use the OS/400 SAVE menu. To do so, enter `GO SAVE` and select option `21` to back up the entire system. This process backs up the entire iSeries server and any Windows 2000 servers that are installed on it. To find out the CL commands that run when you select option `21`, position your cursor on this option,

and press the F1 (help) key. To automate a backup of the complete Windows 2000 environment, simply include these CL commands in your backup program.

Notice that it takes up to seven minutes to vary off a network server description (NWSD). Therefore, to be sure that the NWSD is varied off, you must insert a delay of 420 seconds into any Vary Configuration (VRYCFG) command that you use in a CL program to vary off a Windows 2000 server.

Windows 2000 system drives

Backing up the Windows 2000 system drives involves saving the storage spaces that correspond to the C: and D: drives. You can back up the C: and D: drives to tape or disk. Figure 85 shows an example of a CL program that can be used to back up the C: and D: drives to save files on disk. Backing up to a save file is faster than backing up to tape, because you are saving straight to disk. After you save a storage space to disk, you can either back it up to tape or leave it on disk to provide a fast method of recovering the Windows 2000 drive.

Replace the underlined values with the values that are appropriate for your system. The object names used in the table are for a sample network server description called AS400WIN. Replace these with your own object names.

We recommend you use the Data compression (DTACPR) parameter on the save commands to save disk storage space. Compressing the data provides better performance and results in a shorter save time. When you save to a save file, you must manually select compression because the command default is *DEV. *DEV does not compress a save file.

```
 ********** Beginning of data *********************************************
0001.00 /*****************************************************************/
0002.00      PGM
0003.00 /*                                                                */
0004.00 /* THIS PROGRAM BACKS UP THE WINDOWS 2000 C: AND D: DRIVES TO SAVE      */
0005.00 /* FILES CALLED SAVEC AND SAVED IN LIBRARY SAVEWIN.                     */
0006.00 /*                                                                      */
0007.00 /* VARY OFF THE NETWORK SERVER DESCRIPTION                              */
0008.00         VRYCFG CFGOBJ(AS400WIN) CFGTYPE(*NWS) STATUS(*OFF) +
0009.00           ASCVRYOFF(*NO) FRCVRYOFF(*YES)
0010.00         MONMSG MSGID(CPF0000)
0011.00         DLYJOB DLY(420)
0012.00 /* CREATE THE SAVE FILE LIBRARY                                         */
0013.00         CRTLIB LIB(SAVEWIN)
0014.00         MONMSG MSGID(CPF0000)
0015.00 /* CREATE THE SAVE FILE FOR DRIVE C                                     */
0016.00         CRTSAVF FILE(SAVEWIN/SAVEC)
0017.00         MONMSG MSGID(CPF0000)
0018.00 /* CREATE THE SAVE FILE FOR DRIVE D                                     */
0019.00         CRTSAVF FILE(SAVEWIN/SAVED)
0020.00         MONMSG MSGID(CPF0000)
0021.00 /* SAVE THE C: DRIVE                                                    */
0022.00         SAV DEV('/QSYS.LIB/SAVEWIN.LIB/SAVEC.FILE') +
0023.00           OBJ('/QFPNWSSTG/AS400WIN1') DTACPR(*YES)
0024.00         MONMSG MSGID(CPF0000)
0025.00 /* SAVE THE D: DRIVE                                                    */
0026.00         SAV DEV('/QSYS.LIB/SAVEWIN.LIB/SAVED.FILE') +
0027.00           OBJ('/QFPNWSSTG/AS400WIN2') DTACPR(*YES)
0028.00         MONMSG MSGID(CPF0000)
0029.00 /* VARY ON THE NETWORK SERVER DESCRIPTION                               */
0030.00         VRYCFG CFGOBJ(AS400WIN) CFGTYPE(*NWS) STATUS(*ON)
0031.00         MONMSG MSGID(CPF0000)
0032.00      ENDPGM
        ********** End of data ***********************************************
```

Figure 85. Example CL program to save the Windows 2000 C: and D: drives to save files

Windows 2000 user storage spaces

User storage spaces can also be backed up from the iSeries server by using the CL commands listed in Table 10 on page 171. Because these commands save at a storage-space level, you cannot restore individual files to the Windows 2000 server from these backups.

To automate this process, you could modify the code in Figure 85.

The complete Windows 2000 environment

You can incorporate CL commands from Table 10 on page 171 into your backup program to back up all individual components of the Windows 2000 on the Integrated xSeries Server environment. You could use this type of backup to restore a Windows 2000 server on a backup iSeries server after a disaster has rendered your primary system inoperable.

Figure 86 on page 204 shows an example of a simple CL program that can be used to perform a disaster recovery backup of the complete Windows 2000 server on the Integrated xSeries Server environment to tape. The program backs up all components of the environment.

Replace the *underlined* values with the values that are appropriate for your system as follows:

- The object names used in the table are for a sample network server description called AS400WIN. Replace these with your own object names.
- Replace *TAP01* with the tape device name you are using (if not *TAP01*).

```
*************** Beginning of data ************************************
0001.00 /*********************************************************************/
0002.00      PGM
0003.00      /* VARY OFF THE NETWORK SERVER DESCRIPTION */
0004.00              VRYCFG CFGOBJ(AS400WIN) CFGTYPE(*NWS) STATUS(*OFF) +
0005.00                        ASCVRYOFF(*NO) FRCVRYOFF(*YES)
0006.00              MONMSG MSGID(CPF0000)
0007.00              DLYJOB DLY(420)
0008.00      /* SAVE THE COMMUNICATIONS DEFINITIONS */
0009.00              SAVCFG DEV(TAP01) ENDOPT(*LEAVE)
0010.00              MONMSG MSGID(CPF0000)
0011.00      /* SAVE THE USER-DEFINED MESSAGE QUEUE */
0012.00              SAVOBJ OBJ(AS400WIN) LIB(QGPL) DEV(TAP01) +
0013.00                        ENDOPT(*LEAVE)
0014.00              MONMSG MSGID(CPF0000)
0015.00      /* SAVE THE INTEGRATION CODE (AS/400 SIDE) */
0016.00              SAVLIB LIB(QNTAP) DEV(TAP01) ENDOPT(*LEAVE)
0017.00              MONMSG MSGID(CPF0000)
0018.00      /* SAVE THE INTEGRATION CODE (WINDOWS 2000 SIDE) */
0019.00              SAV DEV('/qsys.lib/tap01.devd') +
0020.00                        OBJ('/QIBM/ProdData/NTAP') ENDOPT(*LEAVE)
0021.00              MONMSG MSGID(CPF0000)
0022.00              SAV DEV('/qsys.lib/tap01.devd') +
0023.00                        OBJ('/QIBM/UserData/NTAP') ENDOPT(*LEAVE)
0024.00              MONMSG MSGID(CPF0000)
0025.00      /* SAVE THE C: DRIVE */
0026.00              SAV DEV('/qsys.lib/tap01.devd') +
0027.00                        OBJ('/QFPNWSSTG/AS400WIN1') ENDOPT(*LEAVE)
0028.00              MONMSG MSGID(CPF0000)
0029.00      /* SAVE THE D: DRIVE */
0030.00              SAV DEV('/qsys.lib/tap01.devd') +
0031.00                        OBJ('/QFPNWSSTG/AS400WIN2') ENDOPT(*LEAVE)
0032.00              MONMSG MSGID(CPF0000)
0033.00      /* SAVE USER STORAGE SPACES (ADD AN ENTRY FOR EACH STORAGE SPACE) */
0034.00              SAV DEV('/qsys.lib/tap01.devd') +
0035.00                        OBJ('/QFPNWSSTG/NTUSER1') ENDOPT(*REWIND)
0036.00              MONMSG MSGID(CPF0000)
0037.00      /* VARY ON THE NETWORK SERVER DESCRIPTION */
0038.00              VRYCFG CFGOBJ(AS400WIN) CFGTYPE(*NWS) STATUS(*ON)
0039.00              MONMSG MSGID(CPF0000)
0040.00      ENDPGM
        ****************** End of data ***************************************
```

Figure 86. Sample CL program to back up the complete Windows 2000 environment to tape

7.8.1.2 Automating file-level backup on the iSeries server

Network server description

You must vary *on* the network server description before you perform a file-level backup.

You can automate file-level backup on the iSeries by using the following techniques:

- QNTC file system
- Tivoli Storage Manager (TSM)
- Windows 2000 backup application

Each of these scenarios is described in the following sections.

Using the QNTC file system
You can automate file-level backup through the QNTC file system by including CL commands from Table 12 on page 182 in your iSeries backup program.

Using Tivoli Storage Manager
You can automate backup at a file level using Tivoli Storage Manager (TSM) - AS/400 Server. Because TSM is an iSeries-based product, you can incorporate TSM commands into your backup program to perform a file-level save of the Windows 2000 server running on the Integrated xSeries Server.

Using a Windows 2000 backup application
You can also start a file-level backup from the iSeries, which runs a Windows 2000 backup application and saves to an iSeries tape drive. This is accomplished by using the Submit Network Server Command (SBMNWSCMD). The SBMNWSCMD command enables you to execute a command through the Windows 2000 command line interface or initiate a Windows 2000 batch program, both from the iSeries server. You can use this capability to run a Windows 2000 backup application from a CL program. Therefore, you can use this technique to include a file-level backup of the Windows 2000 server (using a Windows 2000 backup application) as part of your iSeries backup procedure. Notice, however, that you are still subject to the restrictions described in 7.2.3, “Restrictions on using iSeries tape drives” on page 160.

With Windows 2000, you need to restart the service that controls the operation of the tape drive. This service is unique to the backup application you are using. Therefore, you need to determine the name of this service and restart it through the batch interface.

In the example shown in Figure 87 on page 206, the Windows 2000 Backup program is being used to back up the Windows 2000 D: and E: drives to an iSeries tape drive.

Replace the *underlined* values with the values that are appropriate for your system as follows:

- The object names used in the table are for a sample network server description called AS400WIN. Replace these with your own object names.
- Replace *TAP01* with the tape device name you are using (if not *TAP01*).
- Replace *restart-tape-service* with a batch command to restart the Windows 2000 service for your backup application.

```
 *************** Beginning of data ************************************
0001.00 PGM
0002.00 INZTAP DEV(TAP01) CHECK(*NO) DENSITY(*CTGTYPE)
0003.00 VRYCFG CFGOBJ(TAP01) CFGTYPE(*DEV) STATUS(*OFF)
0004.00 SBMNWSCMD CMD('as400dev /lock tap01') SERVER(AS400WIN) +
0005.00                          SVRTYPE(*WINDOWSNT)
0006.00 SBMNWSCMD CMD('restart-tape-service') SERVER(AS400WIN) +
0007.00                          SVRTYPE(*WINDOWSNT)
0008.00 SBMNWSCMD CMD('ntbackup backup d: e: /tape:0') +
0009.00                          SERVER(AS400WIN) SVRTYPE(*WINDOWSNT)
0010.00 SBMNWSCMD CMD('as400dev /unlock tap01') +
0011.00                          SERVER(AS400WIN) SVRTYPE(*WINDOWSNT)
0012.00 VRYCFG CFGOBJ(TAP01) CFGTYPE(*DEV) STATUS(*ON)
0013.00 ENDPGM
        ****************** End of data ***************************************
```

Figure 87. Example program using the SBMNWSCMD command

The steps are as follows:

1. Initialize the tape media as non-labeled.
2. Vary off the tape drive.
3. Lock the tape drive to Windows 2000.
4. Restart the service that controls the tape drive.
5. Start the Windows 2000 Backup program to back up the D: and E: drives.
6. Unlock the tape drive from Windows 2000.
7. Vary on the tape drive.

7.8.2 Automating restore on the iSeries server

Normally you would run individual CL commands to restore components of the Windows 2000 server on the Integrated xSeries Server environment. However, there are certain restore operations that you may want to automate. You can automate restore on the iSeries server either at a disaster recovery or file level as follows:

- **Automating disaster recovery restore**: You can automate disaster recovery restore by using CL programs. This is described in the following section.
- **Automating file-level restore**: You can automate file-level restore by including the commands described in Table 14 on page 194 in a CL program.

7.8.2.1 Automating disaster recovery restore

Network server description

You must vary *off* the network server description before you perform a disaster recovery restore.

This section provides two examples of automating disaster recovery restore:

- Restoring a User Storage Space
- Restoring the Windows 2000 Environment

Each of these scenarios is described in the following sections.

Restoring a user storage space

You could use a CL program to restore a Windows 2000 drive, created as a user storage space “on the fly”. This might be useful, for example, if you need to recover the Windows 2000 system (C:) drive in a hurry. This scenario can be thought of as “system drive hot spare”. Figure 88 shows an example of a CL program that you could use to automate this process.

Replace the *underlined* values with the values that are appropriate for your system as follows:

- The object names used in the program are for a sample network server description called AS400WIN. Replace these with your own object names.
- Replace the device names in the table as follows:
  - Replace *library* with the name of the library containing the save file.
  - Replace *save-file* with the name of the save file you want to use.

```
 *************** Beginning of data ************************************************
0001.00 /*****************************************************************/
0002.00      PGM
0003.00 /*                                                                       */
0004.00 /* THIS PROGRAM RESTORES THE WINDOWS C: DRIVE SAVED TO A SAVE FILE       */
0005.00 /*                                                                       */
0006.00 /* VARY OFF THE NETWORK SERVER DESCRIPTION                               */
0007.00         VRYCFG CFGOBJ(AS400WIN) CFGTYPE(*NWS) STATUS(*OFF) +
0008.00           ASCVRYOFF(*NO) FRCVRYOFF(*YES)
0009.00         MONMSG MSGID(CPF0000)
0010.00         DLYJOB DLY(420)
0011.00 /* UNLINK THE STORAGE SPACE                                              */
0012.00         RMVNWSSTGL NWSSTG(AS400WIN1) NWSD(AS400WIN) RENUMBER(*NO)
0013.00         MONMSG MSGID(CPF0000)
0014.00 /* DELETE THE STORAGE SPACE                                              */
0015.00         DLTNWSSTG  NWSSTG(AS400WIN1)
0016.00         MONMSG MSGID(CPF0000)
0017.00 /* RESTORE THE STORAGE SPACE FROM A SAVE FILE                            */
0018.00         RST DEV('/QSYS.LIB/library.LIB/save-file.FILE') +
0019.00           OBJ('/QFPNWSSTG/AS400WIN1')
0020.00         MONMSG MSGID(CPF0000)
0021.00 /* RELINK THE STORAGE SPACE                                              */
0022.00         ADDNWSSTGL NWSSTG(AS400WIN1) NWSD(AS400WIN) DRVSEQNBR(3)
0023.00         MONMSG MSGID(CPF0000)
0024.00 /* VARY ON THE NETWORK SERVER DESCRIPTION                                */
0025.00         VRYCFG CFGOBJ(AS400WIN) CFGTYPE(*NWS) STATUS(*ON)
0026.00         MONMSG MSGID(CPF0000)
0027.00      ENDPGM
        ***************** End of data ***************************************
```

Figure 88. Sample CL program to restore a user storage space (the C: drive)

Restoring the Windows 2000 environment

If you want to restore the complete Windows 2000 server on the Integrated xSeries Server environment from backup, Figure 89 on page 208 shows an example of a CL program that you can use. You could use this type of restore to recover a Windows 2000 server on a backup iSeries server after a disaster has rendered your primary system inoperable. Notice that you may need to re-create the TCP/IP interface for the internal LAN line and start the interface. If required, you could add the CL commands to do this to the sample program.

Replace the *underlined* values with the values that are appropriate for your system as follows:

- The object names used in the table are for a sample network server description called AS400WIN. Replace these with your own object names.
- Replace *TAP01* with the tape device name you are using (if not *TAP01*).

```
       ************** Beginning of data ************************************
0001.00 /*****************************************************************/
0002.00      PGM
0003.00      /* VARY OFF THE NETWORK SERVER DESCRIPTION */
0004.00             VRYCFG CFGOBJ(AS400WIN) CFGTYPE(*NWS) STATUS(*OFF) +
0005.00                          ASCVRYOFF(*NO) FRCVRYOFF(*YES)
0006.00             MONMSG MSGID(CPF0000)
0007.00             DLYJOB DLY(420)
0008.00      /* RESTORE THE COMMUNICATIONS DEFINITIONS */
0009.00             RSTCFG OBJ(AS400WIN*) DEV(TAP01) ENDOPT(*LEAVE)
0010.00             MONMSG MSGID(CPF0000)
0011.00      /* RESTORE THE USER-DEFINED MESSAGE QUEUE */
0012.00             RSTOBJ OBJ(AS400WIN) SAVLIB(QGPL) DEV(TAP01) +
0013.00                          ENDOPT(*LEAVE)
0014.00             MONMSG MSGID(CPF0000)
0015.00      /* RESTORE THE INTEGRATION CODE (AS/400 SIDE) */
0016.00             RSTLIB SAVLIB(QNTAP) DEV(TAP01) ENDOPT(*LEAVE)
0017.00             MONMSG MSGID(CPF0000)
0018.00      /* RESTORE THE INTEGRATION CODE (Windows 2000 SIDE) */
0019.00             MD DIR('/QIBM/UserData/NTAP')
0020.00             MONMSG MSGID(CPF0000)
0021.00             RST DEV('/QSYS.LIB/tap01.DEVD') +
0022.00                          OBJ('/QIBM/UserData/NTAP') ENDOPT(*LEAVE)
0023.00             MONMSG MSGID(CPF0000)
0024.00             MD DIR('/QIBM/ProdData/NTAP')
0025.00             MONMSG MSGID(CPF0000)
0026.00             RST DEV('/QSYS.LIB/tap01.DEVD') +
0027.00                          OBJ('/QIBM/ProdData/NTAP') ENDOPT(*LEAVE)
0028.00             MONMSG MSGID(CPF0000)
0029.00      /* RESTORE THE C: DRIVE */
0030.00             RST DEV('/QSYS.LIB/tap01.DEVD') +
0031.00                          OBJ('/QFPNWSSTG/AS400WIN1')
0032.00             MONMSG MSGID(CPF0000)
0033.00      /* LINK THE C: DRIVE */
0034.00             ADDNWSSTGL NWSSTG(AS400WIN1) NWSD(AS400WIN) DRVSEQNBR(3)
0035.00             MONMSG MSGID(CPF0000)
0036.00      /* RESTORE THE D: DRIVE */
0037.00             RST DEV('/QSYS.LIB/tap01.DEVD') +
0038.00                          OBJ('/QFPNWSSTG/AS400WIN2')
0039.00             MONMSG MSGID(CPF0000)
0040.00      /* LINK THE D: DRIVE */
0041.00             ADDNWSSTGL NWSSTG(AS400WIN2) NWSD(AS400WIN) DRVSEQNBR(4)
0042.00             MONMSG MSGID(CPF0000)
0043.00      /* RESTORE THE USER STORAGE SPACES */
0044.00             RST DEV('/QSYS.LIB/tap01.DEVD') +
0045.00                          OBJ('/QFPNWSSTG/AS400WIN3')
0046.00             MONMSG MSGID(CPF0000)
0047.00      /* LINK THE USER STORAGE SPACES */
0048.00             ADDNWSSTGL NWSSTG(AS400WIN3) NWSD(AS400WIN) DRVSEQNBR(5)
0049.00             MONMSG MSGID(CPF0000)
0050.00      ENDPGM
       ****************** End of data ***************************************
```

Figure 89. Sample CL program to restore the Windows 2000 environment from tape

7.8.3 Automating backup on the Windows 2000 server

You can set a timer under Windows 2000 to start a backup application that saves files to either an iSeries tape drive or another tape drive on the network. In the

case of an iSeries tape drive, a command interface is provided by the integration software that enables you to lock the iSeries tape drive to Windows 2000 from a .BAT program running on the server (refer to 7.2.8, “Controlling tape devices in a batch environment” on page 166).

7.8.3.1 Varying off the tape drive from Windows 2000

Notice that the iSeries tape drive must be in a varied off condition before you try to lock it from the Windows 2000 side. It is possible to vary off an iSeries tape drive from Windows 2000 using the Client Access Remote Command (RMTCMD) function, for example:

```
RMTCMD /I C:\path\file.ext /Q //system-name /Z
```

Here, *system-name* is the name of the iSeries, and *path\file.ext* specifies the name and location of the file that contains the following CL command:

```
VRYCFG CFGOBJ(TAP01) CFGTYPE(*DEV) STATUS(*OFF)
```

For this to work, you need to:

1. Install Client Access Express on the Windows 2000 server
2. Configure a Client Access connection to the iSeries
3. Either have an active Client Access connection to the iSeries or have the “Use Windows name and password, no prompting” logon option configured for the iSeries server.

You could use the RMTCMD command in a batch program that runs an unattended backup from Windows 2000, using a Windows 2000 backup application, to an iSeries tape drive.

7.9 Backup and restore performance

This section provides a rough guide regarding the performance of disaster recovery and file-level backups and restores.

Disclaimer

The performance figures that are provided here are specific to the system on which the tests were performed.

The results for your system will vary, depending on the specifications of your iSeries server and tape drive and the load on the system. Therefore, only use these results *as a guide* regarding the performance you will obtain in your particular environment.

For backups and restores from the iSeries side, you can save to and restore from tape, save files, and storage spaces (disaster recovery save only).

For backups and restores from the Windows side, you can save to and restore from tape and disk.

7.9.1 Parallel backups to disk

When you back up to save files on disk, you can perform saves of multiple storage spaces in parallel, rather than serially. This is much easier to do than

backing up in parallel to tape, because in this case, you would need multiple tape drives.

We tested parallel backup by starting two saves of different 500 MB storage spaces simultaneously. We then measured the time it took for the last save to complete. Although we performed these tests interactively, because we were using a dedicated system, the results should be the same if you submit the saves to batch.

7.9.2 Performance test setup

The performance tests were conducted on hardware with the following specifications:

- Dedicated iSeries Model 270 with the following specifications:
  - Processor: #2253 (2-way)
  - Memory: 2 GB
  - Disk: 12 x 8 GB 10K RPM drives
  - Tape unit: QIC MLR3 25GB (6386)
  - Integrated xSeries Server: 700 MHz
  - LAN: 16 Mb token-ring
  - Release level: V4R5

  Notice that the quarter-inch cartridge (QIC) tape unit used is a relatively slow device when compared with the 3570 and 3590 devices. You can expect much better backup and restore performance when you use these devices. Unfortunately, we were unable to gain access to such high speed devices when performing our tests.
- For comparison, some performance measurements for storage space backups to save files were also captured on a dedicated iSeries Model 720 with the following specifications:
  - Processor: #2063 (2-way)
  - Memory: 1 GB
  - Disk: 5 x 17 GB and 5 x 8 GB drives
  - Tape unit: (not applicable)
  - Release level: V4R4
- To obtain optimum performance with the QIC drive, we initialized the tape cartridge using DENSITY(*DEVTYPE), which is the default, rather than DENSITY(*CTGTYPE) on the INZTAP command. In our test environment, we found that using DENSITY(*DEVTYPE) improves performance approximately 25% compared with DENSITY(*CTGTYPE) for storage space saves. This performance difference can be attributed to more efficient use of the optimum block function when the DENSITY(*DEVTYPE) setting is used.
- The test data was 500 MB in size, which included a typical mix of application and data files, varying in size from very small to medium. There were 640 files in 82 folders. Notice that large files are quicker to back up than small files.
- When using iSeries backup commands to save the data to tape, compression is specified by default using DTACPR(*DEV) and COMPACT(*DEV). With the QIC drive used, it makes no difference whether you specify DTACPR(*DEV) or DTACPR(*YES). In both cases, only device data compaction is performed. To measure the uncompressed save rate, we specified DTACPR(*NO) and COMPACT(*NO).

- The Windows backup application used was the Windows 2000 Backup program, which is supplied with the Windows 2000 server software.
- The times quoted for saving to tape do not include rewind time.
- All tests were repeated at least three times. We found that most results were very consistent.

The performance measurements were categorized as follows:

- iSeries disaster recovery backup and restore performance
- OS/400 file-level backup and restore performance
- Windows file-level backup and restore performance

Each of these categories is discussed in the following sections.

7.9.3 iSeries disaster recovery backup and restore performance

Using iSeries disaster recovery backup and restore, we ran the following tests.

7.9.3.1 Backup to and restore from tape (Model 270)

Backup to and restore from tape were performed using the SAV and RST commands through the QFPNWSSTG file system as follows:

- Backup to tape
  - Not using compression: 5.9 GB/hr
  - Using compression: 7.7 GB/hr
- Restore from tape
  - Not using compression: 6.5 GB/hr
  - Using compression: 8.0 GB/hr

Conclusions

The following conclusions were drawn from these results:

- Using compression (the default) significantly improves the save rate.
- Restoring from tape is a little quicker than backing it up.

7.9.3.2 Backup to and restore from a save file serially (Model 270)

Backup to and restore from a save file were performed using the SAV and RST commands through the QFPNWSSTG file system as follows:

- Backup to a save file
  - Not using compression: 82.8 GB/hr
  - Using compression: 82.8 GB/hr
- Restore from a save file
  - Not using compression: 82.8 GB/hr
  - Using compression: 144.9 GB/hr

Conclusions

The following conclusions were drawn from these results:

- The backup and restore performance of save files can only be described as spectacular, especially restore from a compressed storage space.
- The result of restoring from a compressed storage space was unexpected, but multiple tests were performed, and the results were consistent.

- When performing a backup to disk using save files, you should always use compression. This saves disk space and improves performance.
- These results, compared to those of the Model 720 tested in the following sections, show an improvement of approximately three times the throughput.

7.9.3.3 Backup to and restore from a save file in parallel (Model 270)

Backup to and restore from two save files were performed in parallel using the SAV and RST commands through the QFPNWSSTG file system as follows:

- Backup to a save file in parallel using compression: 105.4 GB/hr
- Restore from a save file in parallel using compression: 173.8 GB/hr

Conclusions

The following conclusions were drawn from these results:

- Backing up and restoring storage spaces in parallel substantially improves throughput compared with a serial save and, therefore, reduces the overall save time.
- If possible, always back up and restore storage spaces in parallel.

7.9.3.4 Copying a storage space (Model 270)

A copy of one storage space to another was performed using the CRTNWSSTG command (restore is not applicable). Not using compression resulted in a performance of 37.0 GB/hr (compression not applicable).

Conclusions

The following conclusions were drawn from this result:

- While it is not as fast as backup to a save file, copying a storage space is still relatively fast.
- The performance of this operation, compared with the Model 720, is approximately three times faster.

7.9.3.5 Backup to and restore from a save file (Model 720)

Backup to and restore from a save file were performed using the SAV and RST commands through the QFPNWSSTG file system as follows:

- Backup to a save file
  - Not using compression: 23.0 GB/hr
  - Using compression: 30.0 GB/hr
- Restore from a save file
  - Not using compression: 22.0 GB/hr
  - Using compression: 30.0 GB/hr

Conclusions

The following conclusions were drawn from these results:

- Save and restore performance is virtually identical for save files on a Model 720.
- Compressing the storage space not only results in a disk storage saving, but also improves the performance of the backup and restore.

7.9.3.6 Backup to and restore from a save file in parallel (Model 720)

Backup to and restore from two save files were performed in parallel using the SAV and RST commands through the QFPNWSSTG file system. Backup to a save file in parallel had these results:

- Not using compression: 21.7 GB/hr
- Using compression: 26.1 GB/hr

Conclusions

Backing up storage spaces in parallel degrades throughput compared with a serial save, which increases the overall save time. Therefore, there is no advantage in performing parallel backups over serial backups on a Model 720.

This result is in contrast to the results of this test on the model 270.

7.9.3.7 Copying a storage space (Model 720)

A copy of one storage space to another was performed using the CRTNWSSTG command as follows (restore is not applicable). Not using compression resulted in a rate of 13.4 GB/hr (compression not applicable).

Conclusions

While it is not as fast as a backup to a save file, copying a storage space is still relatively fast.

7.9.4 OS/400 file-level backup and restore performance

Using OS/400 file-level backup and restore, we ran the following tests.

7.9.4.1 Backup to and restore from tape using SAV/RST (Model 270)

Backup to and restore from tape were performed using the SAV and RST commands through the QNTC system as follows:

- Backup to tape using compression: 2.1 GB/hr
- Restore from tape using compression: 4.9 GB/hr

Conclusions

The following conclusions were drawn from these results:

- Performing a file-level restore is at least twice as fast as a file-level save.
- This save rate compares with a maximum rated save rate of approximately 4.5 GB/hr when using a high speed tape drive (3590).

7.9.4.2 Backup to and restore from a save file serially (Model 270)

Backup to and restore from a save file were performed using the SAV and RST commands through the QNTC file system as follows:

- Backup to a save file using compression: 2.2 GB/hr
- Restore from a save file using compression: 7.0 GB/hr

Conclusions

The following conclusions were drawn from these results:

- The data rates for serial file-level backup and restore are not substantially improved by saving to disk.

- These results are not substantially better than the save and restore rates for tape. This means that most of the time is spent retrieving the data from the server and little time was spent actually saving it.

7.9.4.3 Backup to and restore from a save file in parallel (Model 270)

Backup to and restore from two save files were performed in parallel using the SAV and RST commands through the QNTC file system as follows:

- Backup to a save file in parallel using compression: 5.2 GB/hr
- Restore from a save file in parallel using compression: 10.9 GB/hr

Conclusions

The following conclusions were drawn from these results:

- Backing up and restoring files to save files in parallel substantially improves throughput compared with a serial save, thereby reducing the overall save time. In fact, over twice the serial save rate was achieved, which is an anomalous result. However, the results were consistent over several tests.
- Instead of issuing a single SAV command over multiple shares, issue multiple SAV commands in parallel. This should greatly improve the save (and restore) rate.

7.9.4.4 Backup to tape using TSM V3.1.2

For reference, the maximum rated save rate using Tivoli Storage Manager (TSM) V3.1.2 is approximately 12 GB/hr.

Conclusions

This backup was performed using a high speed tape drive (3590) over a high speed LAN. Therefore, the save rate should be regarded as a maximum for this product.

7.9.5 Windows file-level backup and restore performance

If you use a Windows backup application and save to an iSeries tape drive, you could expect to see the following results.

7.9.5.1 Backup to and restore from tape

If you use a 3590 tape drive and Computer Associates Arcserve, you should achieve a save rate of approximately 5.5 GB/hr.

Conclusions

Save rates of up to 6 GB/hr can be achieved, depending on the file size and tape drive type.

7.9.5.2 Backup to and restore from local disk (Model 270)

Backup to and restore from another disk drive on the same Windows 2000 server were performed using the Windows Backup program as follows:

- Backup to a file on disk. Normal save: 30.5 GB/hr
- Restore from a file on disk. Normal restore: 30.5 GB/hr

Conclusions

The following conclusions were drawn from these results:

- File-level backup and restore direct to disk are fast.
- The disk to which the files are saved could be, in turn, backed up to an iSeries tape drive at either a file or storage space level, or left in place to provide a very fast file-level restore capability.

7.9.5.3 Backup to and restore from network drive (Model 270)

Backup to and restore from disk were performed using the Windows Backup program to a network drive on another Windows 2000 server across the network as follows:

- Backup to a network drive. Normal save: 5.8 GB/hr
- Restore from a network drive. Normal restore: 6.0 GB/hr

Conclusions

It is realistic to back up a Windows 2000 server to a network drive. You could use this technique to back up Windows servers to a central iSeries server and then save to tape using a high speed iSeries tape drive. Notice that the save rate highly depends on the speed of the network. Therefore, use a dedicated, high speed LAN if possible.

7.9.6 Final conclusions

The final conclusions are:

- The faster the tape drive is, the faster the backup is. A high speed tape drive, such as the 3590, gives substantially higher save rates than QIC drives, for example.
- Backing up to save files on disk is always faster than to tape, depending on the type of backup. Storage space backups are extremely fast to disk, where file-level saves are only marginally faster.
- Saving to disk as part of a staged backup strategy should be considered as an attractive option, especially when backup windows are small and as the cost of disk storage comes down.
- When you use a Windows backup application to save to a network drive, you can substantially increase the save rate by using a dedicated, high speed LAN.

7.10 Backup technique positioning and recommendations

When selecting a backup technique, you first need to decide whether you want to back up from the iSeries side, Windows 2000 side, or a combination of both. Each technique has its own strengths and limitations. If you come from a Windows background, you may gravitate towards a Windows-centric backup strategy. However, you should consider performing disaster recovery backups from the iSeries side, even if you choose to save at a file level from the Windows side. There is no real equivalent to an iSeries disaster recovery backup on the Windows side.

Table 15 provides a high level positioning guide for each of the tape backup techniques described in this chapter. Each backup technique is rated as High, Medium, or Low against each positioning attribute.

Table 15. Positioning tape backup techniques

Tape backup technique	Performance	Function	Cost
iSeries disaster recovery backup	H	H	L (free)
OS/400 file-level backup using QNTC	L to M	H	L (free)
OS/400 file-level backup using TSM	H	H	H
Windows 2000 Backup program	L to M	M	L (free)
Other Windows 2000 tested backup applications	L to M	H	M

To be fully protected against data loss, you need to perform backups at both a disaster recovery and file level. Disaster recovery backup protects you against a complete loss of the system, where file-level backup enables you to recover individual files. Therefore, you need to perform the following backups to be protected against all possibilities:

- **Complete disaster recovery backup**: This is a backup of all Windows drives (storage spaces) on a regular basis, for example, once per week. The only way you can perform a true disaster recovery backup is from the iSeries side. Such a backup can easily be incorporated into an iSeries backup plan.
- **Complete file-level backup**: This is a backup of all Windows data files on a regular basis, such as once per week. You can perform this type of backup from either the iSeries or Windows side. Be aware, however, that the performance of file-level backup from the iSeries side is not as good as from the Windows side. Therefore, if you decide to perform a complete file-level backup from the iSeries side, make sure that your backup window is large enough to accommodate such a save.
- **Incremental or differential file-level backups**: This is a backup of files that have changed since the last backup, on a frequent basis, such as daily. You can perform this type of backup from either the iSeries or Windows side. Because you are only backing up a relatively small proportion of your Windows files, you should be able to perform such a save equally well from either the iSeries or Windows side.

7.10.1 Recommended backup schedule

As part of your backup strategy, you should have a backup schedule. Such a schedule tells you when to back the various components of the Windows 2000 on the Integrated xSeries Server environment.

To minimize recovery times, the more volatile the data is (that is, the more often it changes), the more regularly it should be backed up.

We recommend that you back up the Windows 2000 server at both a disaster recovery and file level. This allows you to be protected against loss of the iSeries or loss of an individual file. Disaster recovery backup in the context of these recommendations is performed on the iSeries server, where file-level backup can be performed on either the iSeries or Windows 2000 server. If you have not done

so already, read the following sections before you try to create your own backup schedule:

- Section 7.3, “Disaster recovery backup from the iSeries side” on page 167
- Section 7.4, “File-level backup from the iSeries side” on page 174
- Section 7.7, “Backup and restore from the Windows 2000 side” on page 196

We recommend that you back up the Windows 2000 registry regularly because it contains information critical to the operation of the system. To back it up, the tape drive must be connected to the Windows 2000 system whose registry you want to save.

Table 16 summarizes the recommended backup schedule for components of the Windows 2000 on Integrated xSeries Server environment. You can use this table as a guide to create your own backup schedule.

Table 16. Recommended backup schedule

Time frame	**Disaster recovery backup**			**File-level backup**	
	Non-Windows 2000 objects [1]	**Windows 2000 C: and D: drives**	**Windows 2000 application program drives** [2]	**Windows 2000 volatile data** [3] **(user data)**	**Windows 2000 non-volatile data** [3]
Daily		C:		X [8]	
Weekly				X [9]	X
After installation	X	C: and D:			
After installing integration service packs	X	C: and D:			
After making changes to OS/400 configuration objects [4]	X				
After making changes to the Windows 2000 operating system [5]		C:			
After installing a new Windows 2000 application [6]		C:	C: [7]		

Time frame	Disaster recovery backup			File-level backup	
	Non-Windows 2000 objects [1]	**Windows 2000 C: and D: drives**	**Windows 2000 application program drives [2]**	**Windows 2000 volatile data [3] (user data)**	**Windows 2000 non-volatile data [3]**

1. *Non-Windows 2000 objects* include network server and line descriptions, server message queue, QNTAP library, and NTAP directory.
2. *Windows 2000 application program drives* includes all Windows 2000 drives where user applications are installed.
3. *Windows 2000 volatile data* is data that is changing on a daily basis as opposed to *Windows 2000 non-volatile data*, which refers to Windows 2000 files that change infrequently. Volatile and non-volatile data usually refer to data files (also called *user data*). Volatile data includes the Windows 2000 registry.
4. *OS/400 configuration objects* include network server and line descriptions.
5. *Changes to the Windows 2000 operating system* include any changes to the Windows 2000 system drive or registry, such as adding a new user account.
6. *Installing a new Windows 2000 application* may update the registry and create files on the system (C:) drive.
7. After you install a new application or apply patches, you need to save the system (C:) drive plus any other drives containing Windows 2000 applications. It is always a good idea to install applications and store data on different drives.
8. You need to perform a daily incremental or differential backup to save files that changed since the last (weekly) full file-level backup. Refer to 7.4.3, “Incremental versus differential backups” on page 177.
9. You need to perform a full file-level backup, for example, on a weekly basis.

Chapter 8. Updating the integration software

It is important to maintain the software environment of any system. Windows 2000 running on the Integrated xSeries Server is no different. Code updates for this environment are available from two sources: IBM for the OS/400 Integration for Windows Server code and Microsoft for Windows 2000.

Code updates supplied from IBM for Integration for Windows Server can take the following forms:

- **OS/400 PTF**: This type of code update is what would normally be installed on OS/400 and would update code that executes on the iSeries server.
- **Integration for Windows Server code updates**: This type of code update changes the components of the IBM integration code that execute on the Windows 2000 server. These updates take the form of service packs, much like the service packs issued for Client Access. They are cumulative and include all the fixes from previous service packs. These service packs are loaded on the iSeries server as a PTF and are installed on one or all Integrated xSeries Servers. When the fixes are loaded as PTFs, you must take additional steps to install them on the Windows server running on the Integrated xSeries Server. The steps to install the service packs are described later in this chapter.

Microsoft supplies service packs for Windows 2000, which can update any number of components in Windows 2000, including such items as the user interface, security, and system applets. More information on how to obtain a Windows 2000 service pack can be found on the Microsoft home page at:
`http://www.microsoft.com`

8.1 OS/400 Integration for Windows Server Service Packs

Note

If you are installing Windows 2000 on an Integrated xSeries Server for the first time, it is important to obtain the latest OS/400 Integration for Windows Server Service Pack and install it on your iSeries server *before* you install Windows 2000.

IBM-supplied updates to the software on the Integrated xSeries Server (service packs) are available in the form of a PTF only. They cannot be downloaded from the Internet. On the iSeries server, there are several methods available to transfer the code from the OS/400 side to the Windows 2000 side, including Level Check (LVLCHECK), Level Synchronization (LVLSYNC), and QVNASMON.

When you order a service pack PTF through Electronic Customer Support (ECS), a check is made of the PTFs that are currently installed on the iSeries server. This ensures that all required prerequisites are also ordered or available on the system. Once it is installed, a service pack PTF is available to all Integrated xSeries Servers running the Windows 2000 server.

The Web site at `http://www.as400.ibm.com/windowsintegration/ntsp.htm` allows you to determine the latest service pack that is available for your release of OS/400.

8.2 Managing integration service packs

AS/400 NetServer

Before you can apply an OS/400 Integration for Windows Server service pack, you need to set up AS/400 NetServer.

To set up the minimum AS/400 NetServer configuration required to download integration service packs to the Windows 2000 server, refer to 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358.

Service packs that update the IBM-specific files on the Windows 2000 server can be obtained as a single PTF to be installed on the iSeries server. After the PTF is loaded and applied, the code resides in the integrated file system on the iSeries server in the /QIBM/ProdData/NTAP/Service/Image directory.

Several applications are available to manage the downloading of service packs between the iSeries and Windows 2000 servers, using both interactive and batch interfaces. The following applications are supplied:

- **Level Check**: Has an interactive interface (refer to 8.3, “Managing integration service packs interactively”)
- **LVLSYNC**: Has a batch interface (refer to 8.4.1, “LVLSYNC application” on page 224)

During the installation of an OS/400 Integration for Windows Server Service Pack, additional resources are needed. Before you install the service pack, make sure that you have a free drive letter available on the Windows 2000 server. The installation process maps a drive letter to an AS/400 NetServer share set up on the iSeries server. It uses this share to access code on the iSeries server that was installed by the PTF. If all of the 16 drive letters are used by the Windows 2000 server, Level Check fails.

Note: To install updates onto a Windows server running on an Integrated xSeries Server, you must have administrator authority when you sign on to the Windows server.

8.3 Managing integration service packs interactively

To manage integration service packs interactively, the Level Check application is supplied. Level Check is a GUI application that runs on Windows 2000 and is designed to maintain code level synchronization between the iSeries and the integration code running on the Integrated xSeries Server. Its functions include applying and removing OS/400 Integration for Windows Server Service Packs and managing release levels of the integration code running on the Integrated xSeries Server.

8.3.1 Checking the service pack level

When you assess how current your OS/400 Integration for Windows Server service pack is, you must determine which service pack is installed on the Windows 2000 server. You can do this by using the Level Check application.

From the Windows 2000 console, click **Start->Programs->AS400 Windows Server->Level Check**. The *iSeries* box shows the integration service pack that is available for installation from the iSeries server. The *OS/400 Windows Server* box indicates the service pack that is currently installed on the Windows 2000 server.

8.3.2 Installing a service pack

Important

The Windows 2000 server running on the Integrated xSeries Server automatically restarts after the service pack is installed on the server. *Do not* proceed if you are not prepared to restart Windows 2000 (the iSeries does not IPL). The Windows 2000 server restarts and disconnects all users connected to the server, including those connected to the iSeries through the Integrated xSeries Server LAN adapters (if an external host LAN is set up).

After a service pack in the form of a PTF is loaded and applied on the iSeries, you can use Level Check to install this code on the Windows 2000 server.

Follow these steps to install a service pack:

1. Log on to the Windows 2000 console as a user with administrative authority. After a few seconds, Level Check automatically detects whether the service pack level on the iSeries matches the service pack level of the Windows server. If they do not match, the OS/400 Level Check dialog appears. If Level Check does not start automatically, either no service pack is installed, or AS/400 NetServer is not set up correctly.

   To start Level Check manually, click **Start->Programs->AS400 Windows Server->Level Check**.

   If the service pack available on the iSeries appears as SF0000, it is likely that AS/400 NetServer is not set up correctly. In this case, you need to review Chapter 14, “AS/400 NetServer” on page 345, and especially 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358. You should also check the Web site `http://www.as400.ibm.com/windowsintegration/ntsp.htm` for the latest integration service pack and ensure that the corresponding PTF is loaded and applied on your iSeries server.

   If there is an integration service pack available for installation, you should see a window similar to the example in Figure 90 on page 222.

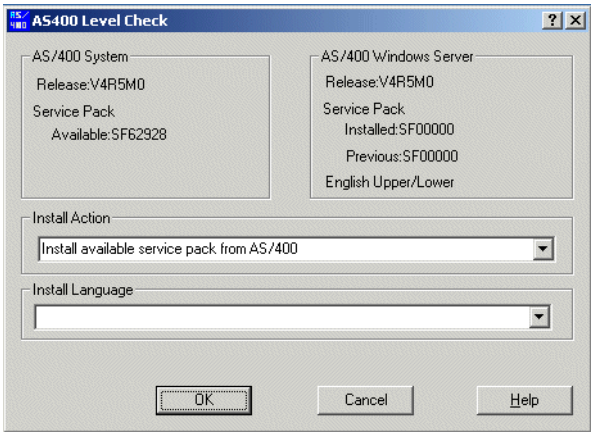

Figure 90. Installing an integration service pack

2. Let's assume that a service pack is available that is at a later level than the one that is currently installed. Select **Install available service pack from OS/400** from the drop-down menu in the Install Action box, if it is not already selected. Click **OK**.
3. The setup wizard starts. Click **Next** and **Next** again. Click **Next** to review the README file, and close it.
4. Click **Next**. Then, either leave the **Select to enable the uninstall option** selected or clear it. If this box is selected, the files that are replaced by installing the service pack are stored on the Windows 2000 system drive. In this case, the service pack can be uninstalled, and the old files are reinstated if there is a problem with the service pack. We recommend that you leave this option selected unless you have very little disk space on the Windows 2000 system drive. Click **Next**.
5. If you want to proceed, leave the **Select NEXT to start the installation** radio button selected, and click **Next**. If you want to cancel the service pack installation, click **Cancel**.
6. When the service pack has been installed, the Installation is complete window is displayed. Click **Finish** to reboot the server.

8.3.3 Removing a service pack

The Level Check program also gives you the option to remove a service pack. However, you can only go back one service pack level. After you remove a service pack, you are unable to select the remove option until another service pack is installed on the Windows server.

Important

The Windows 2000 server running on the Integrated xSeries Server automatically restarts after the service pack is removed from the server. *Do not* proceed if you are not prepared to restart Windows 2000 (the iSeries does not IPL). The Windows 2000 server restarts and disconnects all users connected to the server, including those that are connected to the iSeries through the Integrated xSeries Server LAN adapters (if an external host LAN is set up).

1. Log on to the Windows 2000 console as a user with administrative authority. Start Level Check by clicking **Start->Programs->AS400 Windows Server-> Level Check**.
2. Select **Uninstall current service pack on Windows Server** from the drop-down menu in the Install Action box. Click **OK**.

   You should see a window similar to the example in Figure 91.

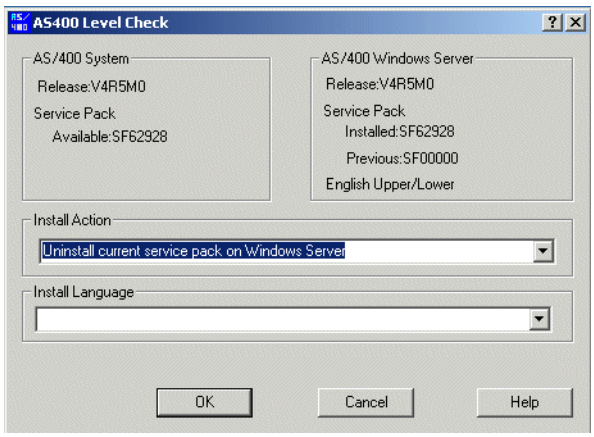

Figure 91. Uninstalling an integration service pack

3. The uninstall wizard starts. Click **Next**.
4. If you want to proceed, leave the **Select NEXT to start the uninstallation** radio button selected, and click **Next**. If you want to cancel the service pack installation, click **Cancel**.
5. When the service pack is removed, the Uninstallation is complete window is displayed. Click **Finish** to reboot the server.

Note

If you are removing a service pack, you must remove the corresponding PTF as well. If you leave the PTF installed on the iSeries server, the next time a user with administrative authority logs on to the Windows server console, they are prompted to re-install the service pack.

An alternative way to remove the service pack is with the Add/Remove Programs applet located in Windows Control Panel. The service pack shows up as an installed program and can be uninstalled from there.

8.3.4 Installing a new release of the integration code

The Level Check *Install release from OS/400* option re-installs the integration code from the iSeries to Windows 2000. This function is intended to upgrade your release level of 5769-WSV Integration for Windows Server software on the Windows server after it is upgraded to a later release on the iSeries. Normally, the integration code is automatically updated when you install a new release of OS/400 and licensed program products. However, there are circumstances when the release levels of OS/400 and the integration code may become out of sync. The Install release from OS/400 option can also be used if you want to revert back more than a single service pack level.

For example, if you upgrade the release level of the OS/400 operating system and the program products, but then restore a backup of your Windows 2000 environment from a previous operating system release, the release levels of the integration code and the operating system will be out of synchronization. Because service packs are release specific, service packs for the new release will not apply until the integration code is upgraded to the later release. You can re-synchronize the code level of the integration code with the OS/400 operating system by using the Install release from OS/400 option.

Another possible use of the Install release from OS/400 option is to change the language version of the integration code. During the initial installation (INSWNTSVR), you must specify a language version. If you want to change this after the initial installation, run Level Check, and choose the Install release from OS/400 option. You are prompted for a language version.

8.4 Managing integration service packs in batch

When managing a large number of Windows servers running on Integrated xSeries Servers, using the interactive interface may not be the most efficient method to manage the servers. To this end, batch interfaces are available, which provide the same functionality as the interactive Level Check application.

8.4.1 LVLSYNC application

LVLSYNC is a character-based interface that provides similar functions to Level Check, but can be run without user intervention. It can be run from a command prompt, a batch file, or from the Submit NWS Command (SBMNWSCMD) command. It has the same functionality as Level Check, including the following functions:

- Install OS/400 integration service packs
- Uninstall OS/400 integration service packs
- Install a new release of the integration code

The command syntax is as follows:

`lvlsync /?` Displays the LVLSYNC command options

`lvlsync /servpack install`
Installs an integration service pack on the Windows 2000 server

`lvlsync /servpack uninstall`
Uninstalls the latest integration service pack from the Windows 2000 server

`lvlsync /release` Upgrades the Integration for Windows Server code on the Windows 2000 server to a new OS/400 release level or reinstalls it

`lvlsync /release /language MRI29xx`
Reinstalls the Integration for Windows Server code on the Windows 2000 server the using language MRI29xx (for example, MRI2924 = US English)

If you want to initiate the command from the iSeries server, you can do this by using the SBMNWSCMD command. This command can run batch commands on

the selected network server. For example, to install an integration service pack on a server called WIN400, you could use the following command:

```
SBMNWSCMD CMD('lvlsync /servpack install') SVRTYPE(*WINDOWSNT) SERVER(WIN400)
```

The error codes that can result from executing LVLSYNC are listed in Table 17.

Table 17. LVLSYNC error codes

Error code	Error
0	No errors
01	Must be an administrator to run lvlsync
02	Release level on Windows Server higher than on OS/400
03	Service pack level on Windows Server higher than on OS/400
04	Cannot install release from OS/400 - language files not on OS/400
05	Syntax not valid
06	Cannot access service pack information on OS/400
07	Cannot map network drive
08	Cannot access service pack information in registry
09	Cannot open qvnacfg.txt file
10	No service pack installed on OS/400
11	NWSD not found
13	NWSD not active
20	No service pack available on OS/400
21	Cannot start Install Shield application
31	Unexpected error invoking lvlsync
44	Unexpected error during lvlsync

8.5 Windows 2000 service packs

Microsoft-supplied service packs update the level of code on the Windows 2000 server. They are available from Microsoft on CD or via the Internet.

Microsoft service pack considerations

It is important for you to verify that the Microsoft service pack you want to install is supported for installation on the Windows 2000 server that is running on the Integrated xSeries Server before you install it.

The Web site `http://www.as400.ibm.com/windowsintegration/ntmssp.htm` provides information on supported Windows 2000 service packs.

We recommend that you apply the latest Microsoft Windows 2000 service pack that is supported on the Integrated xSeries Server.

To determine the current level of the Microsoft service pack, start Windows Explorer. Click **Help** and then **About Windows**.

8.5.1 Applying a Microsoft service pack

To install a Microsoft service pack, complete the following tasks:

1. Download service pack 1 (approximately 62 MB) from the Microsoft Web site at:
   `http://www.microsoft.com/windows2000/downloads/recommended/sp1/default.asp`
2. Click **Start->Run**. In the Open: field, type the name and location of the file that was downloaded. This automatically extracts the files and starts the service pack installation.
3. Follow the steps as shown in the dialog boxes. When the installation procedure has finished installing, the Windows server is restarted.

To apply a Microsoft service pack from CD-ROM, complete the following tasks:

1. Place the Microsoft service pack CD-ROM into the OS/400 CD-ROM drive.
2. The installation is started automatically if you have a Web browser installed. Read the information. Then click the **Install Service Pack** URL to start the install. If you do not have a browser installed or it did not start automatically, execute the SPSETUP.BAT file in the root directory of the CD-ROM.
3. Follow the steps in the dialog box that is shown. When the installation procedure finishes installing, the Windows server restarts.

Chapter 9. Integrated xSeries Server problem determination

This chapter contains information about problem determination of problems that are encountered between the Windows 2000 server and the Integrated xSeries Server. It offers you starting points on the iSeries and Windows 2000 servers to help you solve possible problems.

9.1 General problem determination

If your Windows 2000 server is not functioning properly, try these steps to attempt to correct the problem:

1. Shut down and restart the Windows 2000 server from the Server console.
2. If step 1 doesn't work, vary off the network server description for your Windows 2000 server.
3. Check the status of the network server description and its associated lines, controllers, devices, and TCP/IP interfaces when the status is VARIED OFF.
4. If the problem persists, look for helpful information in the message queues and job logs.
5. Check for helpful information on the Windows 2000 server Integration Web site at: `http://www.iseries.ibm.com/windowsintegration/index.htm`
6. If you need information about collection service data to send to support personnel, see 9.4, "Collection service data for the Windows 2000 server" on page 241.

9.1.1 Message logging

The Windows 2000 server on an Integrated xSeries Server logs information in different places. If there is a problem, this information may help determine the cause. The following sections describe the message logs.

9.1.1.1 OS/400 messages

The monitor job log is a key source of information when troubleshooting all Integrated xSeries Server problems. It contains messages that vary from normal processing events to detailed error messages. The monitor job always runs in the QSYSWRK subsystem with the same name as the network server. To find the job log, use the Work with Active Job (`WRKACTJOB`) command, and find the job in the QSYSWRK subsystem with the same name as your network server.

Follow these steps:

1. On an OS/400 command line, type:

   ```
   WRKACTJOB SBS(QSYSWRK)
   ```

   Press Enter.
2. Look for the job that has a similar name to Network Server.
3. Select option `5` (Work with job).
4. Type `10`, and press Enter to display the job log.
5. Press F10 to see the detailed messages.

If you find useful information in the log, write down the job ID (all three parts: name, user, and number).

Then print the log using the following command:

```
DSPJOBLOG JOB(number/user/name) OUTPUT(*PRINT)
```

This is only useful if your monitor job is still active. If the problem caused your monitor job to end, or if you are debugging a problem that happened prior to the present monitor job, search for a spooled file that contains information in the previous job log. To find spooled files associated with your network server, use the following command:

```
WRKSPLF SELECT(QSYS *ALL *ALL Network_Server_name)
```

9.1.1.2 QVNAVARY job log

The QVNAVARY job log contains messages that pertain to the vary on and vary off of the network server description. Errors pertaining to the shutdown process are also in this job log. To view this log, use the `WRKACTJOB` command, and find the QVNAVARY job in the QSYSWRK subsystem. Type `5` next to the job, and select option `10` to display the job log.

9.1.1.3 Server message queue

If you specified a message queue for your network server, there are messages that pertain to this server in that message queue. To determine if a server message queue was specified, enter the command:

```
DSPNWSD NWSD(networkserver_name)
```

If it is set to *NONE, only serious server-related messages are sent to the QSYSOPR message queue. If a message queue is specified, use the following command to display the messages:

```
DSPMSG MSGQ(library/queue)
```

Use the `OUTPUT(*print)` option on this command to print it.

9.1.1.4 QSYSOPR message queue

The system operator message queue is a common place to look for problems in all areas of the iSeries server. The Integrated xSeries Server updates the QSYSOPR message queue with normal startup and shutdown messages, in addition to failure messages. To display this message queue, enter the command:

```
DSPMSG QSYSOPR
```

These messages may point you to the cause of the problem.

9.1.2 Product Activity Log

The Product Activity Log is part of the System Service Tools that logs hardware and communication error messages on the iSeries. If you receive a blue-screen error from the Windows 2000 server, this creates an entry in the Product Activity Log. A user profile with *SERVICE special authority is needed to start the System Service Tools (STRSST) and view the log.

To view the Product Activity Log, complete the following steps:

1. Enter `STRSST` from an OS/400 command line.
2. Select option `1` (Start a service tool).
3. Select option `1` (Product activity log).

4. Select option `1` (Analyze log).
5. Change the Log value to a `5` (Communications).

   Adjust the From and To dates and times so that they cover the proximity of when the error happened.
6. Press Enter.
7. Set the Report type to `1`, and press Enter to accept the default values for the rest of the options on this display.

You are now at the Log Analysis Report display. If you see an entry for your Integrated xSeries Server resource, use option `5` to display the report. Depending on the message, you may want to use option `6` to print it.

9.1.3 Windows 2000 server Event Viewer

The Event Viewer is an administrative tool that is shipped with the Windows 2000 server. This tool displays error messages encountered by the Windows 2000 server. Conflicts or problems with devices are logged in the system log. The application log contains messages that are associated with the OS/400 integration code that is installed on the Windows 2000 server.

9.1.4 Checking user enrollment services

Use the following methods to determine problems associated with user enrollment.

9.1.4.1 Windows 2000 server

User enrollment uses one Windows 2000 server service to accomplish this task. If there is a problem with enrollment, investigate OS/400 User Management as shown in Figure 92.

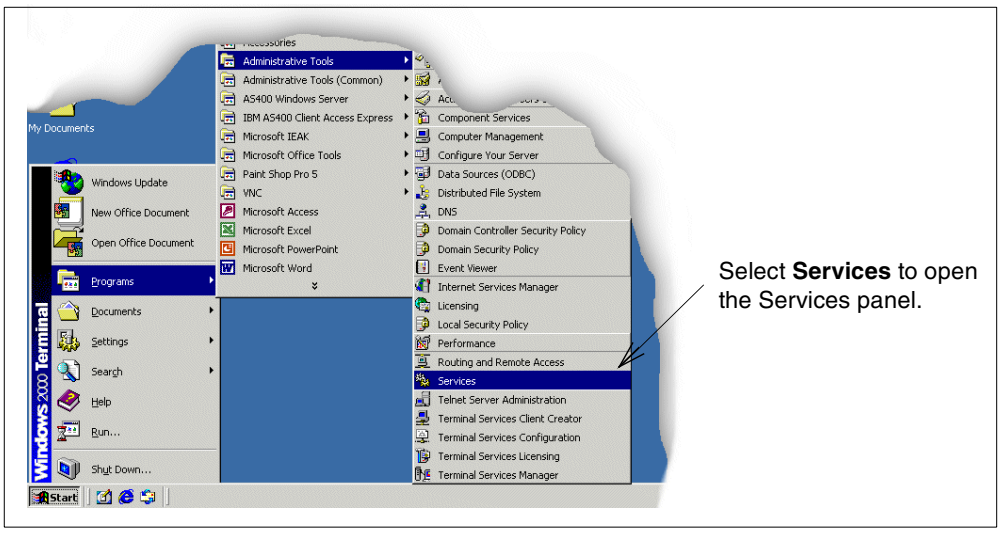

Figure 92. Opening the Services panel

Once the Services window is opened, the OS/400 User Administration service should be listed as shown in Figure 93 on page 230.

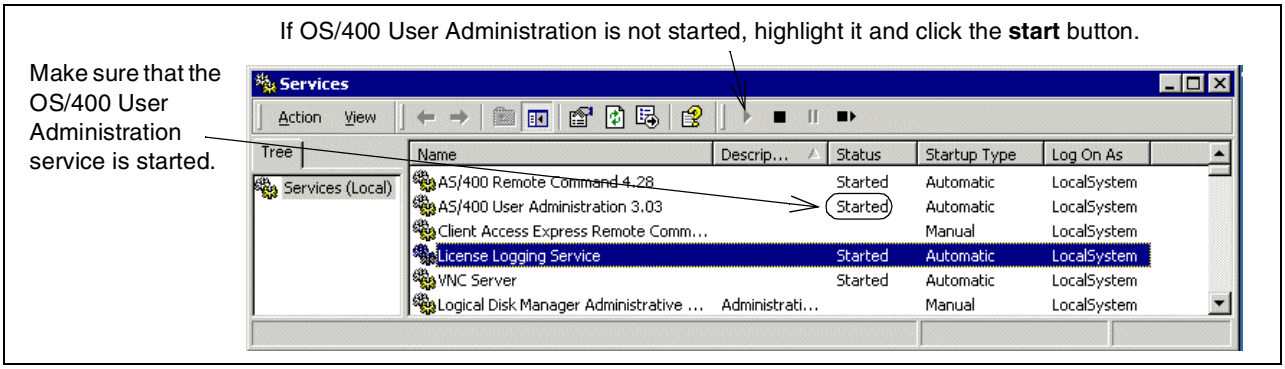

Figure 93. OS/400 User Administration service

If OS/400 User Administration is not listed, complete the following steps to reinstall it:

1. Open a command prompt window.
2. Change to the directory where the integration programs are installed. That is usually c:\winnt\as400wsv\admin.
3. Type: `qvnadaem /install`

   Press Enter.
4. Close the Services window.
5. Reopen the Services window.
6. If you have not started OS/400 User Administration, click **Start**.

9.1.4.2 Checking the internal LAN

Another place to check is the Application Event Log. When the User Administration Service successfully connects to the iSeries server, it logs an event with Event ID 32 `'Successful connection made.'`. If it fails to connect, one Event ID 33 `'Failed to connect.'` is logged. You see Event ID 33 test message if the internal LAN is working. To check the internal LAN, follow these steps:

1. Obtain the IP address from the OS/400 internal LAN interface.
2. Obtain the IP address from the Windows 2000 server internal LAN interface.
3. On the Windows 2000 server, open a command prompt, and enter the following command:

   ```
   ping OS/400 internal LAN IP address
   ```

   If you see the message `Request timed out.`, you cannot connect to the OS/400 internal LAN interface.
4. On an OS/400 command prompt, enter the command:

   ```
   PING RMTSYS('Windows 2000 server internal LAN IP address')
   ```

   If you see the message `No response from host within.....`, you cannot connect to the Windows 2000 server internal LAN interface.

If the internal LAN is not working, verify the IP addresses for the internal LAN, and verify that the interfaces are enabled and started. Vary off the network server description and then vary it on again. If this still does not help, call your next level

of support, or visit the OS/400 Software Knowledge Base at:
`http://www.as400service.ibm.com`

9.1.4.3 From the iSeries server

From the iSeries server, follow these steps:

1. Check the job log for messages.
2. If the job log has User Admin error NTA0282, see 9.1.5, “Problems with user enrollment authorization” on page 231.
3. Check the QSYSOPR message queue for messages.
4. On a command line, type:

   `WRKCFGSTS *NWS`

   Press Enter to make sure that the status of the server is VARIED ON.
5. On a command line, type:

   `WRKNWSENR`

   Press Enter to check enrollment status using the following command, and look for error messages. Press F5 to refresh the status:
6. Type:

   `WRKSYSVAL QRETSVRSEC`

   Press Enter to verify that OS/400 is set to keep passwords. Review the QRETSVRSEC system value, and verify that it is set to 1. Also verify that users who are trying to enroll are signed on to the iSeries server after this value is set.
7. Check the message queue specified in your network server description for messages.
8. On the iSeries server, type:

   `WRKACTJOB`
9. Press Enter. Page down to the QSYSWRK subsystem. Type `5` next to the QPRFSYNCH job, and press Enter. Type `10` and press F10 to view the detailed messages.
10. On the iSeries, type:

    `WRKJOB` *`nwsdname`*

    Here, *nwsdname* is the name of the network server description for your Windows 2000 server. If the job is active, display the job log. Press F10 for more detail messages. If the job is ended, display the spooled file.

9.1.5 Problems with user enrollment authorization

If you see an error (NTA0282) that indicates insufficient authorization to create and update Windows 2000 server users, perform the following actions as appropriate:

- If you are trying to enroll users and groups to a domain for the first time, ensure that you set up a QAS400NT user ID to provide the necessary authorization.
- If you have been successfully enrolling users and groups for awhile, check to see if the OS/400 password for the QAS400NT user has expired. When the

QAS400NT user password expires, the account on the Windows 2000 server also expires. To correct this situation, perform the following steps:

a. Enable the Windows 2000 account.

   On the Windows 2000 server, go to **Active Directory Users and Computers**. Then, follow the steps that are shown in Figure 94.

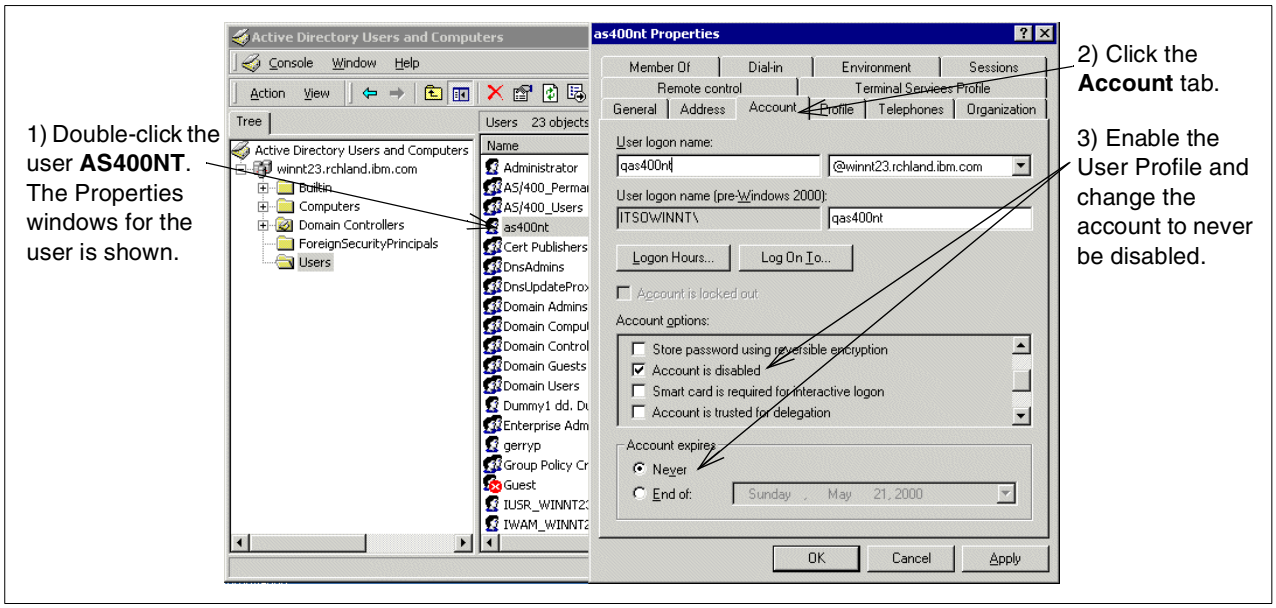

Figure 94. Enable QAS400NT user profile

b. Restart the OS/400 User Administration Service. Follow these steps:

   i. Follow the steps in Figure 92 on page 229.

   ii. Select **OS/400 User Administration**, and then click **Stop** to stop the service.

   iii. Click **Start** to restart the service.

   Restarting the service automatically retries the enrollment of the users and groups.

   To avoid this problem, be sure to change the AS400NT password periodically on your iSeries server to prevent the password from expiring.

c. On the OS/400 command line, enter the Work with NWS User Enrollment (`WRKNWSENR`) command verify that the AS400NT user ID has the status **current*.

d. On the OS/400 display, use the Change User Profile (`CHGUSRPRF`) or Change Password (`CHGPWD`) command to change the AS400NT user password.

e. If you have multiple iSeries servers with multiple Integrated xSeries Servers that participate in a Windows 2000 domain, you can minimize password expiration problems as described in Chapter 6, “User administration” on page 121.

If the problem persists, check the Support Line Knowledge Base on the Web at:
`http://as400service.rochester.ibm.com`

Select **Tech Info and Database**, and then select **Software Knowledge Base**. If you are unable to find a solution here, contact your technical support provider for further assistance.

9.1.6 Password synchronization

If the passwords of a user on the iSeries and Windows 2000 servers do not match, perform the following tasks to determine why:

1. On an OS/400 command line, type:

   `WRKSYSVAL SYSVAL(QSECURITY)`

   Press Enter.

2. Type `5` in the Option field, and press Enter.

3. On an OS/400 command line, type:

   `WRKSYSVAL SYSVAL(QRETSVRSEC)`

   Press Enter.

4. Type `2` in the Option column, and press Enter.

5. Verify that Retain server security data is set to 1. If it is not, change it to `1`. Make sure that all users sign on to the iSeries server after you change this value.

6. On the Windows 2000 server, make sure that the User Administration Service is running (see 9.1.4, “Checking user enrollment services” on page 229).

7. Check the enrollment status of the user. Make sure the user did not already exist on the Windows 2000 server with a different password before you attempted to enroll the user (see Chapter 6, “User administration” on page 121). If the user existed with a different password, enrollment fails. Change the password on the Windows 2000 server to match the iSeries password, and then perform the enrollment procedure again.

8. If the problem persists, check the Support Line Knowledge Base on the Web at: `http://as400service.rochester.ibm.com`

   Click **Tech Info & Databases** and then **Software Knowledge Base**. If you are unable to find a solution here, contact your technical support provider for further assistance.

9.2 Installation problems

If you have problems during installation, perform the following steps:

1. Look at the OS/400 installation job log.

   See Appendix C, “Installation files” on page 459, for an example.

2. To check the network server description, type `WRKNWSD` on a command line and press Enter. Select option `5`. Page through the display and compare it with the example in Figure 95 on page 234.

```
                  Display Network Server Desc  AS27
                                                              04/24/00  15:56:32
Network server description . . . . :   AS4WIN2K
Option . . . . . . . . . . . . . . :   *BASIC
Resource name  . . . . . . . . . . :   LIN07
Network server type  . . . . . . . :   *WINDOWSNT
Online at IPL  . . . . . . . . . . :   *NO
Vary on wait . . . . . . . . . . . :   *NOWAIT
Domain role  . . . . . . . . . . . :   *SERVER
Language version . . . . . . . . . :   2924
Code page  . . . . . . . . . . . . :   850
Server message queue . . . . . . . :   *JOBLOG
  Library  . . . . . . . . . . . . :
Event log  . . . . . . . . . . . . :   *SYS
          *SEC
       *APP
Configuration file . . . . . . . . :   *NONE
  Library  . . . . . . . . . . . . :
Server storage space sizes . . . . :
  Install source size  . . . . . . :     400
  Install source type  . . . . . . :     *NWSSTG
  System size  . . . . . . . . . . :     1024
  System type  . . . . . . . . . . :     *NWSSTG
Server storage space ASP . . . . . :
  Install source ASP . . . . . . . :     1
  System size  . . . . . . . . . . :     1
Synchronize date and time  . . . . :   *YES

Text . . . . . . . . . . . . . . . :   Domain Controller


Network server description . . . . :   AS4WIN2K
Option . . . . . . . . . . . . . . :   *PORTS
Ports  . . . . . . . . . . . . . . :

-----Attached lines------
Port           Attached
number         line
*INTERNAL      AS4WIN2K00

Network server description . . . . :   AS4WIN2K
Option . . . . . . . . . . . . . . :   *STGLNK
Storage space links  . . . . . . . :

----------------------------Storage space links------------------
Network
server
storage        Drive     Text
AS4WIN2K1       3        Windows server AS4WIN2K - System Drive
AS4WIN2K2       4        Windows server AS4WIN2K - Install Drive

Network server description . . . . :   AS4WIN2K
Option . . . . . . . . . . . . . . :   *TCPIP
TCP/IP port configuration  . . . . :
--------------------TCP/IP port configuration---------------------
          Maximum
    Internet           Subnet              transmission
Port address           mask unit
*INTERNAL      192.168.9.6 255.255.255.0 1492

--------------TCP/IP route configuration---------------
Route              Subnet              Next
destination        mask                hop

   (No TCP/IP route configuration found)

Network server description . . . . :   AS4WIN2K
Option . . . . . . . . . . . . . . :   *RSTDEV
Restricted device resources  . . . :
--------------Restricted device resources--------------
*NONE
```

Figure 95. Display Network Server Desc

3. Check the server, network, and line status. Type:

```
WRKCFGSTS *NWS
```

Press Enter. The screen should look similar to the example in Figure 96.

```
Opt  Description       Status      -------------Job-----------
     AS400WNT           ACTIVE
       AS400WNT01       ACTIVE
         AS400NET00     ACTIVE
           AS400WNTCP00 ACTIVE      QTCPIP      QTCP        025
       AS400WNT00       ACTIVE
         AS400NET       ACTIVE
           AS400WNTCP   ACTIVE      QTCPIP      QTCP        025
```

*Figure 96. WRKCFGSTS *NWS display*

4. Check the OS/400 TCP/IP interfaces to verify that Internal LAN interface is active. On a command line, type:

   `NETSTAT *IFC`

   Press Enter. Check for an entry with an address of 192.168.x.y (or the address you specified on the Install Windows Server (INSWNTSVR) command) that is attached to a line with your network server description name ending in 00. See Figure 97.

```
     Internet         Network            Line      Interface
Opt  Address          Address          Description  Status
     127.0.0.1        127.0.0.0        *LOOPBACK    Active
     192.168.3.1      192.168.3.0      AS400WNT00     Active
```

*Figure 97. NETSTAT *IFC display*

5. Check the job logs. Follow these steps:
   a. Type `WRKACTJOB SBS(QSYSWRK)` and press Enter.
   b. Search for a job with the name of the network server description. Type `5` next to the network server description, and press Enter. Select option `10` to view the job log.
   c. On Work with Active Jobs (WRKACTJOB) display, page down further and look for a job called QVNAVARY. Look at the job log.
6. Check the message queue of your server and the QSYSOPR message queue.

If you cannot determine the cause of the installation problem, check the areas covered in 9.3, “Problems starting the network server” on page 236.

9.2.1 Responding to error messages during installation

The Windows 2000 server phase of the installation flags missing information that was not provided during the OS/400 phase of the installation. The following list contains examples of these errors messages and how you should respond to them.

- **Duplicate name on the network**

  If the Integrated xSeries Server has two LAN adapters connected to the same network, the installation program indicates that the computer name already exists on the network. This is a limitation of the Windows 2000 server installation process. To work around this limitation, follow these steps:

a. Disconnect one of the Integrated xSeries Server LAN adapter cables from the network.

b. On the Windows 2000 server console, retype the same computer name.

c. Click **OK** to continue with the installation.

After the installation is complete, you can reconnect the disconnected LAN adapter cable.

- **Error - installing server**

  You may not have specified a value in the To workgroup or To domain parameters of the Install Windows Server display on the iSeries server. If not, you see the error message: `Error - installing server`.

  A setup parameter specified by your system administrator or computer manufacturer is missing or not valid. Therefore, setup asks you to provide this information now.

  After you supply the required information, the unattended setup operation continues. You may want to inform your system administrator or computer manufacturer that the “JoinWorkgroup” value is missing or not valid.

  Click **OK**. The installation program prompts you to make the computer a member of a domain or a workgroup.

9.3 Problems starting the network server

If you are unable to start the Windows 2000 server on an Integrated xSeries Server, there are some things that you need to check. The information may also be requested by software support when troubleshooting the problem.

9.3.1 Network server configuration status

Check the status of the network server description and its associated lines, controllers, and devices. Type:

```
WRKCFGSTS *NWS
```

The display that appears should look similar to the example in Figure 98.

```
Opt  Description       Status      -------------Job-----------
     AS400WNT           ACTIVE
       AS400WNT01       ACTIVE
         AS400NET00     ACTIVE
           AS400WNTCP00 ACTIVE      QTCPIP      QTCP        025
       AS400WNT00       ACTIVE
         AS400NET       ACTIVE
           AS400WNTCP   ACTIVE      QTCPIP      QTCP        025
```

*Figure 98. WRKCFGSTS *NWS display*

Alternatively, if the status of the network server description is not ACTIVE, and there are no messages, vary it off and then vary it back on. If there is a problem varying on the network server description, you should see a message displayed on the status line of your OS/400 session. To display the help text for this message, move the cursor down to the message and press F1. Normally the help

text provides a good indication of the problem. The following list includes common causes of why a network server does not vary on correctly:

- Duplicate IP address.

  The Windows 2000 server and iSeries IP addresses are the same for a single LAN adapter.

- The resource is in use.

  Another network server description is already varied on.

- Incorrect configuration of the port in the network server description.

If your network server description does not become ACTIVE as a result of varying off and then varying back on, check the job log (`DSPJOBLOG`) and QSYSOPR message queue (`DSPMSG QSYSOPR`) for messages.

If you initiated the restart from the Windows 2000 server, perform the following tasks:

1. On an OS/400 command line, type:

   ```
   WRKACTJOB SBS(QSYSWRK)
   ```

2. Press Enter.
3. Locate the job QVNANARY.
4. Type `5` in the Option column to work with the job.
5. If the job is active or on the job queue, type `10` in the Opt column to display the job log. Look for messages and possible corrective action.
6. If the job is ended, enter the Work with Spooled Files command for this job name:

   ```
   WRKSPLF SELECT(*CURRENT *ALL *ALL QVNAVARY)
   ```

7. If the problem is persistent, check the Support Line Knowledge Base Web site at: `http://www.as400service.ibm.com`

   If you are unable to find a solution here, contact your technical support provider for further assistance.

9.3.2 Internal LAN configuration

The protocol on the Internal LAN is TCP/IP. The internal LAN is used for communication between the iSeries and Windows 2000 servers running on the Integrated xSeries Server. Integration functions, such as user enrollment, run over this LAN.

If the Work with Configuration Status (WRKCFGSTS) command reports that your server is still at *Vary on Pending* status and your Windows 2000 server console is up and running, verify that the internal LAN is active.

If the internal LAN TCP/IP addresses of the iSeries and Windows 2000 servers are not correct, the two systems cannot communicate correctly. Perform these steps:

1. The iSeries stores the TCP/IP address of the Windows 2000 server side of the internal LAN in the network server description. It is there for record keeping only. It has no function. Display the network server description of your

Windows 2000 server, and display the TCP/IP Port Information. Notice the address for the *INTERNAL port (192.168.x.y).

2. Check the TCP/IP configuration of the Windows 2000 server by opening **Network and Dial-up Connections**. See Figure 99.

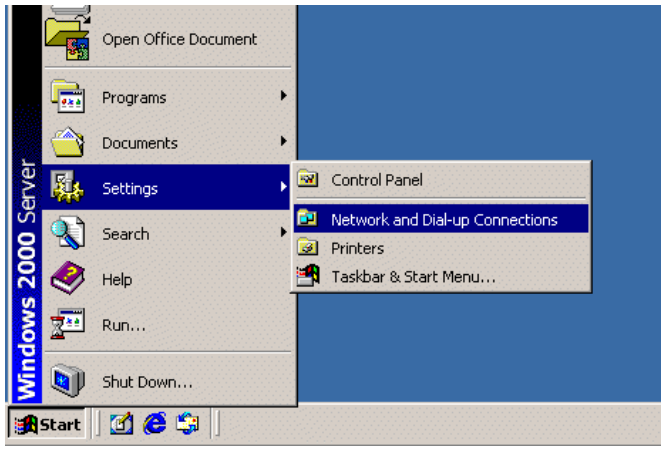

Figure 99. Opening Network and Dial-up Connections

On Network Dial-up Connections, select **Properties**, as shown in Figure 100, to open the properties for the OS/400 Virtual Token Ring Adapter.

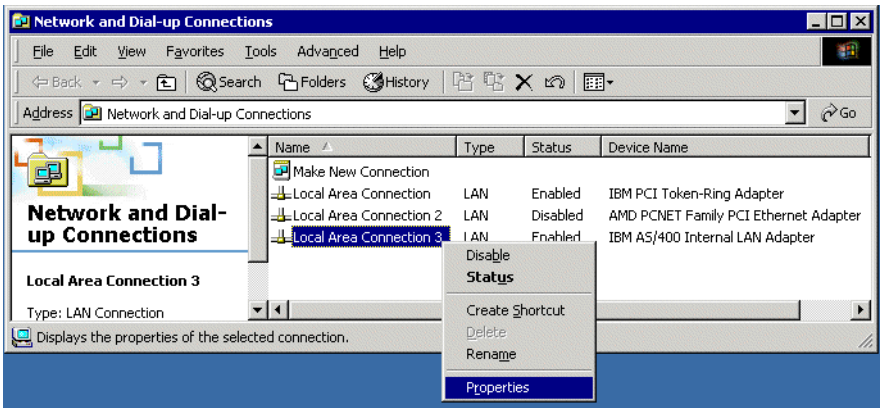

Figure 100. Opening Virtual token-ring adapter properties

When the Local Area Connection Properties display that appears, follow the steps in Figure 101.

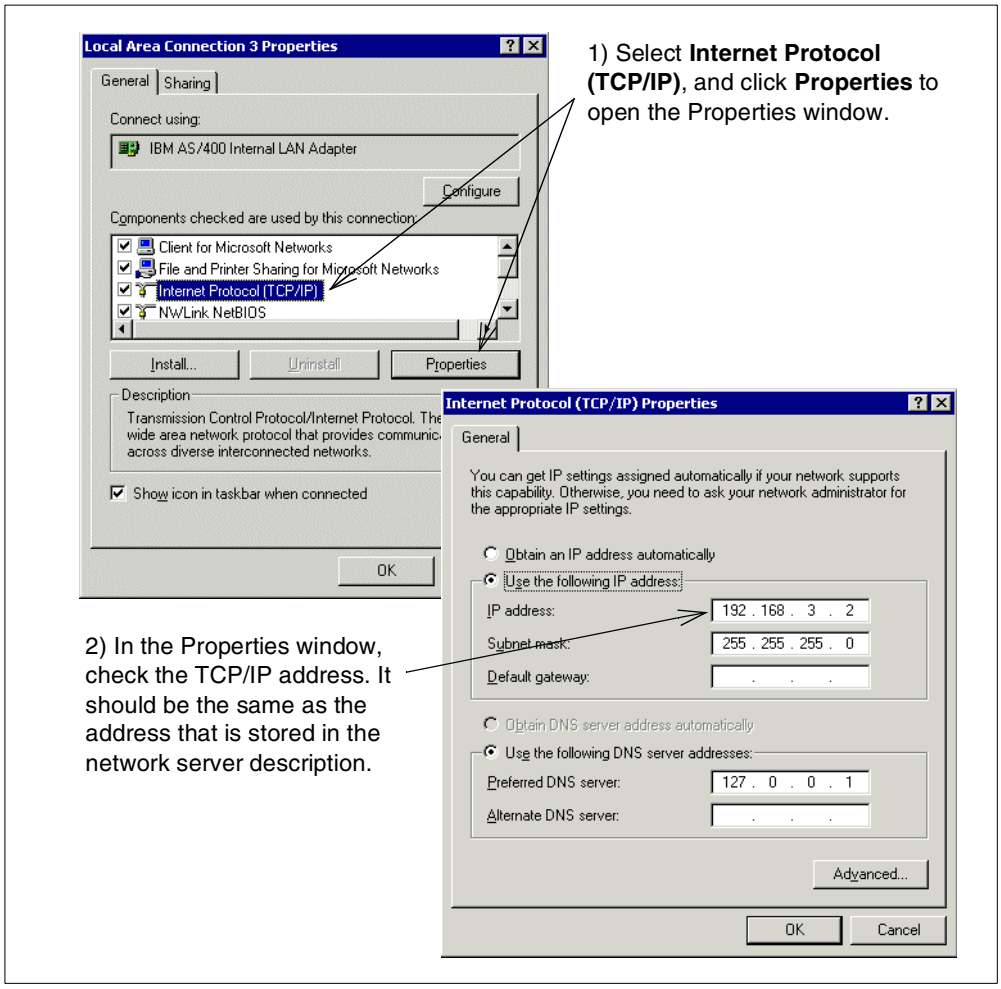

Figure 101. Internal LAN TCP/IP properties

3. Check the OS/400 Internal LAN address, and verify that the TCP/IP interface is active. Type:

   ```
   NETSTAT *IFC
   ```

   Press Enter.

   Notice the following information:

   - The Internal LAN interface is a line with the name of the network server description ending in 00.
   - Notice the address.
   - The internal addresses of the iSeries and Windows 2000 servers, by default, start with 192.168. For example, the OS/400 side may be 192.168.1.1, and the Windows 2000 server may be 192.168.1.2.
   - If the OS/400 interface is not active, select `9` on the NETSTAT display. If the option fails to start the interface, look in the QSYSOPR message queue, the current user job log, and the QTCPIP job log.

If you determine there may be a conflict between the IP addresses used by the internal LAN and IP addresses on the external LAN, refer to Chapter 6, “User

administration” on page 121, to find out how to change the internal LAN IP addresses.

9.3.2.1 Changing the internal LAN IP addresses

OS/400 Integration for Windows Servers uses IP addresses in the range of 192.168.x.y for the virtual internal LAN on the Windows 2000 server on the Integrated xSeries Server. The actual addresses are automatically selected by the Install Windows Server (INSWNTSVR) command. The value for *x* is selected based on the resource number of the Integrated xSeries Server. The INSWNTSVR command looks for a pair of values y and y+1 (starting with y=1) with addresses that are not in use on that iSeries server. The lower number of the pair is used on the OS/400 side of the virtual LAN. The higher number is used on the Windows 2000 server side of the virtual LAN. For example, assume you have a PCI Integrated xSeries Server with a resource name of LIN07. After you run the INSWNTSVR command, you may end up with the following addresses for the virtual LAN:

```
2890 (LIN07)
192.168.7.1 (OS/400 Side)
192.168.7.2 (Windows 2000 server Side)
```

Depending on your network, there can be conflicts with addresses that are already in use. If this happens, these addresses can be changed so that the internal LAN uses addresses on its own subnet on the iSeries server. To make sure it is on its own subnet, use the same value of x for both sides of the virtual LAN, and make sure the value of 192.168.x is unique on your network. For example, the new IP addresses for the Integrated xSeries Server discussed previously may be changed to:

```
2890 (LIN07)
192.168.17.1 (OS/400 Side)
192.168.17.2 (Windows 2000 server Side)
```

To change the virtual LAN IP addresses, perform the following steps:

1. On an OS/400 command line, type:

   ```
   DSPNWSD NWSD(name) OPTION(*PORTS)
   ```

   Here, *name* is the name of the network server description. Press Enter.

   Write down the name of the Attached line for the port number *INTERNAL. This is also known as the line description.

2. Type `CFGTCP` on an OS/400 command line, and press Enter. Select option `1` to display the TCP interfaces. Write down the IP address and subnet mask associated with the line description that you found in step 1.

3. On the Windows 2000 server console, open **Network and Dial-up Connections**. See Figure 99 on page 238 for an example.

   a. Open the TCP/IP properties, as shown in Figure 101 on page 239. Change the IP address for the IBM Virtual Token Ring Adapter to the new value that you selected. Write down the value of this new IP address because you will need it later.

   b. Click **OK**.

   c. The Windows 2000 server tells you that you need to shut down and restart for the changes to take affect. You are asked if you want to do that now. Click **No**.

4. Shut down the Windows 2000 server without restarting it.
5. Vary off the network server description.
6. Use the Remove TCP/IP Interface (RMVTCPIFC) command, and specify the IP address that you wrote down in step 2.
7. Use the Add TCP/IP Interface (ADDTCPIFC) command to add the new interface. Use the new IP address that you selected for the OS/400 side of the virtual LAN. You must also enter the subnet mask and line description that you wrote down in steps 1 and 2.
8. Enter the Change Network Server Description (CHGNWSD) command. Page down to the section labeled TCP/IP Port Configurations. Change the IP address in the Internet Address field for the Port *INTERNAL to the value that you used in step 3. Press Enter for the change to take affect.
9. Vary on the network server description.

9.4 Collection service data for the Windows 2000 server

The Windows 2000 server on the Integrated xSeries Server supports dumps and allows you to mirror the Windows 2000 Event Log for remote troubleshooting. To take advantage of the available diagnostic tools, perform these tasks:

1. Read 9.4.1, “Creating a Windows 2000 memory dump on the iSeries server”.
2. Read 9.5, “Using the network server description dump tool” on page 243, to find out how this dump can tell you which configuration and log files to look at first for problem analysis.
3. Look for diagnostic information in the message and job logs.

9.4.1 Creating a Windows 2000 memory dump on the iSeries server

You can create a Windows 2000 server memory dump file on the Integrated xSeries Server to help you solve problems with the Windows 2000 server. When you install the Windows 2000 server on the Integrated xSeries Server, the dump goes to the C: drive, C:\WINNT\Memory.Dmp, by default.

The memory dump is enabled by default if the C: drive has enough room for the paging file. To verify that the memory dump support is enabled or to write the memory.dmp file to a different drive, follow these steps:

1. Open System Properties as shown in the steps in Figure 102 on page 242.

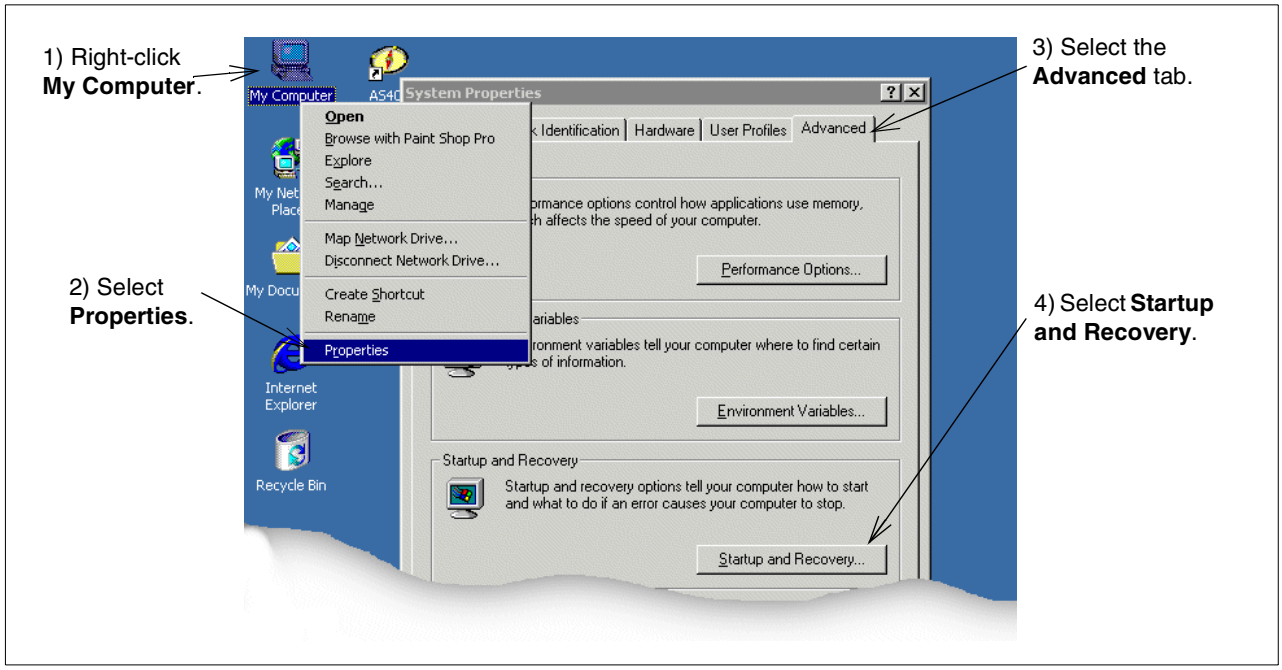

Figure 102. Running Startup and Recovery options

2. Control or change the settings as shown in the example in Figure 103.

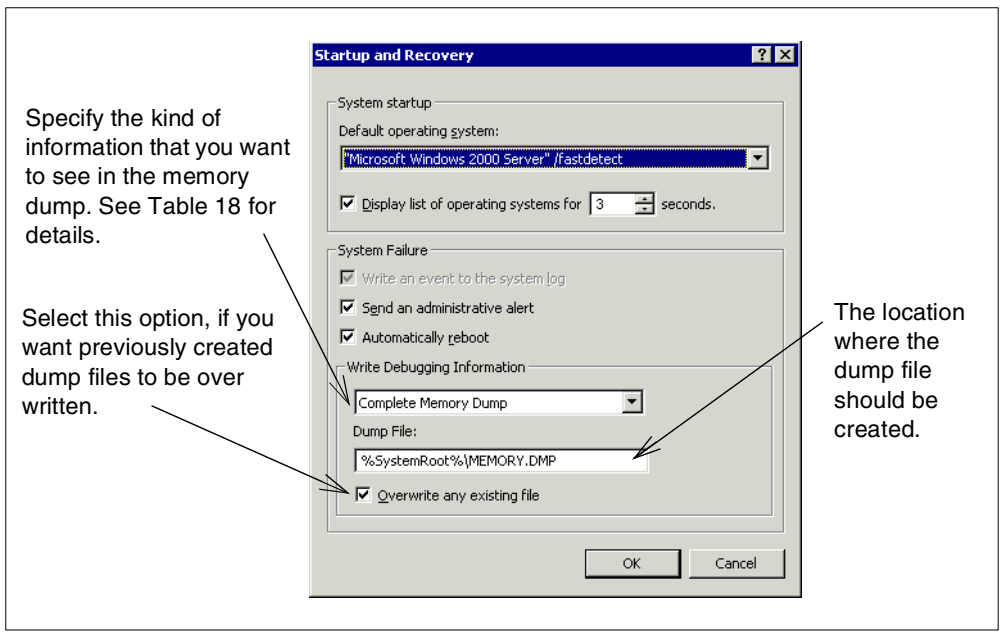

Figure 103. Startup and Recovery options

3. When you have made your changes, click **OK**.

There is also an option to automatically reboot your Windows 2000 server. If the server logs are not audited in a reasonable period, we suggest that you turn off this function. It may happen that your server already runs on stop errors, but you never notice it, because the server reboots. This may cause serious problems.

Table 18. Memory dump options

Selection	Description
Small Memory Dump	Records the smallest set of useful information that will help identify why the system stopped unexpectedly. This option requires a paging file of at least 2 MB on the boot volume of your computer and specifies that Windows 2000 will create a new file each time the system stops unexpectedly. A history of these files is stored in the directory listed under Small Dump Directory.
Kernel Memory Dump	Records only kernel memory, which speeds up the process of recording information in a log when the system stops unexpectedly. Depending on the amount of RAM in your computer, you must have from 50 MB to 800 MB available for the paging file on the boot volume.
Complete Memory Dump	Records the entire contents of system memory when the system stops unexpectedly. If you choose this option, you must have a paging file on the boot volume large enough to hold all of the physical RAM plus one megabyte (MB).
None	No memory dump.

9.5 Using the network server description dump tool

You can use the network server description dump tool (QFPDMPLS) to dump the different configuration and log files that are used with your Windows 2000 server. To do this, you need *ALLOBJ special authority.

Complete these steps:

1. On an OS/400 command line, type:

   ```
   VRYCFG CFGOBJ(NWSDNAME) CFGTYPE(*NWS) STATUS(*OFF)
   ```

   Press Enter to vary off the *NWSDNAME network server description.

   Attention

   If you do not vary off the network server description before you run QFPDMPLS, you risk the possibility of data corruption on the C: and D: drives.

2. On an OS/400 command line, type:

   ```
   CALL QFPDMPLS PARM(nwsdname)
   ```

   The *nwsdname* is the network server description name. Press Enter.

   The program creates a database file, QGPL/QFPNWSMP, with multiple members. Each database file member name has the network server description name followed by two digits (01 to 99). For example, for a network server description named MYSERVER, the first member name would be MYSERVER01.

3. Display the member to see the contents of the different files associated with your server description. Different files are important for problem analysis, depending on which installation step is causing a problem.

Note

You cannot use QFPDMPLS to retrieve files on the system (C:) drive if you convert the drive to NTFS.

9.6 Problems with the CD-ROM

If you have problems sharing the CD-ROM drive, follow these steps:

1. Verify the device is active on the OS/400.
2. Verify that a CD is in the CD-ROM drive.
3. Verify that the CD-ROM appears in the Windows 2000 server Disk Administrator.
4. Look for messages in the Event Viewer.

You may also want to verify that the CD-ROM is working from OS/400. Insert a CD-ROM in the drive, and enter following command at the prompt:

```
DSPOPT VOL(*ALL) DEV(OPT01)
```

Figure 104 shows an example of the command output.

```
                  Display Optical Volume Attributes

  Volume . . . . . . . . . . . . . . . :   W2SSEL_EN
  Device . . . . . . . . . . . . . . . :   OPT01
  Authorization list . . . . . . . . . :   QOPTSEC

Volume Header Information:
  Internal Volume ID . . . . . . . . . :   W2SSEL_EN
  Serial Number  . . . . . . . . . . . :
  Volume type  . . . . . . . . . . . . :   *PRIMARY
  Media type . . . . . . . . . . . . . :   *CD-ROM
  Media format . . . . . . . . . . . . :   *ISO9660
  Coded character set ID . . . . . . . :   500
  Volume-full threshold  . . . . . . . :   100
  Volume sequence number . . . . . . . :   1
  Create date  . . . . . . . . . . . . :   12/07/99
  Create time  . . . . . . . . . . . . :   12:00:00
  Text . . . . . . . . . . . . . . . . :   W2SSEL_EN

                                                                      More...
Press Enter to continue.

F3=Exit   F12=Cancel   F14=Additional volume attributes
```

Figure 104. Display Optical Volume Attributes

9.7 Problems with the tape drive

Chapter 11, “OS/400 components of the Windows 2000 server” on page 263, explains sharing tape devices. If you experience problems using these devices, try the options listed here:

- A common reason why the tape drive is not accessible from the Windows 2000 server is that the driver has not been installed. Click **Start->Programs->Administrative Tools->Computer Management**. You should see a window similar to the example in Figure 105. Right-click the tape drive, and select **Properties**.

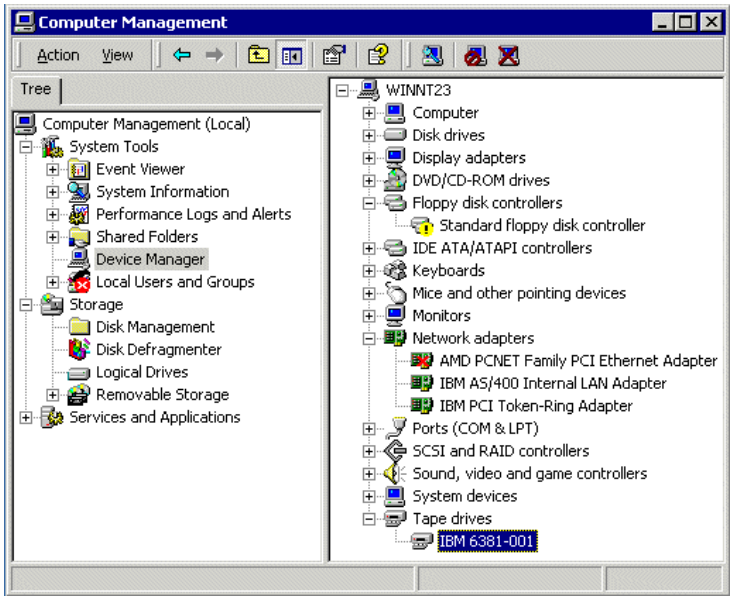

Figure 105. Windows 2000 server Device Manager

The next window (Figure 106 on page 246) shows the driver details. You should see similar information on your window. If not, refer to 7.2.1, “iSeries tape drives” on page 159, for instructions on how to install the driver.

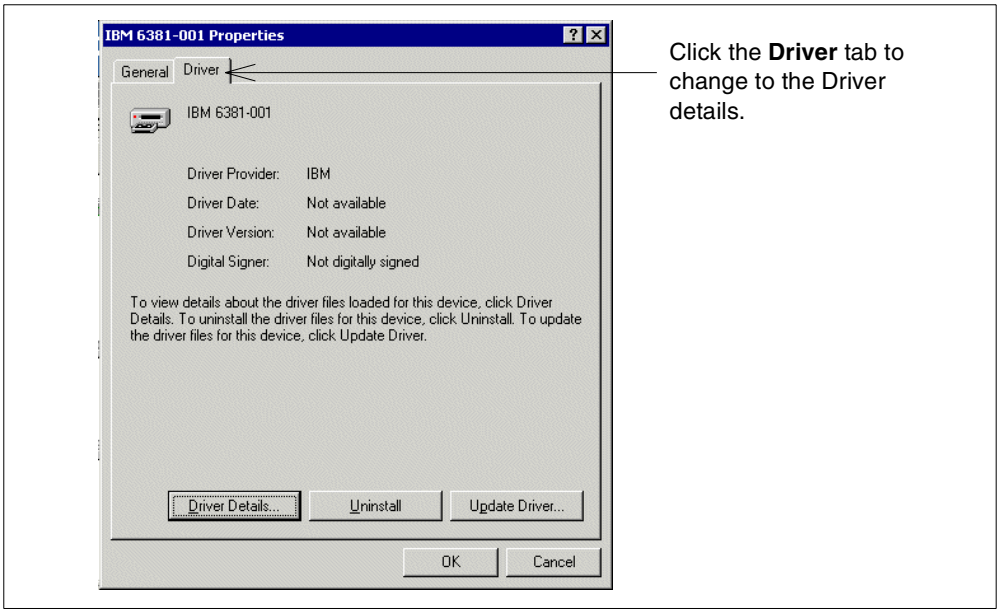

Figure 106. Driver details

Note

Make sure the tape is correctly initialized. This must be done from the OS/400 side according to the instructions in 7.2.5, “Formatting a tape” on page 163. The tape must be initialized as *non-labeled*.

- If your tape device does not display on the OS/400 Devices panel, make sure that it is supported. Tape libraries and certain tape drives are not supported for the Windows 2000 server running on the Integrated xSeries Server. You can find more information on tape drives supported in Informational APAR II11119.
- More advanced applications may lock devices to services that continue after the application interface is dismissed. This prevents other applications from being able to use the device. These services may restart automatically after a system restart and lock the device to the application.

  To see services of an application (such as Seagate and Computer Associates), follow these steps:

  a. Select **Start->Programs->Administrative Tools->Services**.

  b. If necessary, you can stop services from the Services window.
- If your tape device does not lock on the Windows 2000 server, verify the following items:

  – It is varied *off* on the iSeries server.

  – It appears on the SCSI Adapters panel in the Control Panel under the qvndvstp adapter.
- If it does not appear on the SCSI Adapters panel, check the Windows 2000 server Event Viewer for messages about why it is not supported.
- If no messages appear in the Event Viewer, attempt to load the driver for the device, and check the Event Viewer again.

- If the tape device appears in the SCSI adapters panel, but it is not started, try starting it. Then, look for messages in the Event Viewer. Unsupported devices will not start.
- If you have multiple Windows 2000 servers on multiple Integrated xSeries Servers, ensure that the tape drive is unlocked on all Windows 2000 servers, except on the one that you want to use.
- Verify that the drive is not on the list of restricted devices on the iSeries server by using the Display Network Server Description (DSPNWSD) command.

9.8 Problems with blue screens

In the event that you receive a blue screen error from the Windows 2000 server, the iSeries may log information about this in the Product Activity Log in System Service Tools. See 9.1.2, “Product Activity Log” on page 228, for more details on this. After you receive the blue screen, you cannot communicate to the Windows 2000 server. You must vary the network server off and then vary it on again to recover. Follow these steps:

1. If you see the error message `ECONREFUSED (3425)` when you try to vary off a Windows 2000 server, check to see if the internal iSeries Internet addresses are routed to a Software Common Knowledge IR System (SOCKS) server that is acting as a firewall. Routing the internal LAN through a firewall causes communications failures.
2. Look in the QSYSOPR message queue for errors. It may not be obvious, so look at the time stamps on the messages.
3. Look in the Product Activity Log for errors received at the time of the failure. Display the report on the error, and look for clues in the description that relate to the problem.
4. Check the Support Line Knowledge Base on the Web at:
   `http://as400service.rochester.ibm.com/supporthome.nsf/Document/10000051`

   Or check `http://www.microsoft.com/windows2000/default.asp` and search for the error message if the problem persists.

If you are unable to find a solution here, contact your technical support provider for further assistance.

9.9 Problems with the Windows 2000 server

You can monitor Windows 2000 server Event Logs from the iSeries server. Windows 2000 server Event Logs are recorded in the OS/400 job log or message queue that you specify. For problems with the Windows 2000 server, service personnel can access this information by way of remote link to the iSeries.

Servers that you create on a V4R5 server have this support enabled, by default. If your server was created prior to V4R3, you must turn on the support for event logging. To enable event logging or change the messages you want recorded, follow these steps:

1. Type `CHGNWSD` on an OS/400 command line, and press F4 to change the network server description.

2. In the Network server description field, enter the name of your network server description, and press Enter.
3. Scroll down to the Server message queue field, and enter the name of the message queue and library where you want the messages stored. If you do not specify a message queue, messages will go to the OS/400 Monitor job log. You can also specify *NONE, in which case console messages are not placed in a message queue.
4. Scroll down to Event Log.
5. In the blank to the right, specify the event log messages that you want recorded in the OS/400 message queue.
   - ***ALL**: Sends all event log messages to the message queue.
   - ***NONE**: Disables sending of event log messages.
   - ***SYS**: Sends system event log messages to the message queue.
   - ***SEC**: Sends security event log messages to the message queue.
   - ***APP**: Sends application event log messages to the message queue.

> **Note**
>
> If you propagate the security log (by specifying `*ALL` or `*SEC`), be sure to set up the message queue with proper security. You need to do this because the status of user logons and password changes may appear in the log.

6. Press Enter to enable event log monitoring from the iSeries server.

Note: If you have a problem with event log messages not displaying correctly in the message queue, see 9.12, “Problems with unreadable messages in the server message queue” on page 251.

9.10 Problems with code updates

The list in this section provides suggestions on troubleshooting problems when you apply OS/400 Integration for Windows 2000 server Service Packs.

- Verify that the service pack PTF is applied on the iSeries server. To do this, use the Display PTF (`DSPPTF`) command to view the service pack PTF. Make sure that it is either temporarily applied or permanently applied.
- Verify the service pack that you have on the Windows 2000 server by using **Add/Remove Programs** in the Windows 2000 Control Panel.
- Verify that AS/400 NetServer is configured correctly and started. For configuration directions, see Chapter 14, “AS/400 NetServer” on page 345. For troubleshooting, see 9.11, “Problems with AS/400 NetServer” on page 250. AS/400 NetServer is used to download the service pack code located in the OS/400 Integrated File System of the iSeries to the Windows 2000 server.
- Ensure that you enabled the guest user profile on AS/400 NetServer. If you didn’t do so, enable the guest user profile so that guests can access the AS/400 NetServer (see Chapter 14, “AS/400 NetServer” on page 345). After you enable guest access, first stop and then restart AS/400 NetServer. Then, retry running the Level Check program.

- If you are unable to run Level Check, check if there is already an instance of Level Check (or LVLSYNC) on the system. The Windows 2000 server allows only one instance of Level Check at a time. If there is already an instance of either program in operation, a new call to either program will return. Finish using the current Level Check (or LVLSYNC) program before you try to start a new instance.
- Check the system event log on the Windows 2000 server for any messages that pertain to Level Check.
- Make sure the QSERVER subsystem is active using the Work with Subsystems (WRKSBS) command on the iSeries server.
- Make sure that you are logged on to the Windows 2000 server with administrative authority. A service pack update makes changes to the HKEY_Local_Machine registry key. By default, you must have administrative authority (on the Windows 2000 server) to change this registry key.
- From an OS/400 display, use the Work with Link (WRKLNK) command to ensure there is a SERVICE.LVL file in the /QIBM/ProdData/NTAP/Service/Image folder.

  This is part of the OS/400 IFS and is visible using OS/400 Client Access Operations Navigator. If you use Operations Navigator, you must start with File Systems\Root, and then follow the path starting with QIBM. The following two files in the service directory show the level of the service pack that is in the Image folder:

  – Readmesp.txt
  – Service.lvl

  You can display these files with a text editor, such as NotePad under Windows 2000 or EDTF on the iSeries to determine the version of the service pack.

The following list shows some actions and problems that can occur with these files. This list may help you solve problems that can occur after you click OK:

- If the action was Install available service pack from OS/400, review ptflog.txt for more information.
- If the action was Uninstall current service pack on NT Server, review ptfunin.txt for more information.
- If the action was Install release from OS/400, review vrmflog.txt for more information.
- The Level Check program performs the specified action and restarts the system. It may take a short time for the system shutdown and startup to occur.
- Check the system and application event log on the Windows 2000 server for any messages pertaining to Level Check.
- Check the Support Line Knowledge Base on the Web http://www.as400service.ibm.com if the problem persists.

  If you are unable to find a solution here, contact your technical support provider for further assistance.

9.11 Problems with AS/400 NetServer

The most common causes of problems with NetServer are that it is not configured or not started.

AS/400 NetServer is described in detail in Chapter 14, “AS/400 NetServer” on page 345. To determine if AS/400 NetServer is properly configured on the iSeries, check the following conditions:

1. Verify that the QSERVER subsystem is active on the iSeries server. Use the Work Subsystem (WRKSBS) command (this lists the active subsystems). If it is not active, start it with the Start Subsystem (STRSBS) command.
2. Verify that there is a QZLSSERVER job running in the QSERVER subsystem. This should start automatically. If you do not see it, search for a job log in a spooled file for user QPGMR. Look in the User Data column for QZLSSERVER.

   The preferred way to restart this job is with Operations Navigator (see Chapter 14, “AS/400 NetServer” on page 345, for details).

   Restarting the QSERVER subsystem also restarts this job, but restricts users from accessing the OS/400 Integrated File System while the subsystem is down.
3. Verify that there is a QZLSFILE prestart job running in the QSERVER subsystem. It should be in a Program Start Request Wait state (PSRW). Use the following command to verify this:

   ```
   WRKACTJOB SBS(QSERVER)
   ```

   Press F14 to display the prestart jobs. If the job is not active, restart the job with the following command:

   ```
   STRPJ SBS(QSERVER) PGM(QSYS/QZLSFILE)
   ```
4. Determine if the NetBIOS ports are in the correct state. Type NETSTAT on an OS/400 command line, and press Enter. Select option 3 (Work with TCP/IP connection status). Look for NetBIOS ports in Listen and *UDP states. The output should be similar to the example in Figure 107.

```
                    Work with TCP/IP Connection Status
                                                          System: TEST400
Local internet address  . . . . . . . . . . . :   *ALL

Type options, press Enter.
  4=End   5=Display details

     Remote           Remote     Local
Opt  Address          Port       Port       Idle Time  State
     *                *          netbios >  002:03:30  Listen
     *                *          netbios >  000:10:30  *UDP
     *                *          netbios >  000:03:14  *UDP
     *                *          netbios >  002:03:30  Listen
                                                                      More...
F5=Refresh   F11=Display byte counts   F13=Sort by column
F14=Display port numbers   F22=Display entire field   F24=More keys
```

Figure 107. NETSTAT command with AS/400 NetServer active

When you try to access the OS/400 Integrated File System (IFS) from the Windows 2000 server through AS/400 NetServer, the access may fail in the following situations:

- You are using a Universal Naming Convention (UNC) name with an IP address in it.
- There are both internal and external LAN paths between the Windows NT server and iSeries.

Either change the UNC name to use the AS/400 NetServer name or disable the external LAN path, and then retry the access.

9.12 Problems with unreadable messages in the server message queue

The Windows 2000 Event Log messages do not display correctly if the message queue coded character set identifier (CCSID) is set to `*HEX` (65535). If you see unreadable messages in the server message queue (identified by the MSGQ parameter of the network server description), use the Change Message Queue (`CHGMSGQ`) command to change the server message queue CCSID to something other than `*HEX` (65535), for example `*MSG`.

For example, if the message queue name is MYSVRQ in library MYLIB, you can use the following command at the OS/400 console to change the message queue CCSID:

```
CHGMSGQ MSGQ(MYLIB/MYSVRQ) CCSID(*MSG)
```

9.13 Windows 2000 server recovery tools

The Windows 2000 server offers some tools that can help you repair a damaged server. This section gives you an overview of how the tools can help you.

9.13.1 Advanced options menu

The Advanced Options menu has a secondary boot menu that includes stripped down versions of the Windows 2000 server. During the boot process, press F8 to activate the menu. The following options may appear:

- **Safe Mode**: Starts only essential services to get the Windows 2000 server running. Uses the graphical Explorer interface.
- **Safe Mode With Networking**: Like Safe Mode but loads some network services to let you use network resources.
- **Safe Mode With Command Prompt**: Like Safe Mode, but instead of Explorer interface, a command shell is used. You can even start graphical applications through the command prompt or by using the Task Manager. You can start the Task Manager by pressing Ctrl+Alt+Delete.
- **Enable Boot Logging**: Creates the file ntbtlog.txt on top of your system root directory. You can review the file to see the drives that are loaded. We suggest that you run this option once your server is successfully up and running and rename the file. If you run into problems, you can compare both files to more easily find the possible cause.
- **Enable VGA Mode**: This option allows you to fix problems with the video driver.

- **Last Known Good Configuration**: Every time you boot your Windows 2000 server and log on successfully, it stores the configuration information for the local machine in the Registry under HKEY_LOCAL_MACHINE\SYSTEM. If you choose this option, you are reverting all non-security related Registry changes made during the last session.
- **Directory Server Restore Mode**: Restores Active Directory on a domain controller. This option is not available on computers that are running Windows 2000 Professional or are on member servers.
- **Debugging Mode**: Starts Windows 2000 in kernel debug mode, which allows a debugger to access the kernel for troubleshooting and system analysis. This option needs a serial port.

9.13.2 Recovery Console

The Recovery Console is a command line utility the lets you perform various tasks such as copying system files from a CD-ROM or the D: drive, starting and stopping services, and formatting disks.

Since there is no floppy disk drive available on the Integrated xSeries Server, it is necessary to install the Recovery Console as a boot option on your Windows 2000 server. This step is only possible if your server is up and running. Therefore, we suggest that you install the Recovery Console after you finish the Windows 2000 server installation. To install it, open a command prompt, enter the commands shown in bold in Figure 108, and press Enter.

```
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-1999 Microsoft Corp.

C:\WINNT\Profiles\Administrator>d:

D:\>cd i386

D:\I386>winnt32 /cmdcons
```

Figure 108. Installing the Recovery Console commands

The window shown in Figure 109 appears.

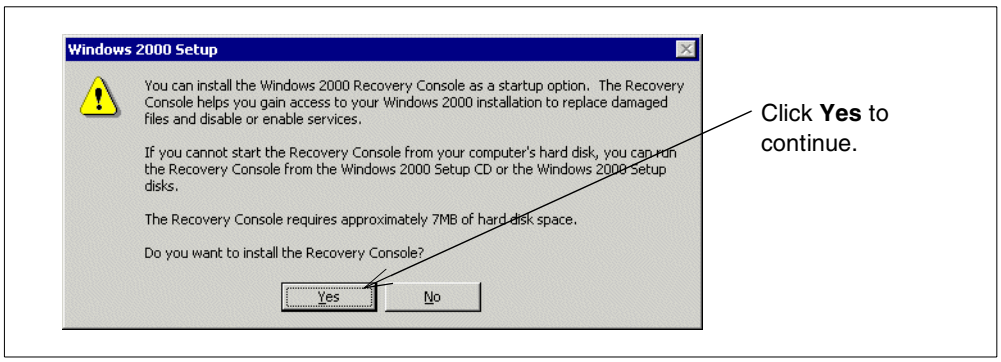

Figure 109. Recovery Console installation

The Windows 2000 server shows a confirmation window, which indicates that the Recovery Console is installed. Click the **OK** button. The next time you start your Windows 2000 server, you see the new boot option “Recovery Console”.

If you need help for the available commands, type `help` at the Recovery Console command prompt, and then press Enter.

9.14 Problems with customization

If you suspect that a network server description configuration file that you created is causing an error, try resetting the network server description configuration file parameter to `*NONE`. If the error disappears, your network server description configuration file most likely has a problem.

If the network server description configuration file is causing errors, use one of the following methods:

- Continue without using your own network server description configuration file.
- Use an earlier working version of the Windows 2000 file.
- Repair your network server description configuration file.

9.14.1 Resetting the Configuration file parameter

You can set the Configuration file parameter of the network server description to *NONE to prevent the changes that are causing errors from being made to the Windows 2000 server file. To prevent OS/400 from using your network server description configuration file, follow these steps:

1. Type `WRKNWSD` on the OS/400 command line, and press Enter to work with your network server descriptions.
2. On the line next to the network server that is having problems, type option `2` (Change).
3. In the Configuration file field, type `*NONE`.
4. Vary on the network server, and see if the error has gone away.

9.14.2 Using a previous version of the Windows 2000 file

If you have a working version of the Windows 2000 file, you can change the Windows 2000 file back to this working version. To change the Windows 2000 file, follow these steps:

1. Set the Configuration file parameter of the network server description to `*NONE` to prevent the changes that are causing errors from being made to the Windows 2000 server file.
2. Select the Windows 2000 server file that you want to reset to a previous version.
3. Log on to the server, or use the Submit Network Server Command (`SBMNWSCMD`) command from the OS/400 console to rename the files. Follow these steps:
   a. Rename the file that is causing problems to another name.
   b. Rename the previous version of the Windows 2000 server file to the original name.
4. When you vary on the network server, OS/400 uses the previous version of the Windows 2000 file.

9.14.3 Repairing the network server description configuration file

If you want to repair your network server description configuration file to eliminate the errors, follow these steps:

1. Check the job log for error and recovery information.
2. Edit the network server description configuration file.
3. Vary on the network server again.

9.15 Problems with drive letter changes: Upgrading from V4R2

Version 4 Release 2 of OS/400 Integration for Windows Server reserved drives F:, G:, H:, I:, and J: as place holder drives. As a result, Windows NT began assigning network storage space drive letters on drive K:. Version 4 Release 2 PTF MF18124 and Version 4 Release 3 removed those place holder drives, so now network storage space drives begin at F when viewed from Windows NT.

For details, read Chapter 19, “Windows NT to Windows 2000 server migration” on page 435.

9.16 Problems with Windows 2000 Server Terminal Services

Windows 2000 Server Terminal Services is described in detail in Chapter 12, “Windows 2000 server Terminal Services” on page 275. Most problems with Windows 2000 Terminal Server can be traced to incorrect code levels or installation errors. Installation notes for Windows 2000 Terminal Server are available on the Web at: `http:\\www.as400.ibm.com/nt`

Chapter 10. Integrated xSeries Server hardware and software

This chapter describes, in detail, the hardware and software that are required to run the Windows 2000 server in the Integrated xSeries Server.

10.1 Integrated xSeries Server hardware

If you want to run the Windows 2000 server on the Integrated xSeries Server, you need a supported adapter. This section describes such adapters. Figure 110 shows the 700 MHz Integrated xSeries Server #2890.

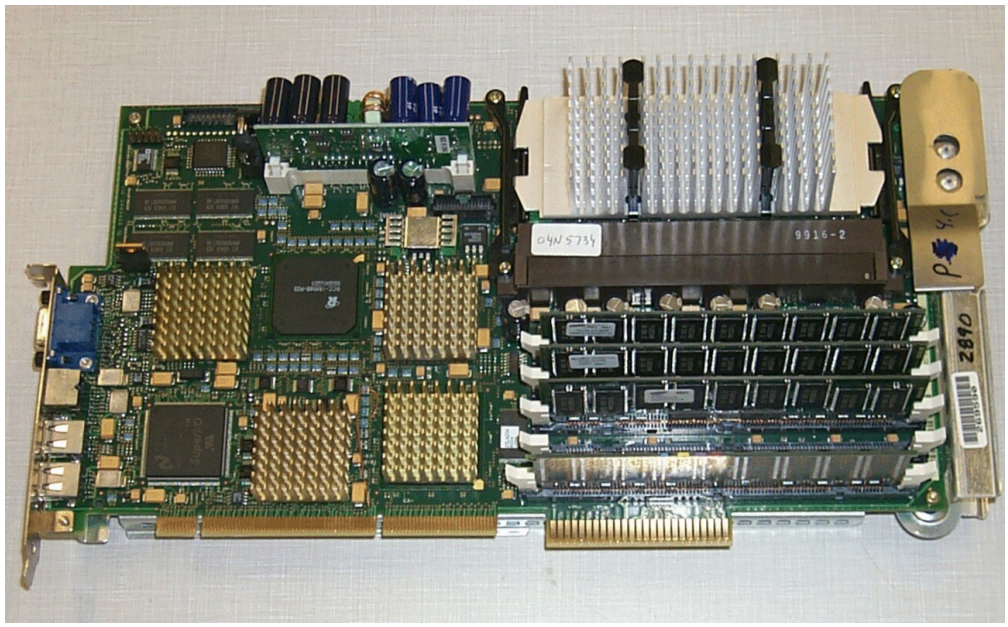

Figure 110. Integrated xSeries Server 700 MHz #2890

10.1.1 Overview

The Windows 2000 server-capable Integrated xSeries Server adapters are only supported on the iSeries server 270 and 8xx models. There are two types of Windows 2000 server-capable integrated servers available: a 333 MHz Integrated Netfinity Server model and the new 700 MHz Integrated xSeries Server model. Table 19 describes the features all the Integrated PC Server adapters.

This chapter focuses on the new 700 MHz model. For a more detailed overview of the older models, refer to *AS/400 - Implementing Windows NT on the Integrated Netfinity Server*, SG24-2164.

Table 19. Integrated xSeries Server CCIN and feature numbers

Feature code	System model	CCIN numbers	Description
#2852	150	2850-011	Pentium Pro Integrated Netfinity Server
		285A-003	Windows Server Bridge

Feature code	System model	CCIN numbers	Description
#2854	600/620/S10/S20/720	2850-001	Pentium Pro Integrated xSeries Server
		285A-003	Windows Server Bridge
#2857	170	2850-001	Pentium Pro Integrated Netfinity Server
		285A-003	Windows Server Bridge
#2865	600/620/S10/S20 720/730/740	2850-012	Pentium II Integrated xSeries Server
		285A-003	Windows Server Bridge
#2866	170	2850-012	Pentium II Integrated xSeries Server
		285A-003	Windows Server Bridge
#2868	150	2850-012	Pentium II Integrated xSeries Server
		285A-003	Windows Server Bridge
#2790	820/830/840	2890-001	Pentium III Integrated xSeries Server
#2890	270	2890-001	Pentium III Integrated xSeries Server
#6617	All RISC systems with Book Packages	6617-001	Pentium Pro Integrated xSeries Server
#6618	All RISC systems with Book Packages	6617-012	Pentium II Integrated xSeries Server

The #2790 and #2890 models of the Integrated xSeries Server consist of the same hardware. Any statements made concerning the #2890 model also apply to the #2790 model.

The #2790 and #2890 Integrated xSeries Server and any Integrated xSeries Server migrated to a 50xx Migration Tower cannot serve as an external host LAN for your iSeries server.

Table 20 shows an overview of the available Integrated xSeries Server parts.

Table 20. Integrated xSeries Server parts

Description	Part number	Feature number
Keyboard/Mouse extension cable	44H8676	n/a
Y-cable	7G3794	n/a
Video extension cable	44H8676	n/a
128 MB Dimm	29L0955	#2795 or #2895 *
256 MB Dimm	29L0956	#2796 or #2896 *
1 GB Dimm	29L0957	#2797 or #2897 *
* Feature numbers 279x are for the #2790 Integrated xSeries Server, and feature numbers 289x are for the #2890 Integrated xSeries Server.		

10.1.2 Hot plug

Hot plug for the Integrated xSeries Server applies generally to those iSeries servers that support hot plug, with the exception of the 5074 I/O tower. Table 21 lists the specific models.

Table 21. Hot plug capability

AS/400e server model	Hot plug in system unit	Hot plug in #5075 I/O tower	Hot plug in #5074 I/O tower	Lan adapter hot plug
270	Yes	Yes	n/a	Yes
820	Yes	Yes	No	Yes
830	No	n/a	No	Yes
840	No	n/a	No	Yes

The Integrated xSeries Server must be varied off prior to performing concurrent maintenance on either the #2890 server card or any associated LAN adapter card.

10.1.3 Hardware details

The 700 MHz Integrated xSeries Server offers the following hardware features:

- Intel 700 MHz Pentium III
- Hot plug on selected iSeries servers
- Up to 4 GB memory
- Up to 16 Integrated xSeries Server per iSeries
- Up to three LAN adapters (all hot plug PCI)
- 10/100 Mbps Ethernet
- 4/16/100 Mbps token-ring
- 2 x Universal Serial Bus (USB) ports
- Savage4 chipset from S3
- VGA, keyboard, and mouse ports

10.1.4 PCI packaging

The PCI Integrated xSeries Server contains the following parts:

- The Integrated xSeries Server processor card
- Up to three PCI LAN adapters
- Mouse, keyboard, monitor, and cable

The card needs one PCI slot in the iSeries server. In addition, one to three PCI slots are required for LAN adapters, which fit in the slots reserved for this purpose in the PCI-based iSeries server. Figure 111 on page 258 shows part of a photo of the Integrated xSeries Server card and its ports.

Figure 111. Integrated xSeries Server ports

10.1.5 Memory options

The Integrated xSeries Server has four main storage slots. Each main storage slot can contain either a 128 MB, a 256 MB, or a 1024 MB main storage card. Providing a main storage range from 256 MB to 4196 MB (4 GB). When the maximum memory is installed, only 3712 MB will be addressable. At least one main storage card is required. See Table 20 on page 256 for the feature and part numbers.

10.1.6 External device support

There are several ports available on the 700 MHz Integrated xSeries Server adapter for the connection of external devices. You can attach a display, keyboard, mouse, and any USB device to the Integrated xSeries Server ports.

10.1.7 LAN adapters

Depending on your model, you can use up to three LAN adapters for the 700 MHz Integrated xSeries Server. You can drive all LAN adapters at their maximum data rate.

The host LAN is not supported on the new 700 MHz Integrated xSeries Server adapters or old migrated ones. Therefore, you need a LAN adapter dedicated to your Integrated xSeries Server to connect the iSeries to your LAN.

The #2890 supports up to two LAN adapters. The #2790 supports up to three LAN adapters, depending on the system or tower in which it is installed.

See Table 22 for the available LAN adapters for the #2890 and #2790 Integrated xSeries Servers.

Table 22. Available LAN adapters for the #2890 and #2790 Integrated xSeries Server

Feature number	Description
#2744	100/16/4 Mbps token-ring
#4838	100/10 Mbps Ethernet

10.1.8 Machine pool requirements

The machine pool memory requirement by the integration software depends on the type of Integrated xSeries Server that you use. See Table 23 for details.

Table 23. Integrated xSeries Server machine pool memory requirements

Integrated xSeries Server	Minimum memory required	Additional memory required for LAN adapters
6617	5400 KB	1800 KB for each 2838, 2723, or 2724 network adapter card.
2850	1800 KB	1800 KB for each 2838, 2723, or 2724 network adapter card.
2890	856 KB	You do not need to consider network adapter cards that you install with this Integrated xSeries Server because they cannot serve as shared external host LAN adapters for the iSeries.

For example, if you have one #2890 Integrated xSeries Server, you only need 856 KB more of machine pool memory. You do not need to consider any more memory for the LAN adapters used by the Integrated xSeries Server.

10.1.9 Number of Integrated xSeries Servers per iSeries

There are 16 Integrated xSeries Servers per iSeries depending on the model. If you require additional Integrated xSeries Servers beyond 16, contact your IBM marketing representative.

10.1.10 Comparison with PC servers

For performance considerations, you can compare the Integrated xSeries Server with any common PC server with the same processor and memory. Some differences with the common PC server are explained in the following sections.

10.1.10.1 OS/400 shared devices

The following hardware is shared between the iSeries and the Integrated xSeries Server:

- **Disk storage:** The Integrated xSeries Server uses iSeries disks, which can provide greater reliability and improved performance compared to PC disks.
- **CD-ROM drive**: The Integrated xSeries Server shares the CD-ROM drive with the iSeries.

- **Tape devices**: The Integrated xSeries Server shares tape devices with the iSeries.

10.1.10.2 Not included hardware

The following hardware is not included in the Integrated xSeries Server:

- **Diskette drive**: There are no plans to support the attachment of a diskette drive. However, you can use a diskette drive shared by another Windows machine on the network or a diskette drive that can connect to the USB port on the Integrated xSeries Server.
- **Direct-attached CD-ROM drive**: With Windows 2000, it should be possible to attach a CD-ROM drive to the USB port of an Integrated xSeries Server. However, this is an unsupported device.
- **Multimedia**: There is no support for directly attached multimedia devices, but the Integrated xSeries Server can serve multimedia files in the same way as a PC-based server. You should also be able to attach any USB device that supports the Windows 2000 server. However, this is not supported.

Note

USB support is provided through the Windows 2000 server. Windows NT 4.0 has no built-in USB support.

10.2 Integrated xSeries Server software

This section covers the Microsoft and IBM licensed software requirements.

10.2.1 Microsoft software

The Windows 2000 server, Windows NT 4.0, or Windows NT 4.0, Terminal Server Edition, is required for running the Windows server on the Integrated xSeries Server.

You need to plan for the number of users who are going to use the server. Then, purchase the appropriate number of Windows server and client licenses from a Microsoft reseller.

Because each Integrated xSeries Server operates as an individual server platform, you need a separate Windows server license for each Integrated xSeries Server on which you install a Windows server.

10.2.2 AS/400 licensed programs

You must install the licensed programs shown in Table 24.

Table 24. Required AS/400 licensed programs

Licensed program or option	Description
5769-SS1 base	OS/400 Version 4 Release 5
5769-WSV base	Integration for Windows Server
5769-WSV Option 1 *	Integration for Windows NT 4.0
5769-WSV Option 2 *	Integration for Windows 2000

Licensed program or option	Description
* Depends on the Windows server version you plan to install on the Integrated xSeries Server.	

Apply the latest PTFs for OS/400 and 5769-WSV. Also keep the latest service pack for your Windows server available. For the latest PTF and service pack information, go to: `http://www.iseries.ibm.com/windowsintegration/index.htm`

To use TCP/IP applications, such as Telnet or FTP, on the iSeries server, you must install the license program TCP/IP Connectivity Utilities for OS/400, 5769-TC1. This licensed program is not required to run the Windows server on the Integrated xSeries Server.

Chapter 11. OS/400 components of the Windows 2000 server

When a Windows 2000 server is created and installed on the Integrated xSeries Server, there are a number of objects created on the iSeries and Windows 2000 servers that are unique to this implementation. There are also some objects that are common to both the iSeries and Windows 2000 servers.

This chapter examines the following components of this environment:

- OS/400 components
- Windows 2000 server components
- Common components

11.1 OS/400 and AS/400 components

There are two stages during installation when objects are created. The first stage is when the licensed program Integration for Windows Server (5769-WSV) is installed. The second stage is when the Install Windows Server (INSWNTSVR) command is run.

The licensed program installation results in the creation of the following objects on the iSeries server:

- QNTAP library
- NTAP directory in the integrated file system

When you run the Install Windows NT Server (INSWNTSVR) command, the following objects are created on the iSeries server:

- Network server description
- Communication objects
- TCP/IP interfaces
- Storage spaces
- Message queue

After installation, the following devices can be shared between the iSeries and Windows 2000 servers:

- Tape drive
- CD-ROM drive

Each of these components is described in the following sections.

11.1.1 QNTAP library

The QNTAP library is created when the licensed program Windows Server Integration (5769-WSV) is installed on the iSeries server. It contains the objects that are required to install and administer the Windows 2000 server.

When a secondary language version of the Windows Server Integration is installed, some objects are created in the QSYS29xx library.

11.1.2 Integrated file system (IFS) directories

In common with some of the other program products available on the iSeries server, there are objects created in the IFS that are used by the integration software.

11.1.2.1 QIBM directory

The /QIBM/ProdData/NTAP and /QIBM/UserData/NTAP subdirectories, as shown in Figure 112, contain the Windows Server Integration files.

> **Note**
>
> Do not modify these directories or any file contained within them in any way. Doing so may interfere with the operation of the server.

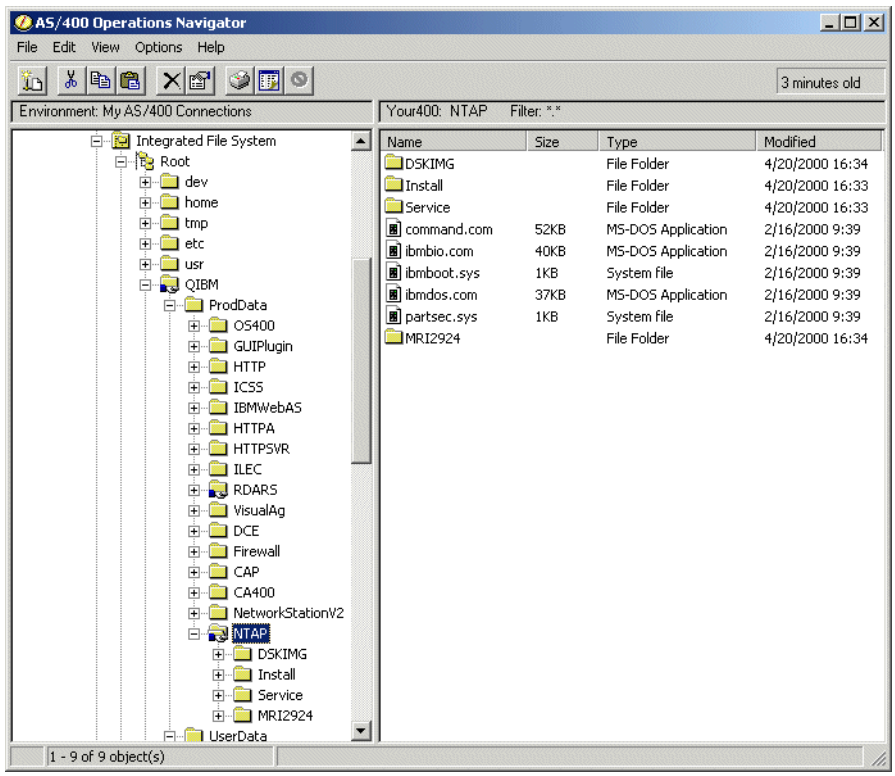

Figure 112. Components of the QIBM directory

The directories contain drivers and service packs used by the Windows Server Integration or the Windows 2000 server to access the iSeries disk, CD-ROM, and tape devices.

11.1.2.2 QNTC file system (NetClient)

In OS/400 Version 4 Release 5, support for save and restore is integrated. For details on backup and restore, see Chapter 7, “Backup and restore” on page 151. For details on the QNTC file system (also called NetClient), refer to Chapter 13, “QNTC file system” on page 333.

11.1.3 Network server description

The name of the network server description is defined in the INSWNTSVR command (for example W2KSVR1). A network server description is an object that defines a particular server environment on the iSeries server, in this case, a Windows 2000 server environment. You can create as many network server descriptions as you want, each with its own particular characteristics. However, only one can be active at a time on an Integrated xSeries Server adapter. For example, you could create a Windows 2000 server network server description for production and a second Windows 2000 server network description for testing, but only one network server description can be active at a time on one Integrated xSeries Server adapter. You can have up to 16 Integrated xSeries Server in your iSeries, depending on your iSeries model.

The network server description holds the resource name of the Integrated xSeries Server adapter on which your Windows 2000 server runs. You can change this value to another Integrated xSeries Server adapter. This allows you to have a hot spare adapter available. If one Integrated xSeries Server adapter fails, you can point the network server description to the hot spare Integrated xSeries Server adapter and vary on the network server description.

To display the network server description of your Windows 2000 server, type `WRKNWSSTS` on an OS/400 command line, and press Enter. Type `5` in front of the network server description, and press Enter. See Figure 113 for an example of the output.

```
                  Display Network Server Details
                                                        System:   AS23
Windows server status:
  Connected users . . . . . . . . :   1
  Processor utilization . . . . . :   1
  Paging file utilization . . . . :   4
  Registry quota utilization  . . :   24

Windows server version:
  Version . . . . . . . . . . . . :   5.0
  Build number  . . . . . . . . . :   2195
  Service pack level  . . . . . . :



AS400 Integration with Windows server version:
  Version . . . . . . . . . . . . :   V4R5M0
  Language version  . . . . . . . :   2924
  Service packs . . . . . . . . . :   SF00000
                                                                  Bottom
Press Enter to continue.

F3=Exit   F5=Refresh   F6=Print   F12=Cancel
```

Figure 113. Display Network Server Details

11.1.4 Communications objects

For the iSeries server to communicate with the Windows 2000 server, the following communications objects are created by the INSWNTSVR command:

- Line description
- TCP/IP controller description
- TCP/IP device description

These communication objects (Figure 114) are discussed in detail in this section.

```
                          Work with Configuration Status                AS23
                                                          04/28/00  12:59:48
Position to  . . . . .               Starting characters

Type options, press Enter.
  1=Vary on   2=Vary off   5=Work with job   8=Work with description
  9=Display mode status    13=Work with APPN status...

Opt  Description       Status               -------------Job--------------
     W2KSVR1          ACTIVE
       W2KSVR100      ACTIVE
         W2KSVNET     ACTIVE
           W2KSVTCP00 ACTIVE               QTCPIP      QTCP        077609
```

Figure 114. Line, controller, and device description of the network server description

11.1.4.1 Line description

A line description for the internal token-ring LAN is created. The line description for the internal LAN takes the name of the network server description and adds the suffix 00 to it. Therefore, the network server description with a name of W2KSVR1 has an internal LAN line description called W2KSVR100. The creation of the internal LAN is fully automatic and always takes place regardless of other configuration options.

11.1.4.2 TCP/IP controller description

A TCP/IP controller for the internal LAN is created automatically for you. The TCP/IP controller description uses the first five characters of you network server description name, followed by the character NET. The internal LAN line in our example has a controller called W2KSVNET.

11.1.4.3 TCP/IP device description

Each TCP/IP controller has a matching TCP/IP device description that follows the same naming convention as the controller, except that the letters NET are replaced by TCP. In our example, this would be W2KSVTCP.

11.1.5 Storage spaces

The Integrated xSeries Server does not have its own dedicated disks. It uses OS/400 storage spaces for storing data. A *storage space* is a chunk of iSeries disk storage that is allocated for use by a network server, which is the Windows 2000 server running on the Integrated xSeries Server, in this case. In some cases where you migrated from Windows NT 4.0 and OS/400 Version 4 Release 4 and earlier, you may have *server storage spaces*.

The Windows 2000 server sees storage spaces as physical disk drives.

11.1.5.1 Server storage space

If you migrated from OS/400 Version 4 Release 4 or earlier, with an Integrated xSeries Server running Windows NT 4.0, you may have a server storage space. It represents the C: drive. Server storage spaces are stored in the QUSRSYS library with an object type of *SVRSTG.

11.1.5.2 User storage space

They are located in the IFS in the /QFPNWSSTG directory. You can create a user storage space with up to 64000 MB. Before you can use a user storage space, you must format it with the disk administrator from Windows 2000. A user storage space can only be linked to one network server description at a time. However, you can unlink a user storage space and link it to another network server description.

If you install applications to your user storage spaces and link the storage space to another network server description, keep in mind that the application may not work anymore. Windows applications mostly use the Windows 2000 registry or copy files to the %SYSTEMROOT%/SYSTEM32 directory. Sharing information from shared directories may also be lost.

When you run the INSWNTSVR command, you can specify a message queue to contain the messages issued by the Windows NT Server during its normal operation, as well as mirroring Windows NT Event Log messages. This message queue can be stored in any OS/400 library (QGPL is a good place to keep it).

Prior to Version 4 Release 3, the messages contained in it, are normally informational, but if the server encounters an error, the message is entered into this message queue. With Version 4 Release 3, you can mirror Windows NT Event Log messages straight into this queue. The Windows NT Event Log is the central repository for error reporting on Windows NT and consists of system, security, and application-related messages. The default is to monitor all three message types. However, you can choose to mirror a combination of these message types, all of them, or none of them to the server message queue. You can change the level of message logging to the iSeries at a later time, if necessary, by using the Change Network Server Description (CHGNWSD) command. Notice if the security log is mirrored, be sure to set up the message queue with an appropriate level of security because the status of user logon and password changes may appear in the log.

11.1.6 Tape drive

The OS/400 tape drive or drives can be configured for use by the iSeries or Windows 2000 server that is running on an Integrated xSeries Server in the iSeries at any given time. Both systems cannot use the same tape drive simultaneously.

If you have multiple tape drives in the iSeries, each one is allocated separately. It is possible to have different tape drives dedicated to the iSeries and to the Integrated xSeries Servers.

Notice that you can restrict the tape drives that can be allocated to the Windows 2000 server. Tape devices are restricted by specifying the devices that are *not* to be made available to the Windows 2000 server. Devices to be restricted can be identified at the following two points:

- During installation by listing the devices in the Restrict device resources (RSTDEVRSC) parameter of the INSWNTSVR command.
- After installation by using the CHGNWSD command to list the devices in the Restrict device resources (RSTDEVRSC) parameter of the network server description.

  Note: The network server description must be varied off for this change to be made.

Although the tape drive itself can be used by either the Windows 2000 server or the iSeries server, the actual tapes have different formats between the two operating systems. It is not possible to use the same tape for a backup using a Windows 2000 server backup application and a backup using OS/400 backup commands without reformatting it to the appropriate format.

11.1.7 CD-ROM drive

Sharing the CD-ROM drive between the iSeries and Windows 2000 servers is accomplished by means of device drivers that are supplied as part of the OS/400 Integration for Windows Server code.

Starting with OS/400 Version 4 Release 3, the CD-ROM drive can be shared simultaneously between the iSeries and Windows servers. No user action is required to initiate the sharing. The Windows 2000 server can use the iSeries CD-ROM drive the same as it uses a PC CD-ROM drive. The iSeries CD-ROM drive appears as a local CD-ROM drive in My Computer under the Windows 2000 server.

11.2 iSeries components

Within the Windows 2000 server running on the Integrated xSeries Server, there are components that are different from, or not present in, a PC server. The following list shows these components:

- C: and D: drive
- OS/400 services under the Windows 2000 server
- Network configuration
- Registry entries
- OS/400 devices

Each of these components is described in the following section.

11.2.1 C: and D: drive

The C: drive contains the Windows 2000 server executables and other files that are needed by the Windows 2000 server. The files needed for integration with the iSeries server are also located on the C: drive.

The D: drive contains the installation images for the Windows 2000 server and for the integration programs.

We recommend that you do not install any programs on the C: or D: drive. It is also necessary to set proper permissions on those drives, if you use Windows 2000 Server Terminal Services.

11.2.2 OS/400 services under Windows

To support the integration of the iSeries with the Windows 2000 server or Windows NT server, the services described in the following sections run on your server.

11.2.2.1 OS/400 user administration service

This service performs the following functions:

- Receives user enrollment and update requests
- Handles shutdown (vary off) requests from the iSeries server
- Returns statistics to the iSeries, such as CPU percent busy, Registry quota, and disk usage
- Starts a thread to begin Windows 2000 server Event Log monitoring

11.2.2.2 OS/400 remote command service

This service handles requests from the OS/400 Submit Network Server command (SBMNWSCMD). It runs the command in batch mode and returns the results of the command back to the iSeries server.

11.2.2.3 OS/400 Service monitor service

This service is only necessary on Windows NT Server 4.0. It checks periodically to see if the OS/400 User Administration service is running and restarts if it is not active. The Windows 2000 server can restart services automatically. Therefore, this service is not necessary on the Windows 2000 server.

To check if those services are running, open the Services window on your Windows server.

11.2.3 Network configuration

When you install the Windows 2000 server on the Integrated xSeries Server, an additional LAN adapter is installed. This is a virtual LAN adapter used for the virtual token-ring. The virtual token-ring is used for communication between the iSeries and Windows 2000 servers on the Integrated xSeries Server.

11.2.4 Registry entries

During the installation process, some entries are made to the Windows 2000 server Registry. For example, the OS/400 User Administration service uses the Registry to store information about enrolled user groups and user profiles.

We recommend that you do not change the registry manually unless you are really sure what the consequence will be.

11.2.5 OS/400 devices

The iSeries server shares disk, tape, and CD-ROM devices through SCSI drivers. Information about these devices can be found in the Windows 2000 server Hardware Manager. Figure 115 on page 270 shows an example.

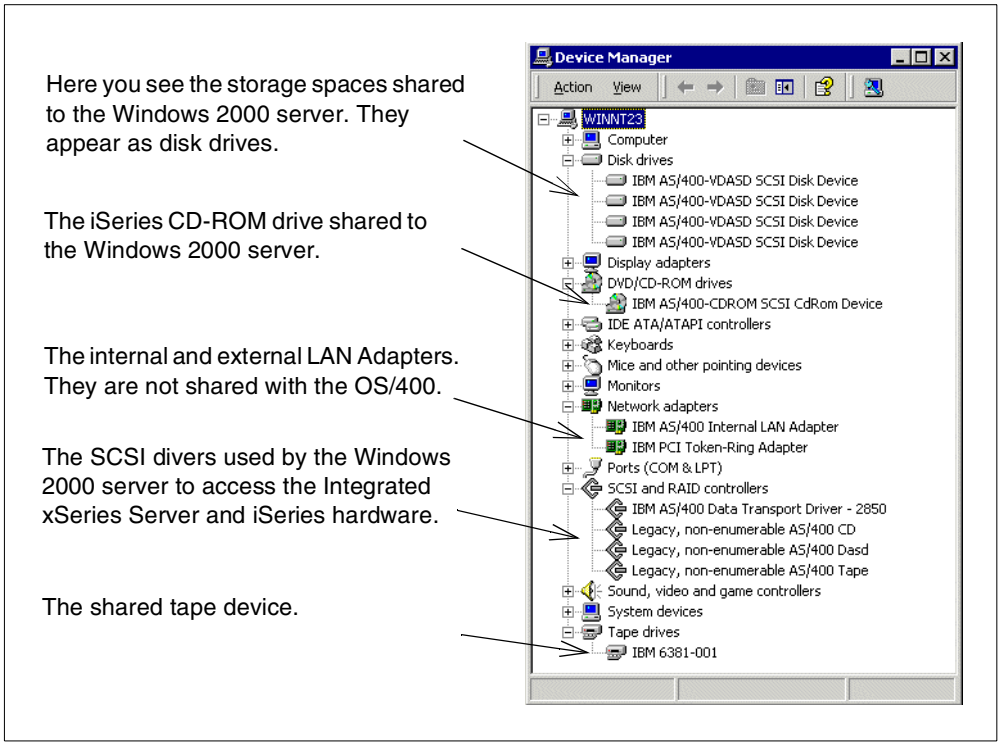

Figure 115. Windows 2000 server Hardware Manager

11.3 Common components

Some components are common to both the iSeries and Windows 2000 servers on the Integrated xSeries Server environment. These are the internal LAN and network protocols. These components are covered in the following sections.

11.3.1 Internal LAN

One of the unique features of the Integrated xSeries Server running the Windows 2000 server is the virtual (internal) LAN. The internal LAN appears to both operating systems as a true token-ring LAN connection. The internal token-ring runs over the system bus, which gives it some advantages over a common LAN:

- It is not affected by routers or hub failures on the network, since there are none.
- It is not accessible outside the iSeries server, which makes it is highly secure.
- It provides good performance, because there are no other systems on the LAN.

For these reasons, you can use the internal LAN as a reliable, secure, high-speed connection between the iSeries and Windows 2000 servers. See Figure 116 for an overview of the internal LAN.

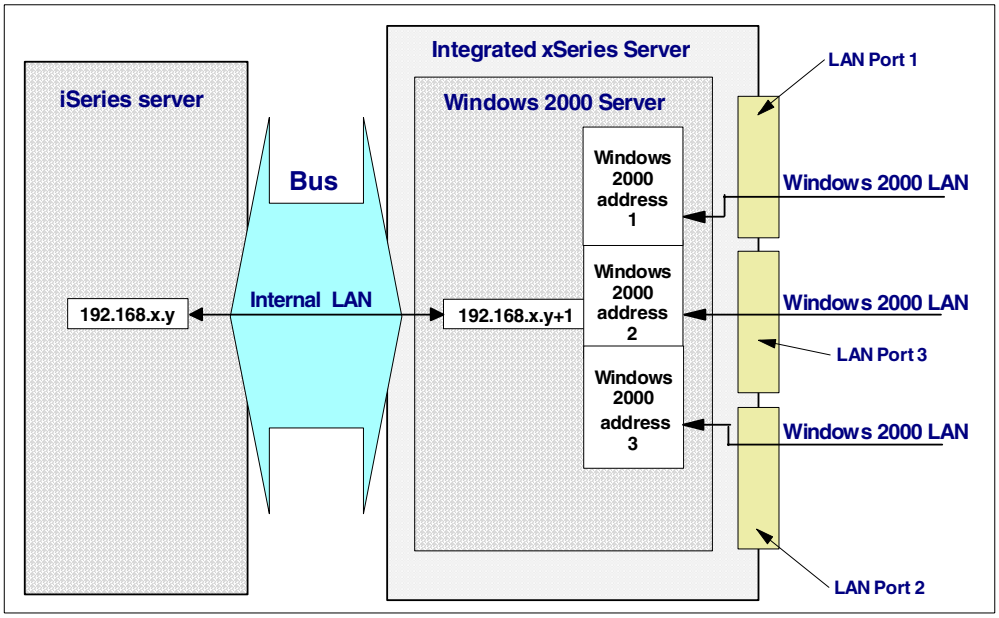

Figure 116. Intern LAN structure for the Integrated xSeries Server running the Windows 2000 server

The internal LAN can only support the TCP/IP protocol. Therefore, you cannot use applications on the internal LAN that use other protocols such as SNA.

For each Integrated xSeries Server running the Windows 2000 server, there is a separate internal LAN. You cannot simply change the internal LAN TCP/IP addresses so that they are on the same subnet. However, you can change the OS/400 IP datagram forwarding parameter (CFGTCP, option 3) to *YES.

Because only the integration services use the internal LAN, you can expect good performance for Windows 2000 server applications that use the internal LAN.

OS/400 Integration for Windows Server uses a bus-level connection for the following functions, which has little effect on the performance of the internal LAN:

- Disk drive access
- CD-ROM drive access
- Tape drive access
- Vary on and off the Integrated xSeries Server

11.3.1.1 Internal LAN IP addresses

You can let the iSeries generate IP addresses for the iSeries and Windows 2000 server ends of the internal LAN, or for the Version 4 Release 4 systems and above, override them by entering your own IP addresses in the Internal LAN port parameter of the INSWNTSVR command. We recommend that you use *GEN to let the INSWNTSVR command generate IP addresses for the OS/400 and Windows NT sides of the internal LAN, unless you have a good reason to override the defaults. The IP addresses that are generated have the form 192.168.zzz.nnn. The *zzz* in the IP address is taken from the number at the end of the Integrated xSeries Server resource name. It is a number that makes the address unique on the iSeries server. The INSWNTSVR command looks for a pair of values nnn and nnn+1 (starting with nnn=1) that are not in use on that iSeries server. The lower number of the pair is used on the OS/400 side of the

virtual LAN, and the higher number is used on the Windows NT side of the virtual LAN.

Consider the example of an Integrated xSeries Server with a resource name of LIN03. After you run the INSWNTSVR command, you could end up with the following addresses for the virtual LAN:

- 192.168.3.1 (OS/400 side)
- 192.168.3.2 (Windows NT side)

If there is a conflict with addresses that are already in use on your network, these addresses can be changed so that the internal LAN uses unique addresses. To ensure that the internal LAN is on its own subnet, make sure the value of 192.168.zzz is unique on your network. As an example, the new IP addresses for the Integrated xSeries Server discussed previously might be changed to:

- 192.168.17.1 (OS/400 side)
- 192.168.17.2 (Windows 2000 server side)

The IP addresses for the OS/400 and Windows 2000 server sides of the internal LAN must be on the same IP subnet, and that IP subnet must be unique on the network. For example, the OS/400 internal LAN IP address may be 192.168.2.1, and the Windows 2000 server internal LAN IP address may be 192.168.2.2. In this case, no other systems on the network should use IP addresses that have the form 192.168.2.nnn.

The subnet mask that is used for both sides of the internal LAN is 255.255.255.0.

11.3.1.2 IP address conflicts

This section discusses the possibility of an address conflict between the IP addresses assigned to the internal LAN and those that are being used on the external network.

As described in the previous section, the IP addresses used on the internal LAN are assigned by the INSWNTSVR command, although you can override the default assignment by specifying your own addresses. Therefore, if you plan carefully, you should not get into a conflict situation. However, if you have an address conflict after installation, you can manually change the IP addresses that are used by the internal LAN.

If you decide to enter your own addresses for the OS/400 and Windows 2000 server sides of the internal LAN, specify the OS/400 and Windows 2000 server IP addresses in the form `xxx.yyy.zzz.nnn`, where *xxx*, *yyy*, *zzz*, and *nnn* are decimal numbers that range from 0 through 255. The IP addresses selected must be unique across all network server description objects and the OS/400 TCP/IP configuration. The xxx.yyy.zzz value in the IP address for the OS/400 side must match the xxx.yyy.zzz value for the IP address of the Windows 2000 server side of the internal LAN. However, the values for *nnn* must be different.

For a description of how to change the IP addresses on the internal LAN, refer to 9.3.2.1, “Changing the internal LAN IP addresses” on page 240.

11.3.2 Network protocols

A Windows 2000 server running on a PC can use either the NetBIOS or TCP/IP protocols. A Windows 2000 server running on the Integrated xSeries Server uses NetBIOS over TCP/IP by default.

If you have a TCP/IP network that is composed of more than one TCP/IP subnet, you may need to add entries to your name servers to enable servers and clients to find each other on the network.

The following two common name servers can be used in this environment:

- **Domain name service (DNS)**

  A DNS server is used to resolve TCP/IP host names to IP addresses in larger networks. To use a DNS server, you need to specify the TCP/IP address of the DNS server in the Windows 2000 server and client TCP/IP configuration files.

  If your network has a DNS available, the iSeries, Windows 2000 server, and optionally, all its clients should each have an entry in the server mapping table.

  Notice that the iSeries server provides DNS (and also DHCP) server capabilities, starting at Version 4 Release 2. If you want to use Active Directory, make sure that your DNS server supports the functions that are needed by the Windows 2000 server Active Directory.

- **Windows Internet Name Service (WINS)**

  A Microsoft WINS server is used to resolve NetBIOS names to TCP/IP addresses in Microsoft networks. To use a WINS server, you need to specify the TCP/IP address of the WINS server in the Windows TCP/IP configuration.

  Refer to the appropriate Microsoft documentation to set up WINS.

You can also use the static configuration files that are provided by your PC's operating system to resolve names to TCP/IP addresses. This method requires more administration than either DNS or WINS because each PC must be maintained individually. Using static configuration files provides a cost-effective way of solving the name resolution problem in small networks where the cost of a DNS or WINS server may be difficult to justify. The following list shows two static configuration files that you can use:

- **HOSTS**

  The HOSTS file on a Windows PC is used by TCP/IP applications to resolve TCP/IP host names to IP addresses.

  Note: The HOSTS file on a Windows 2000 server running on an Integrated xSeries Server is overwritten with the contents of the iSeries hosts file each time the network server description is varied on. All changes to the Windows 2000 server HOSTS file should be done through the iSeries server for this reason.

- **LMHOSTS**

  The LMHOSTS file on a Windows PC is used by NetBIOS applications to resolve NetBIOS names to TCP/IP addresses. This file can be very useful when you are working with AS/400 NetServer. Refer to 14.3, "Finding AS/400 NetServer in the network" on page 352, for more information.

A Distributed Hosts Configuration Protocol (DHCP) server can be used in a network to automatically allocate IP addresses to TCP/IP-capable computers.

Notice you should always allocate fixed IP addresses to servers in your network, in this case, the iSeries and Windows 2000 servers.

TCP/IP is required for the virtual token-ring adapter (which sits on the Windows 2000 server end of the internal LAN) and is the strategic protocol for the Windows 2000 server. If the NetBEUI or IPX protocols are not needed on your network, they can be disabled or removed from the Windows 2000 server network configuration after the Windows 2000 server installation has completed.

Chapter 12. Windows 2000 server Terminal Services

Terminal Services is now a built-in feature of the Windows 2000 server. It allows consolidating user desktops and applications to the Integrated xSeries Server and takes advantage of the OS/400 integration. This chapter describes how to setup a simple environment and how to take advantage of the OS/400 integration.

12.1 Overview

This section describes how to create an OS/400 user profile, place an IBM Network Station on the user's desk top, and enroll the user in the line of business application on the iSeries server. The user will then be up and running with all their PC and *OS/400 legacy* applications using a single user profile.

With intelligent management and the use of OS/400 Version 4 Release 5, Integrated xSeries Server, Windows 2000 server, and IBM Network Station, you can reduce the management overhead you experience in a separate server environment.

This chapter provides ideas and simple examples of how the Windows 2000 server, Citrix MetaFrame, and an Integrated xSeries Server can be set up to give you management advantages.

12.1.1 What's new with Windows 2000 Server Terminal Services

Windows 2000 Server Terminal Services adds some new functions over Windows NT 4.0, Terminal Server Edition. Here is a short overview:

- **Automated local printer support**: This feature provides the ability to detect, install, and access printers that are attached to Terminal Services Clients. Such local printers are automatically made the default for that user, without exposing the printer to other Terminal Server or network users.
- **Clipboard redirection**: Provides the ability to cut and paste between applications running on the local machine and those running on the Terminal Server.
- **Performance enhancements**: Some improvements to caching, packet utilization, and frame size have provided several performance improvements.
- **Remote control**: Administrators can view, control, and interact with other Terminal Services Client sessions.
- **Network load balancing support**: Terminal Services Client can connect to the least busy member of a pool of Terminal Services Servers.
- **Microsoft Management Console integration**: Lets you manage Windows 2000 Server Terminal Services from one place.

12.2 Server modes

The Windows 2000 server that is built in Terminal Services allows a choice of server modes: Remote Administration or Application Server mode.

12.2.1 Remote Administration

Remote Administration gives system administrators a GUI-based method for remotely administering any Windows 2000 server over a TCP/IP connection. You can administrate file and print sharing, edit the registry from another computer on the network, or perform most any task that is accessible from the console.

Remote Administration mode only installs the components of Terminal Services that are required to provide remote access. It does not install the application-sharing components or affect the process scheduler; these functions are in the Application Server mode. This means Remote Administration can be run with very little overhead.

Terminal Services allows a maximum of two concurrent Remote Administration connections. In this mode, only system administrators can enable connections. Therefore, the server is protected from inadvertent or malicious access by an end user. No additional licensing is required for the two Remote Administration connections, and a Terminal Services license server is not required.

12.2.2 Application Server

In Application Server mode, applications can be deployed and managed from a central location. This saves administrators initial development and deployment time, as well as the time and effort required for maintenance and upgrade. Once an application is deployed via Terminal Services, many clients can connect using a Remote Access connection, local area network (LAN), or wide area network (WAN).

Licensing is required when deploying a Terminal Server as an application server. Each client, regardless of the protocol used to connect to a Terminal Server, must have the Terminal Services Client Access License (TSCAL) and the Windows 2000 server Client Access License (2000CAL). While each copy of Windows 2000 Professional includes a TSCAL, access from earlier versions of Windows NT and clients using other platforms require the purchase of additional TSCALs and 2000CALs.

Figure 117 shows you an overview of clients that you can connect to Windows 2000 Server Terminal Services. For some clients, additional software, such as Citrix MetaFrame, is required. Windows 2000 Server Terminal Services supports only Windows clients. Citrix MetaFrame adds support for other clients.

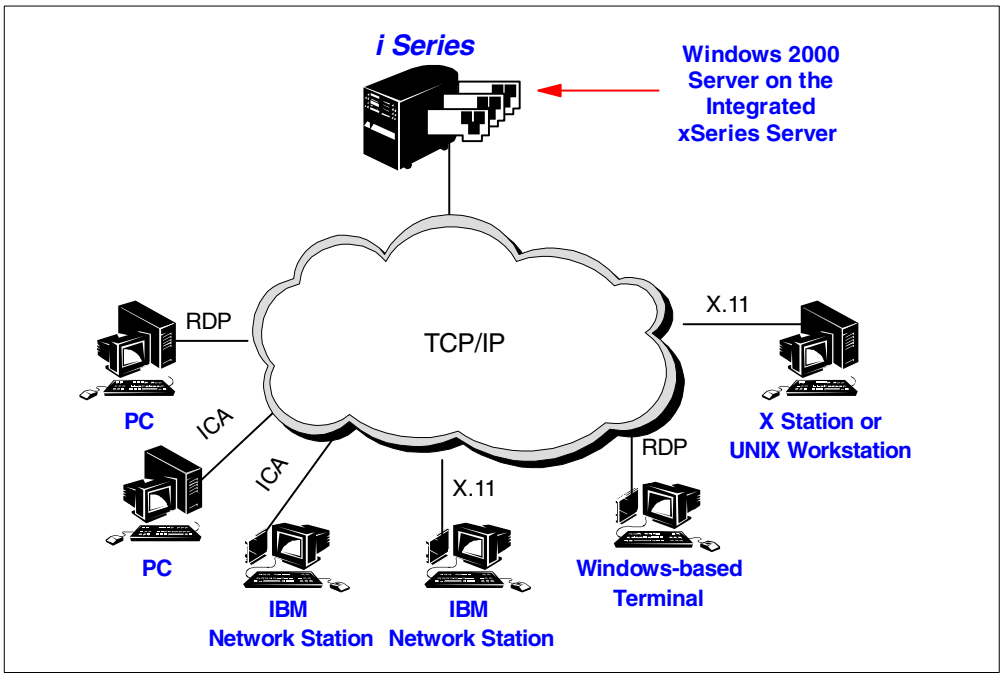

Figure 117. Clients connected to Windows 2000 Server Terminal Services

One of the most manageable solutions is to use IBM Network Stations as your clients with the iSeries as the boot server. The iSeries server supplies network stations with all the boot code and configuration information that they need at the time they are started. If you must change the configuration of a user, such as giving them access to an iSeries server, you simply go into the Network Station Manager and change the configuration for that user. The IBM Network Station can even be used when only a legacy twinaxial cable is available.

IBM Network Stations can run a 5250 session, 3270 session, a browser, Java, and a Terminal Server Client natively. Other functionality is provided by Windows 2000 Server Terminal Services. This is ideal if green-screen users are migrated to IBM Network Stations because most of their base functionality is provided by the IBM Network Station, with minimal overhead on the Windows 2000 server.

12.2.3 Flexibility and manageability

One of the major advantages of Terminal Server on the Integrated xSeries Server is its ability to leverage on, and integrate to, the strong iSeries hardware and operating systems at its base. Some of the advantages of the environment are:

- **Up to 16 Windows 2000 servers consolidated into one OS/400**

  Depending on the model of iSeries you have, up to 16 Integrated xSeries Servers can be installed and managed in a single iSeries server.

- **Ability to have a hot spare server available, if required**

  If an Integrated xSeries Server card fails, it is not difficult to switch over to another card. All that is required is that the spare card has equivalent I/O and memory capabilities as the card that failed. Then vary off the Integrated xSeries Server that failed, change the hardware resource to the spare card, and vary it on.

- **Better disk management**

  With the iSeries server managing the disk storage, it is simple to allocate more disk capacity to a Windows 2000 server, even remotely. All that is required is that the disk space be available on the iSeries server. To allocate it to the server, you follow these steps:

  a. Create a new storage space.
  b. Vary off the server.
  c. Attach it to the server.
  d. Vary the server back on, and then sign on to the Windows 2000 server.
  e. Format the storage space.

  If you have an existing storage space that you want to move, you can unlink it from one server and link it to another server.

  Also, the iSeries server provides support for RAID and mirroring, so you don't need to worry about that on your Windows 2000 server running on the Integrated xSeries Server.

- **More flexible testing**

  Using a single physical Integrated xSeries Server, you can define a test and production server. When you want to carry out testing, you vary off the production server and vary on the testing server, which minimizes the risk to production.

- **Improved general management**

  Apart from managing the disks remotely, other management facilities are available including monitoring Windows 2000 server Event Log messages in an OS/400 message queue, submitting commands from the iSeries to the Windows 2000 server, and remotely rebooting the server.

12.2.4 Terminal Server structure

Windows 2000 Server Terminal Services consists of five components:

- **Multi-user kernel**: The multi-user kernel extensions, which were originally developed for Windows NT Server 4.0, Terminal Server Edition, have been enhanced and fully integrated as a standard part of the Windows 2000 server family kernel. These reside on the server at all times, regardless of whether Terminal Services is enabled.
- **Remote Desktop Protocol (RDP)**: A key component of Windows 2000 Server Terminal Services is the protocol that allows a client to communicate with the Terminal server over a network. This protocol is based on International Telecommunications Union's (ITU) T.120, an international standard, multiple-channel protocol that is used first in Microsoft NetMeeting conferencing software. It is a Unicode-compatible protocol tunable for any environment that allows for network localization, automatic disconnection, and remote configuration. It supports three levels of encryption. It also supports different bandwidth allocations by allowing client-side bitmap caching and optional compression for low-bandwidth connections.
- **Terminal Services Client software**: This is the client software that displays the familiar 32-bit Windows user interface on a client machine. The client software is a very small software application that establishes and maintains the connection between a client and a server running Terminal Services. It transmits all input from the user to the server, such as keystrokes and mouse

movements, and all output from the server, such as application display information and print streams.

- **Terminal Services Licensing service:** This service is required whenever Terminal Services is enabled for application serving. The service allows Terminal Services to obtain and manage its Terminal Services Client Access Licenses (CALs) for connecting devices. It can manage unlicensed, pre-licensed, temporarily licensed, and CAL licensed clients. It also supports both ordinary CAL and Internet Connector Licensing for Terminal Services. The Remote Administration mode does not use the Terminal Services Licensing service.
- **Terminal Services Administration Tools**: These tools consist of software that manages Terminal Services, including Terminal Services License Manager, Terminal Services Client Creator, Terminal Services Client Configuration, and Terminal Services Manager.

Figure 118 shows which services are provided by the server and which are done by the client.

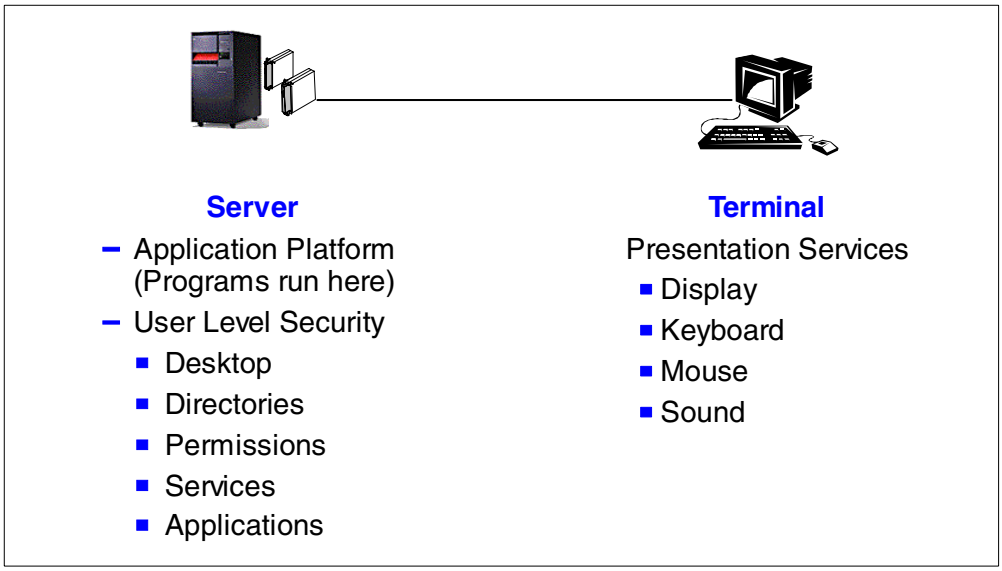

Figure 118. Tasks carried out by the Terminal Server and Client

To interact with users, the display, keyboard, and mouse information must be communicated back and forth between the server and the users' workstations. To facilitate this, a communications protocol is used. Microsoft uses RDP, with client support limited to Windows terminals, such as Windows CE, Windows for Workgroups 3.1, Windows 95, 98, and NT, and Windows 2000. To connect other platforms to Windows 2000 Server Terminal Services, you need additional software such as Citrix MetaFrame.

Figure 119 on page 280 shows an overview of the protocol that is used to connect clients to Windows 2000 Server Terminal Services.

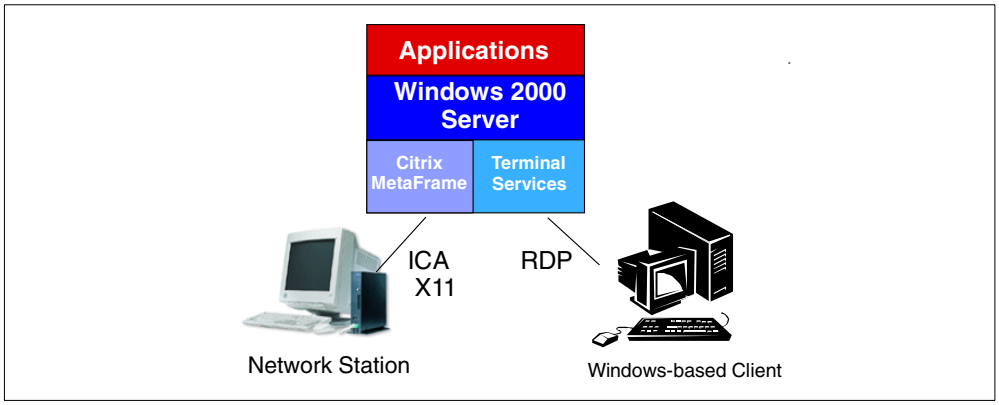

Figure 119. Protocol and Client details

Take care when using RDP because it is designed to be used on a LAN. Consequently, it implements minimal compression, which results in spikes where relatively large amounts of data must be sent quickly. These characteristics would lead to poor performance over a low speed link, such as dial-in or most WAN environments.

12.2.5 Citrix MetaFrame

Citrix Systems (`http://www.citrix.com`) produced a product called MetaFrame to extend the capabilities of Terminal Services. To highlight Citrix's strength in this market, MetaFrame has evolved from Citrix WinFrame, which was a multi-user version of Windows NT 3.51.

MetaFrame is significant in that it extends the reach of Terminal Services and, therefore, the ability to consolidate servers in your organization. Through their experience with WinFrame, Citrix developed MetaFrame to give improved connectivity to remote clients and better management of the Terminal Services environment.

12.2.5.1 Independent Computing Architecture (ICA)

At the heart of MetaFrame is a structure called Independent Computing Architecture (ICA), which includes a server software component, a network protocol component, and a client software component. On the server, ICA separates the application logic from the user interface at the server and transports it to the client over standard network protocols, such as IPX, SPX, NetBEUI, TCP/IP, PPP, and other popular network connections, such as asynchronous, dial-up, LAN, WAN, wireless, Internet, and intranet.

The ICA structure transports keystrokes, mouse clicks, and display updates to the client, and it consumes less than 20 KB/sec. of network bandwidth. Because ICA is implemented at the system level, it is efficient so that only keystrokes, mouse clicks, and display updates travel the network. Methods used to improve the performance include intelligent compression with state persistence and intelligent caching of Windows objects, such as bitmaps, brushes, and pointers.

Unlike RDP, which is only implemented on Windows desktops, ICA has a wider range of clients. The range of clients includes:

- IBM Network Station (V3.0)
- DOS
- Windows 3.1
- Windows for Workgroups
- Windows 95/98
- Windows NT Workstation/Server
- Windows CE
- OS/2
- Macintosh (68000 and PowerPC)
- UNIX (Sun Solaris, HP-UX, IBM AIX, Digital, SGI IRIX, LINUX, SCO)
- Java
- Microsoft Internet Explorer ActiveX Control
- Netscape Navigator Plug-in

ICA has also been ported to EPOC32, RISC OS, Windows CE, ARM, and the QNX OS embedded operating system.

As shown in Figure 119, another protocol, X11, is available. This protocol is primarily used for UNIX clients to interact with Terminal Server. This lets graphical UNIX terminal run Windows applications and cut and paste across the two operating systems. IBM Network Station with Network Station Manager V3 or later is capable of running both ICA and X11.

Note: For the IBM Network Station, we recommend that you use an ICA connection.

For details on how to install Citrix MetaFrame, go to 12.9, “Citrix MetaFrame” on page 305.

12.3 Windows 2000 Server Terminal Services installation

It is not difficult to install Windows 2000 Server Terminal Services on the Integrated xSeries Server, because Terminal Services is part of the Windows 2000 server. You must go through the same planning considerations as with the Windows 2000 server. However, there are a few differences that are highlighted in this section. Here is a summary of the tasks you must perform:

1. Read through the documentation, and highlight special considerations for the Terminal Server installation.
2. Complete the preliminary planning steps including printing and filling out of the worksheets in Chapter 2, “Installation planning” on page 17, and in 2.6, “Installation worksheet” on page 30.
3. Install the integration software from IBM.
4. Perform the iSeries setup tasks.
5. Install the Windows 2000 server as explained in Chapter 3, “Installing the Windows 2000 server” on page 37.
6. Conduct a few configuration tasks on the Windows 2000 server to complete the installation.

Be sure to read Chapter 3, “Installing the Windows 2000 server” on page 37, which discusses the installation procedures for the Windows 2000 server on the Integrated xSeries Server.

12.3.1 Important current Terminal Server information

Before you begin, it is important that you have the latest information pertaining to Terminal Server on the Integrated xSeries Server. Find this information on the Web at: `http://www.iseries.ibm.com/windowsintegration/index.htm`

12.3.2 Changes during the INSWNTSVR command

The installation procedure for Terminal Server is similar to the process for the Windows 2000 server. This section highlights the differences that you must consider during the planning and installation of the Install Windows Server (INSWNTSVR) command. In this section, we assume that a new Windows 2000 server has been installed, not an upgrade from Windows NT Server, Terminal Server Edition (TSE).

12.3.2.1 Server domain role

Because of the work that the server must perform, Microsoft recommends that you do not set up your Terminal Server as a primary domain controller or a backup domain controller. If your network is small, there should be no problem, especially if this server is the only server that can be used to propagate user profiles from OS/400 to Windows 2000 for the domain.

When you install the Windows 2000 server on the Integrated xSeries Server, the server is, by default, installed as a member server. Figure 120 shows how the domain role is defined.

```
                    Install Windows Server (INSWNTSVR)

Type choices, press Enter.

Network server description . . . > WIN2K          Name
Resource name  . . . . . .                        Name
Domain role  . . . . . .          *SERVER         *DMNCTL, *BKUCTL, *SERVER
Windows server version . . . . .  *WIN2000       *NT40, *WIN2000
```

Figure 120. Install Windows Server command: Domain role

12.3.2.2 The system drive

There are two major differences that you must consider when you create the system drive (C: drive) on a Windows 2000 Server Terminal Server: size and format.

Size

In a standard installation, a Terminal Server depends more on its C: drive than on the Windows 2000 server, because the C: drive typically has more RAM installed, which requires more swap space, and has more application activity. The size certainly must be increased from the default of 500 MB to at least 2000 MB, with the maximum capacity being 8000 MB. If the capacity exceeds 2047 MB, NTFS is mandatory. A rough formula for minimum disk size should be:

```
MinimumDiskSize=500 MB + ApplicationSpace + 2 x INSRAM
```

A description of the formula follows:

- *500 MB* is a base required by the Windows 2000 server with a small space for additional objects required in the Windows directories.

- *ApplicationSpace* is required for installing any application that will be installed on the C: drive.

  Note: There may be shared applications that insist on installing on the same drive as Windows. You should allocate 500 MB at a minimum.

- *2 x INSRAM* is two times the number of MB of RAM installed on the Integrated xSeries Server for a swap file.

When you run the INSWNTSVR command, the SVRSTGSIZE parameter appears, indicating the C: drive size, as shown in Figure 121.

```
                    Install Windows NT Server (INSWNTSVR)

Server storage space sizes:
   Install source size  . . . . .   200          200-2047
   System size  . . . . . . . . .   1023         500-8000, *CALC
 Storage space ASP:
   Install source ASP . . . . . .   1            1-16
   System ASP . . . . . . . . . .   1            1-16
Convert to NTFS  . . . . . . . .   *YES         *NO, *YES
```

Figure 121. Changes to the C: drive size on the INSWNTSVR command

Format

Because users will actually run applications on the server, an unsecured drive may result in accidental damage, which will effect other users. Therefore, security on the C: drive should be set up. This requires setting up the C: drive as NTFS to permit the administrator to setup permissions on the directories installed on the C: drive to protect them from being damaged.

When you run the INSWNTSVR command, the CVINTFS parameter appears, indicating the C: drive format, as shown in Figure 122.

```
                    Install Windows NT Server (INSWNTSVR)

Server storage space sizes:
   Install source size  . . . . .   200          200-2047
   System size  . . . . . . . . .   1023         500-8000, *CALC
 Storage space ASP:
   Install source ASP . . . . . .   1            1-16
   System ASP . . . . . . . . . .   1            1-16
Convert to NTFS  . . . . . . . .   *YES         *NO, *YES
```

Figure 122. Changes to the C: drive format on the INSWNTSVR command for TSE

12.3.3 Windows part of the Terminal Server installation

After you install your Windows 2000 server, you need to activate Terminal Services. Open the Control Panel, and follow the steps shown in Figure 123 and Figure 124 on page 284.

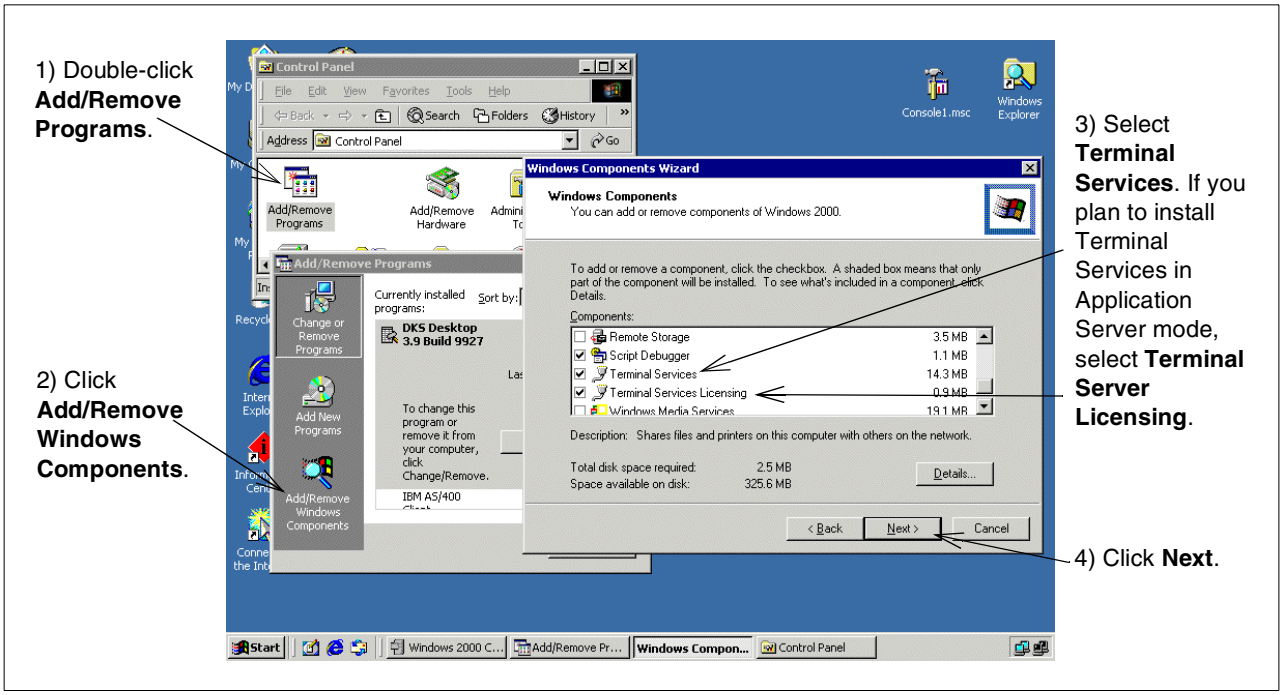

Figure 123. Installing Terminal Services

Next, the Terminal Services Installation wizard appears. Select the mode in which you want Terminal Services to be installed.

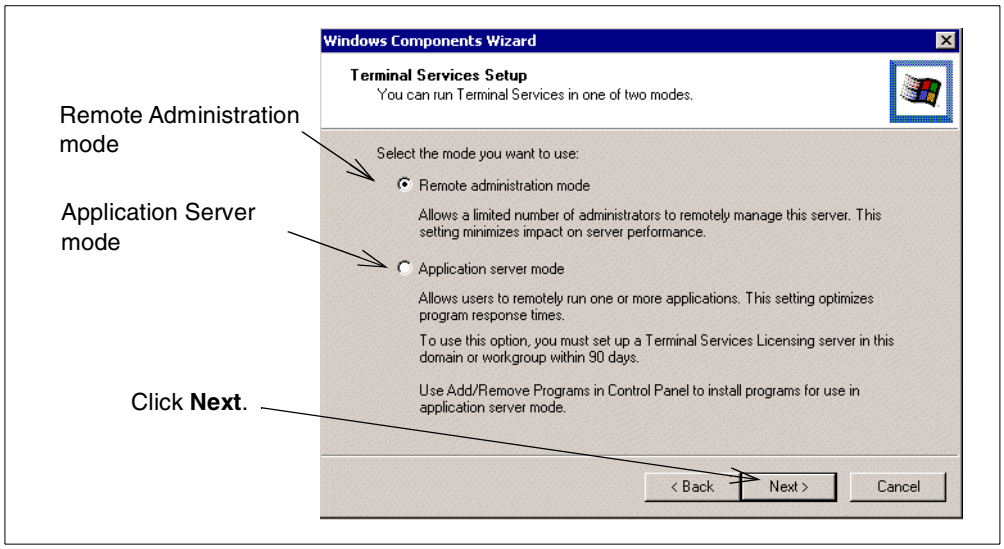

Figure 124. Terminal Services Setup

Remote Administration mode allows only up to two Administrators to sign on to Terminal Services. You should not use this mode to connect an end user to the server, because the end user will have all permissions on the server. The Remote Administration mode has less performance overhead than the Application Server mode has, so you can really use this installation mode for implementing Remote Administration of your departments. If you install Remote Administration, read the

following section. Otherwise, continue with 12.3.3.2, “Application Server installation” on page 285.

12.3.3.1 Remote Administration installation

Windows now starts the installation. Complete the sequence shown in the following figures.

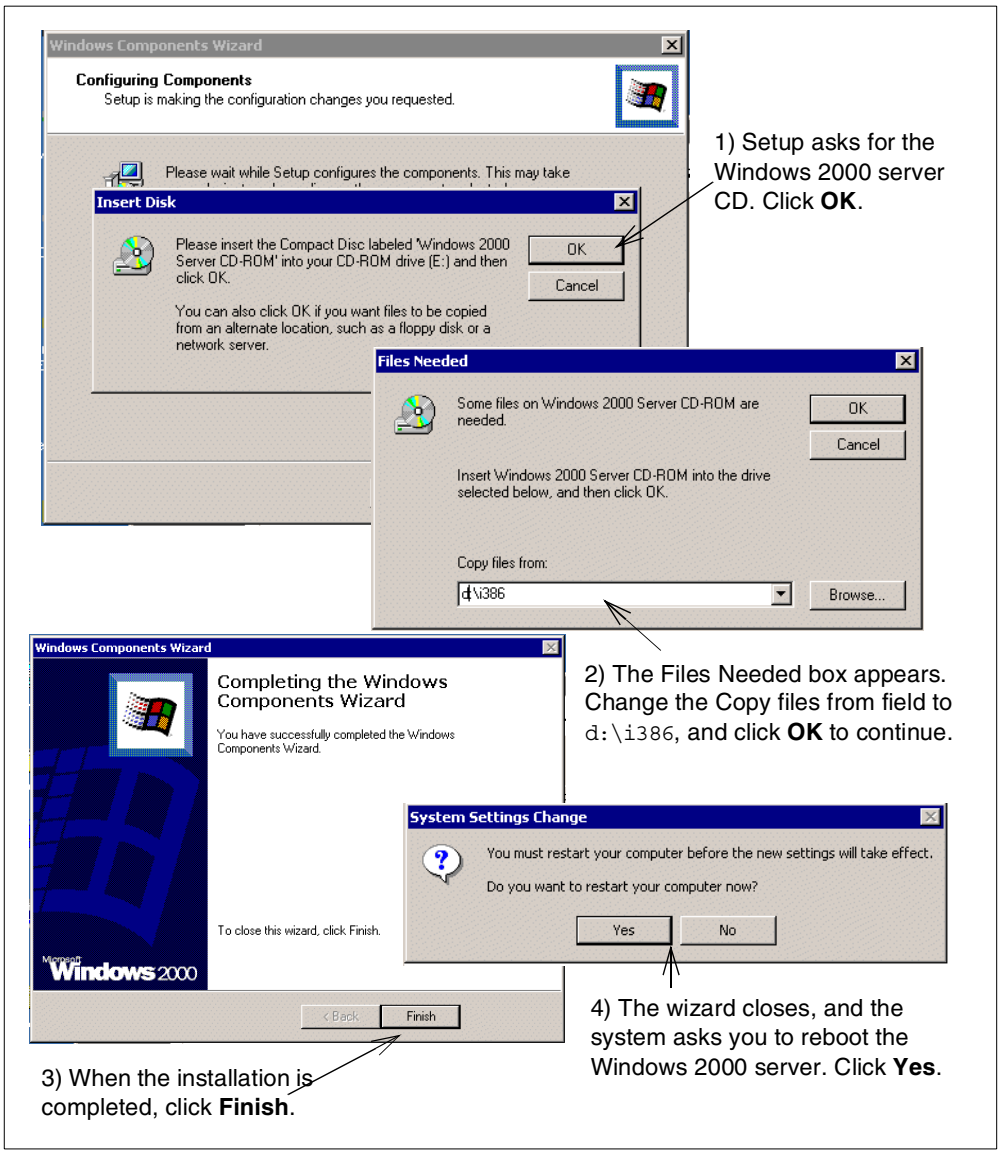

Figure 125. Remote Administration installation

After the Windows 2000 server is rebooted, you can install Terminal Server Client on your PC. See 12.6, “Terminal Services Client” on page 293, for details.

12.3.3.2 Application Server installation

The next step is to decide what kind of security to use.

The Permission setting depends on your environment, the clients you are connecting, and the applications you are going to install. In this example, we use Permissions compatible with Terminal Server 4.0 Users, as shown in Figure 126.

You can always change this setting in the Terminal Services Configuration as described in 12.5, “Terminal Services Management” on page 291.

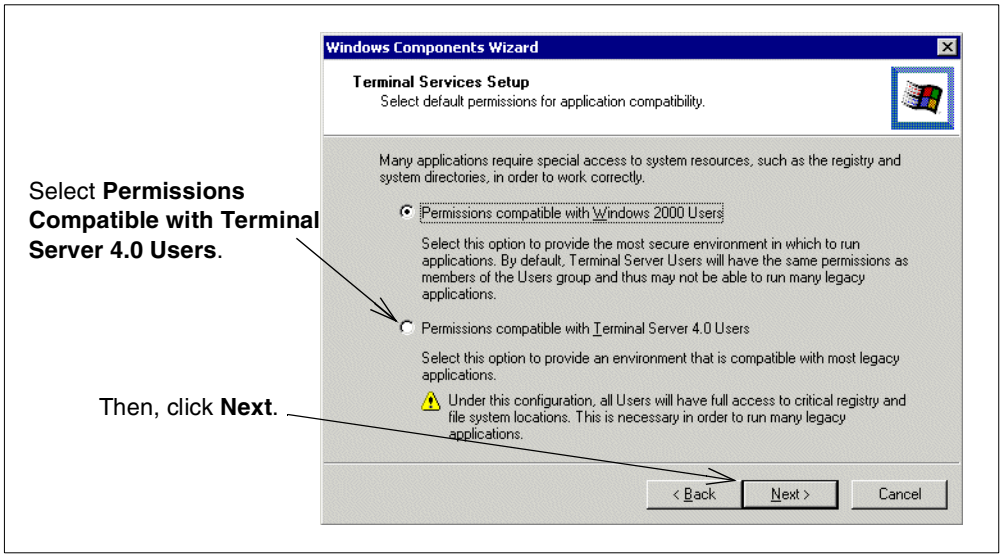

Figure 126. Terminal Services security

Some already installed applications may not work correctly with Windows 2000 Server Terminal Services. If such applications are already installed, the wizard shows a warning similar to the example in Figure 127. Write down the list of affected programs (circled in Figure 127) before you continue. The installation wizard will show you applications you already installed, such as the administration or backup tools. These applications are installed for single user mode, which in some cases is acceptable. Depending on the effect you want, try to run the program after installation, and if necessary, reinstall it.

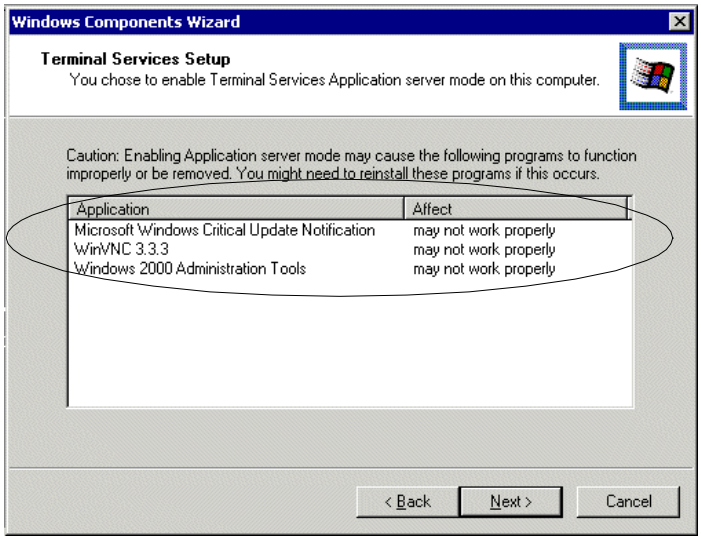

Figure 127. Installed applications that may not work

The next step is to decide where to install the license server database and to whom you want to make this license server available. You can choose to make the license server available for your entire enterprise or a domain or workgroup.

For large enterprises, it may be more suitable to install a Windows 2000 server only for Terminal Services Licensing and one for Terminal Services. In small network environments, choose to make the Terminal Services License server available to your domain or workgroup. The initial Terminal Services License Database is about 20 MB in size.

Follow the steps in Figure 128 for the Terminal Services Licensing Setup display.

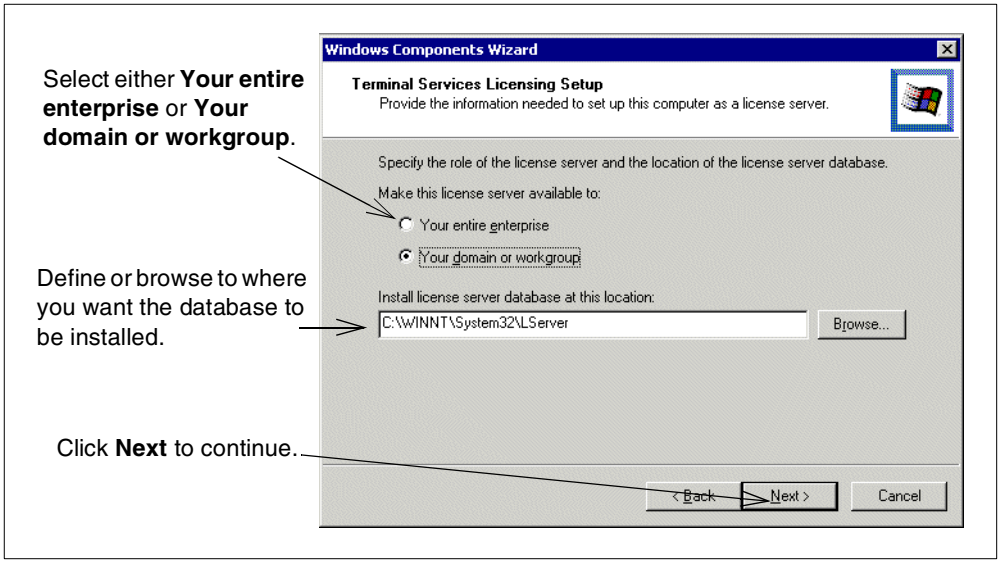

Figure 128. License server setup

Next, follow the steps that are shown in Figure 129 on page 288.

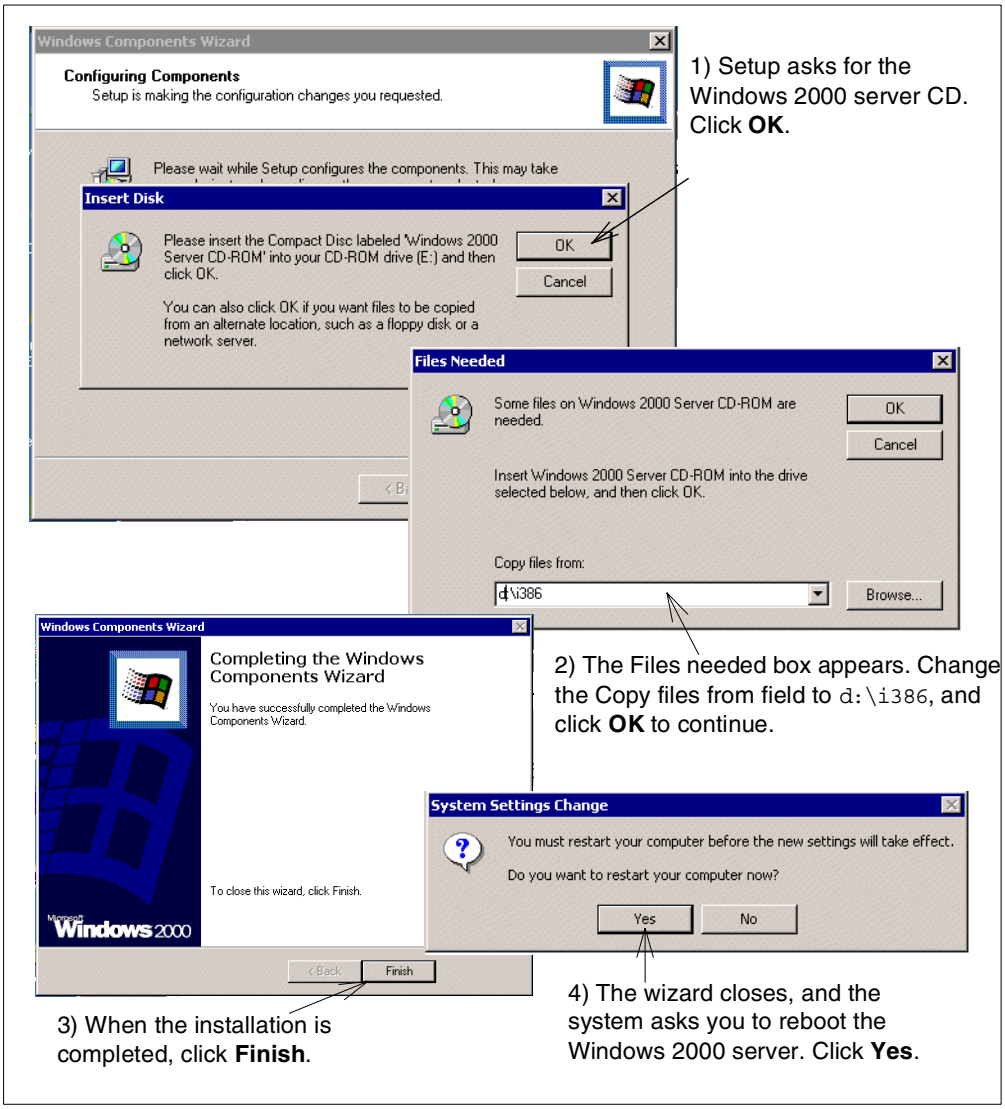

Figure 129. Application Services installation

Now that you have installed the Windows 2000 Server Terminal Services, you may continue with the steps in any of the following sections:

- Section 12.5, “Terminal Services Management” on page 291
- Section 12.6, “Terminal Services Client” on page 293
- Section 12.7, “Installing applications on the Windows 2000 Server Terminal Server” on page 295

12.4 Terminal Services Licensing

Before you install clients, you need to enable Terminal Services Licensing. Two licenses are required: the Terminal Services Client Access License (TSCAL) and the Windows 2000 server Client Access License (2000CAL). Each copy of Windows 2000 Professional includes a TSCAL. This section only discusses the TSCAL.

Terminal Services Licensing is only required if you use the Application Server mode. Remote Administration mode does not require licensing.

12.4.1 Activating Terminal Services Licensing

There are four connection methods to activate your license server:

- **Internet**: The Internet offers the quickest and easiest way to activate and install licenses, and it is the method that is recommended by Microsoft. This method requires Internet connectivity from the device running the Terminal Services Licensing Administration tool. Internet connectivity is not required from the license server itself. The Internet method uses TCP/IP to connect directly to the clearinghouse.
- **Web**: The Web method should be used when the device running the Terminal Services Licensing Administration tool does not have Internet connectivity, but you have access to the World Wide Web through a Web browser from another machine. The URL for the Web method is displayed in the Licensing Wizard.
- **Phone**: The phone method allows you to talk to a Microsoft Customer Service Representative to complete the activation or license installation transactions. The appropriate telephone number is determined by the country you chose in the Licensing Wizard and is displayed by the wizard.
- **Fax**: The fax method allows you to fax a page generated by the Licensing Wizard containing the necessary activation or license installation information to the Microsoft Customer Service Center. Microsoft then returns the necessary information to you via return fax. A return fax number is required to complete the transaction in this manner.

When you activate the license server, Microsoft provides the server with a limited-use digital certificate that validates server ownership and identity. Microsoft uses the X.509 industry standard certificate for this purpose. Using this certificate, a license server can make subsequent transactions with Microsoft and receive *client license key packs*. A client license key pack contains multiple Terminal Services Client Access Licenses for distribution by the license server.

A license server must be activated only once. While waiting to complete the activation or license installation processes, your license server can issue temporary licenses for clients that allow them to use terminal servers for up to 90 days.

Open Terminal Services Licensing Manager as shown in Figure 130 on page 290. Then follow the steps in Figure 131 to activate Windows 2000 Server Terminal Services Licensing.

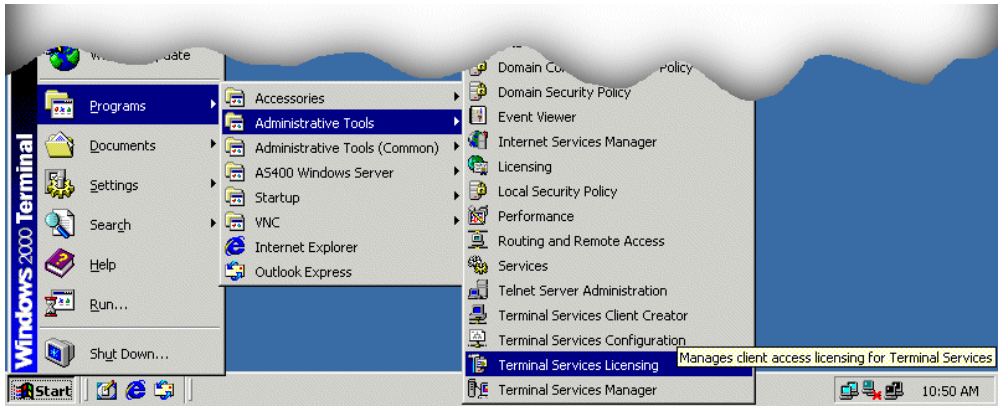

Figure 130. Terminal Services Licensing Manager

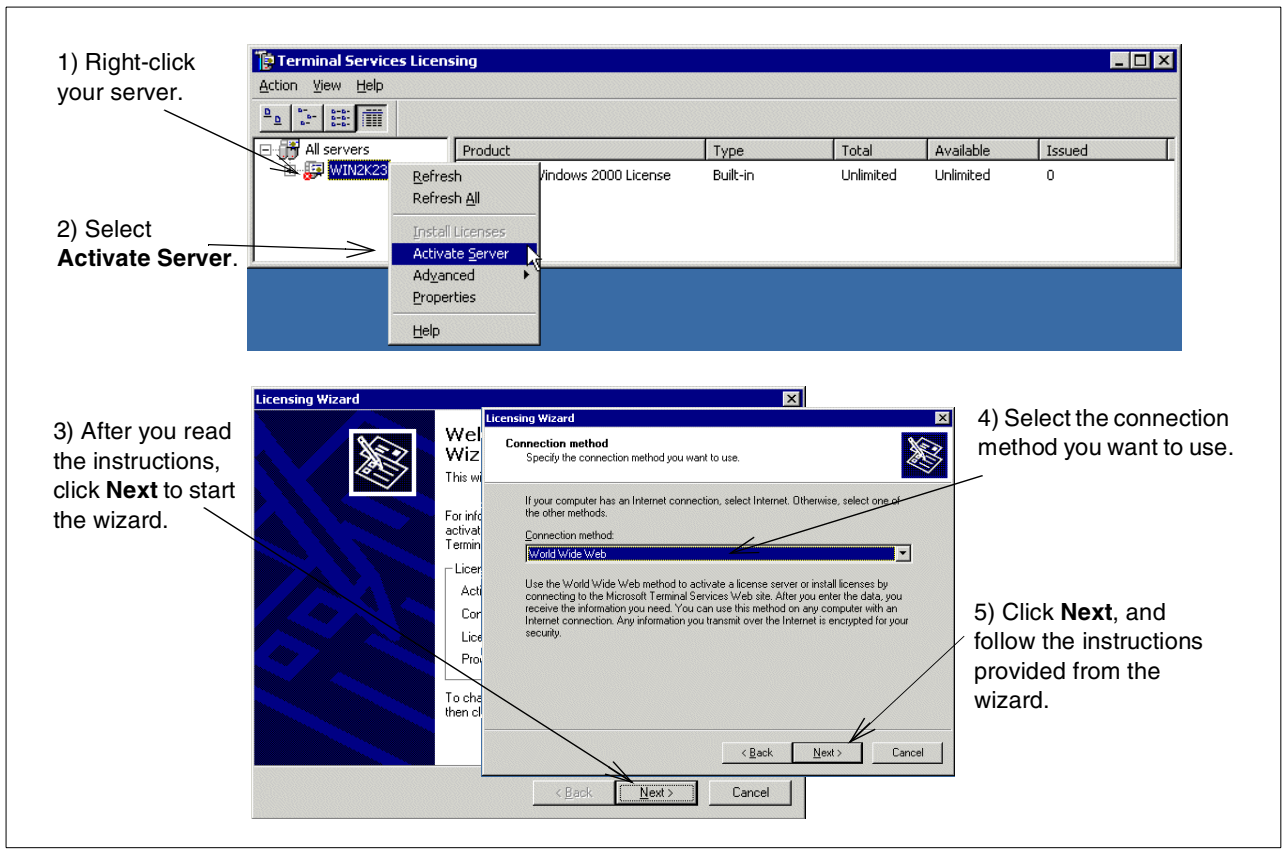

Figure 131. Starting the Terminal Services Licensing Wizard

After you complete the steps required by the wizard, Terminal Services Licensing is installed on your server.

If you need more detailed information about Windows 2000 Server Terminal Services Licensing, go to: `https://activate.microsoft.com/faq.asp`

Or, contact your Microsoft dealer.

> **Note**
>
> In this scenario, we installed the licensing service on the same computer as the Terminal Server. In an actual deployment scenario, Microsoft recommends that you install the licensing service on a separate computer, which must also be the domain controller.

12.5 Terminal Services Management

This section describes the tools that are available to manage the Windows 2000 Server Terminal Services. Microsoft provides four utilities related to Terminal Services Management, which are:

- Terminal Services Client Creator
- Terminal Services Licensing
- Terminal Services Configuration
- Terminal Services Manager

This section covers Terminal Services Configuration and Terminal Services Manager. While Terminal Services Configuration allows you to change the general settings of Terminal Services, Terminal Services Manager enables you to manage active sessions.

12.5.1 Terminal Services Configuration

Terminal Services Configuration allows you to configure some settings of Terminal Services. Figure 132 shows you how to start Terminal Services Configuration.

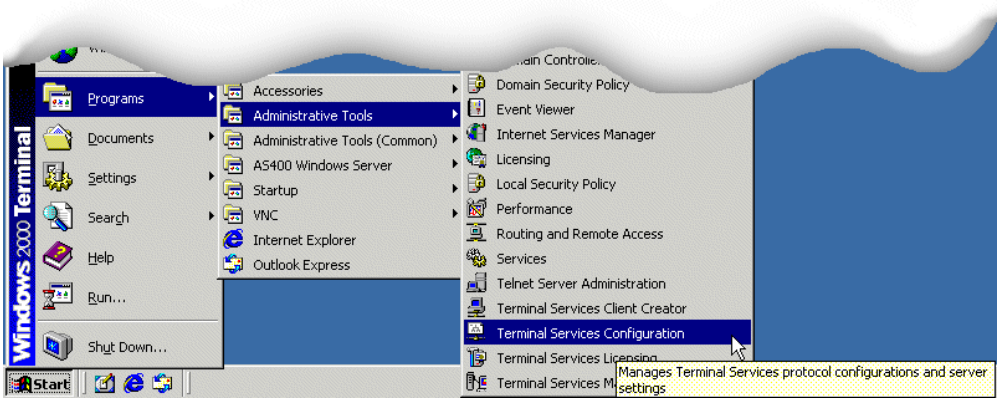

Figure 132. Terminal Services Configuration

A window similar to the example in Figure 133 on page 292 appears. The top configuration options are explained in this figure. Right-click any line in the Details view to change the setting or obtain more details.

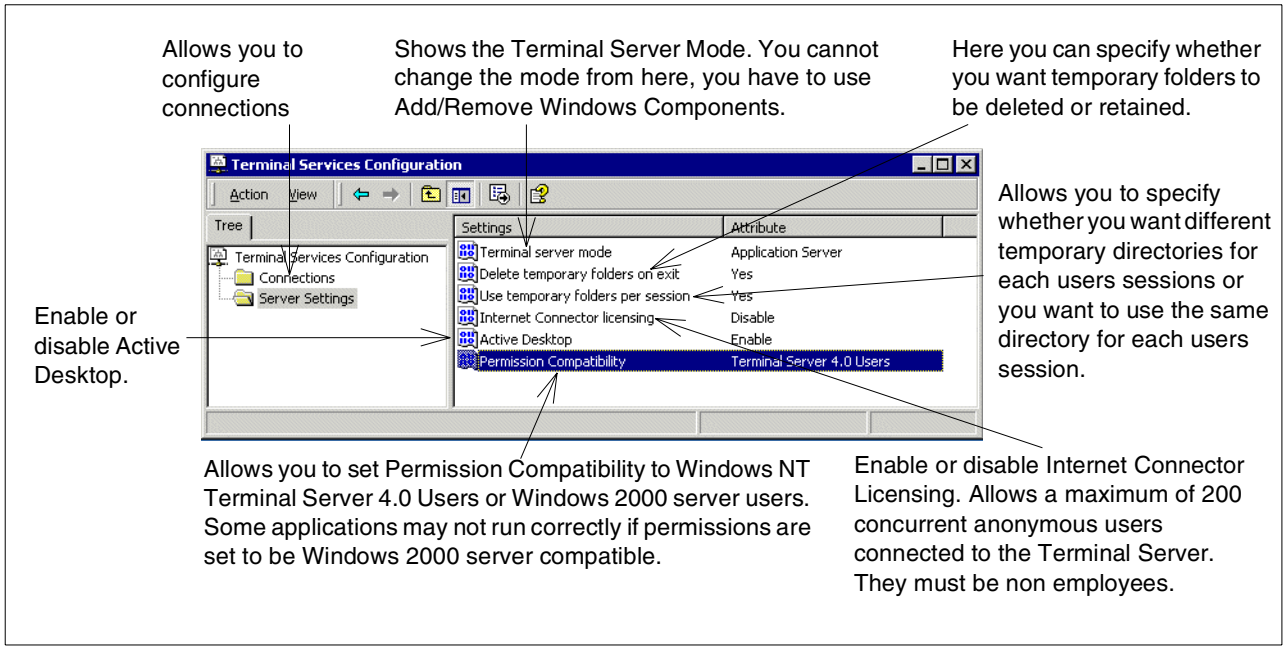

Figure 133. Terminal Services Configuration

12.5.2 Terminal Services Manager

Terminal Services Manager allows you to manage Terminal Services sessions. Figure 134 shows you how to start Terminal Services Manager.

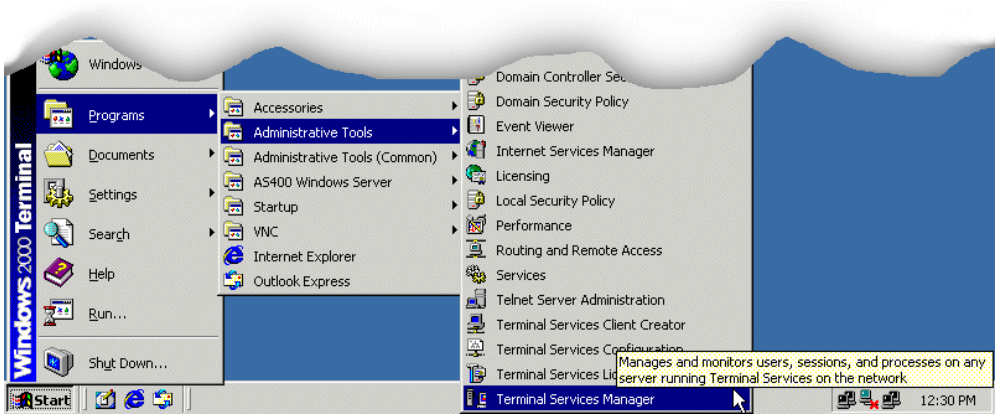

Figure 134. Terminal Services Manager

Then, a window similar to the example in Figure 135 appears.

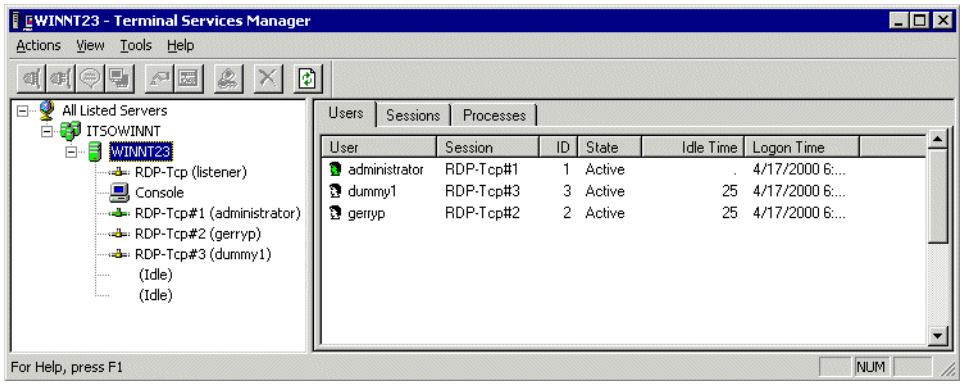

Figure 135. Terminal Services Manager

Right-click any item in the tree view or detail view to see a list of actions that you can perform. Depending on your permissions and the item you selected, you can select one of the following actions:

- Find servers in the domain/in all domains
- Connect/disconnect from all servers in the domain
- Connect/disconnect a session
- Send a message
- Remote control a session
- Get status information

12.6 Terminal Services Client

Terminal Services Client allows you to connect from a Windows PC to Windows 2000 Server Terminal Services.

12.6.1 Installing Terminal Services Client

You can install the Terminal Services Client from a network share or create installation disks. Since the Integrated xSeries Server has no floppy disk drives, you need a PC with a network connection to your Windows 2000 server running Terminal Services and a floppy drive. For this example, we shared the server directory `C:\WINNT\system32\clients\tsclient` and installed the clients from there.

From the client PC, connect to the share. Follow the instructions, shown in Figure 136 on page 294, given by the setup program to install the Windows 2000 Server Terminal Services Client.

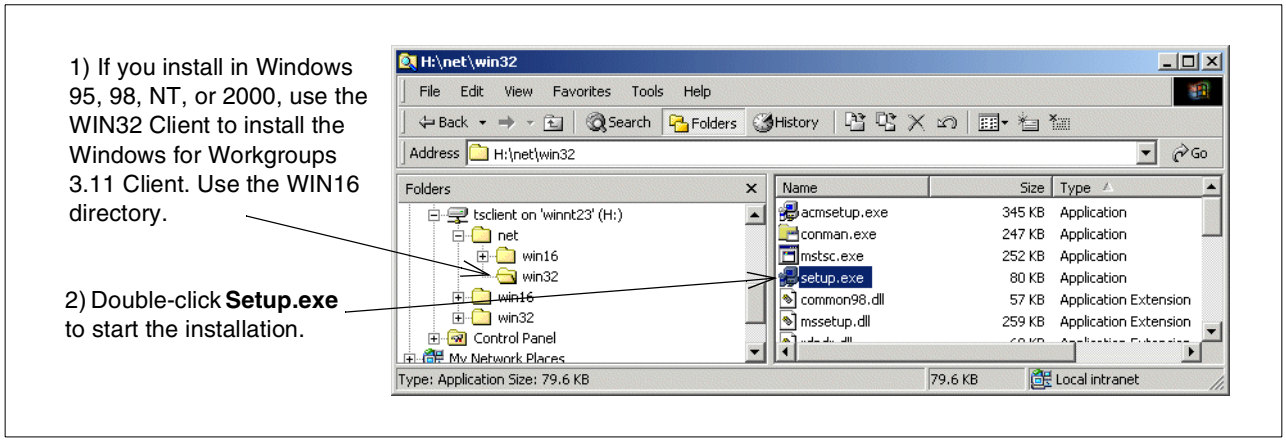

Figure 136. Installing Terminal Services Client

12.6.2 Connecting to the Terminal Server

Open Client Connection Manager as shown in Figure 137.

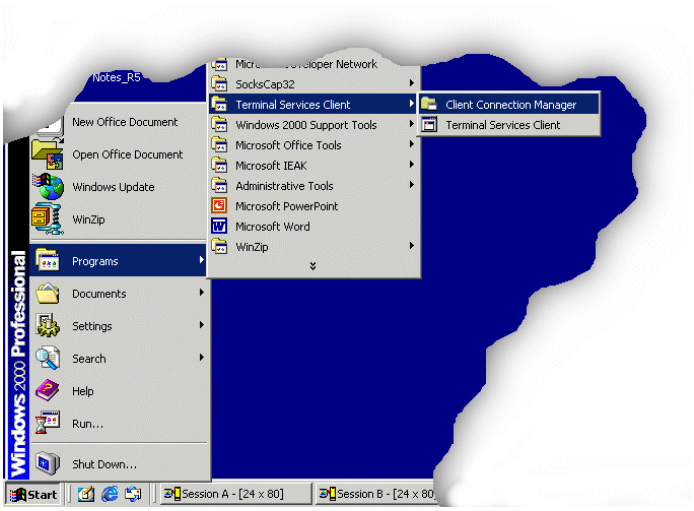

Figure 137. Opening Client Connection Manager

To create a connection, click the **Client Connection** wizard button, as shown in Figure 138.

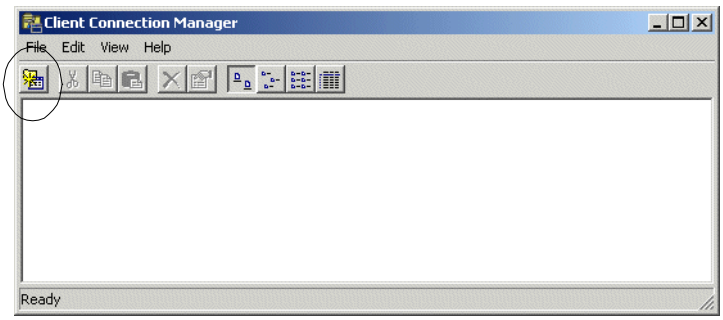

Figure 138. Creating a connection

The connection wizard starts. Follow the instructions given by the wizard to complete the configuration. An icon is added to the Client Connection Manager, with the name of the connection you just configured. Double-click the icon to start the connection.

12.7 Installing applications on the Windows 2000 Server Terminal Server

This section shows you how to install applications on Windows 2000 Server Terminal Services. In most cases, an Office Suite is used to enable word processing, spreadsheet, and presentation applications. Microsoft Office is still the market leader in this segment, so we chose Microsoft Office 2000 for this example. For the second example, we chose IBM Client Access Express V4R5. For more examples and details, refer to the IBM Redpaper *Implementing Windows 2000 Terminal Services and Citrix MetaFrame on IBM Netfinity Servers*, REDP0030, which is on the IBM Redbooks Web site at:

`http://www.redbooks.ibm.com/redpapers/abstracts/redp0030.html`

12.7.1 Microsoft Office 2000

You install Microsoft Office 2000 from Microsoft Office 2000 CD 1 on the Windows 2000 Server Terminal Server in much the same way you install Microsoft Office on a client computer. When you install Microsoft Office on a Terminal Server, the users who connect to the server are limited to your Microsoft Office configuration and cannot install or remove features. If you need different Microsoft Office configurations for your users, you need to install them on different Terminal Servers.

Because of the restrictions, you cannot select the following installation options for any Microsoft Office feature:

- Run from CD or Run from Network
- Run all from CD or Run all from Network
- Installed on first Use

Instead, you have to determine which Microsoft Office features your users need, and use the installation options:

- Run from My Computer
- Run all from My Computer
- Not Available

12.7.1.1 Prerequisites

To install Microsoft Office 2000 on the Terminal Server, you need the installer transform file and the Custom Installation Wizard, which are part of the Microsoft Office 2000 Resource Kit. You can download this toolbox from the Microsoft Office home page located at:

`http://www.microsoft.com/office/ork/2000/appndx/toolbox.htm`

Look for the **Office Resource Kit core tool set**, and download it.

12.7.1.2 Installation

To install the Office Resource Kit core tool set, double-click the downloaded file. The installation wizard guides you through the installation. You need to install at least the Custom Installation Wizard and the Terminal Server Tools.

After installation, start the Custom Installation Wizard as shown in Figure 139.

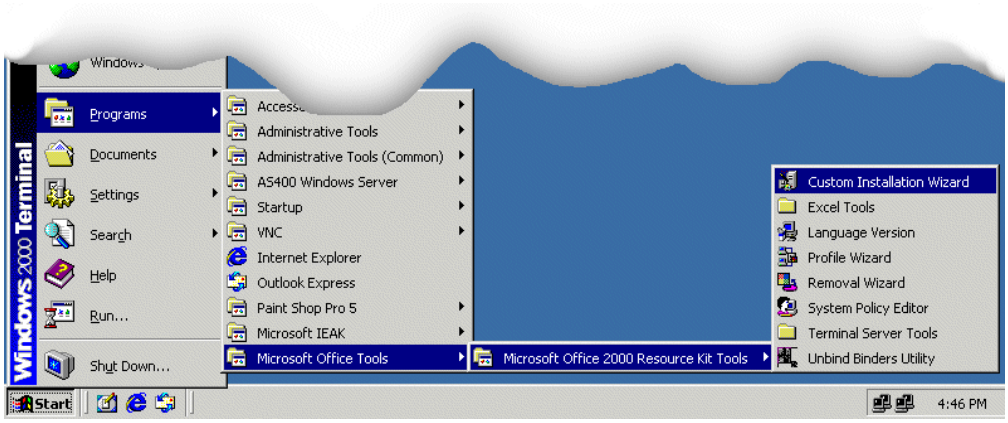

Figure 139. Starting the Office 2000 Custom Installation Wizard

A window appears that is similar to the example in Figure 140.

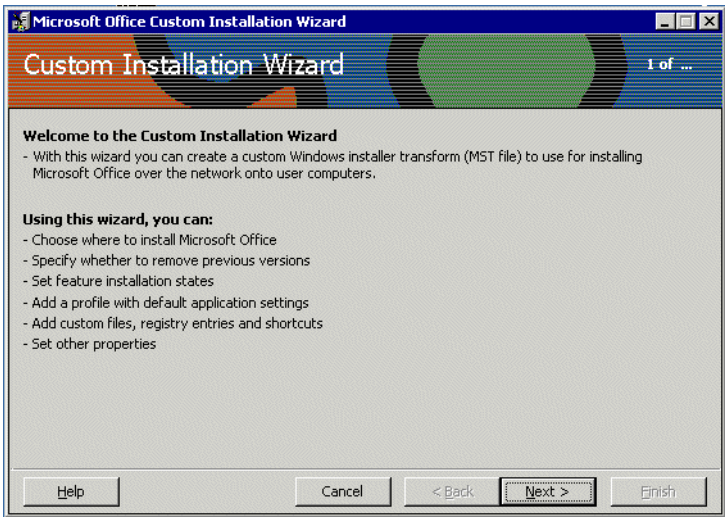

Figure 140. Office 2000 Custom Installation Wizard

Click **Next** to continue the Custom Installation configuration. Insert the Microsoft Office 2000 CD 1 in the iSeries CD-ROM drive. Then follow the steps shown in Figure 141.

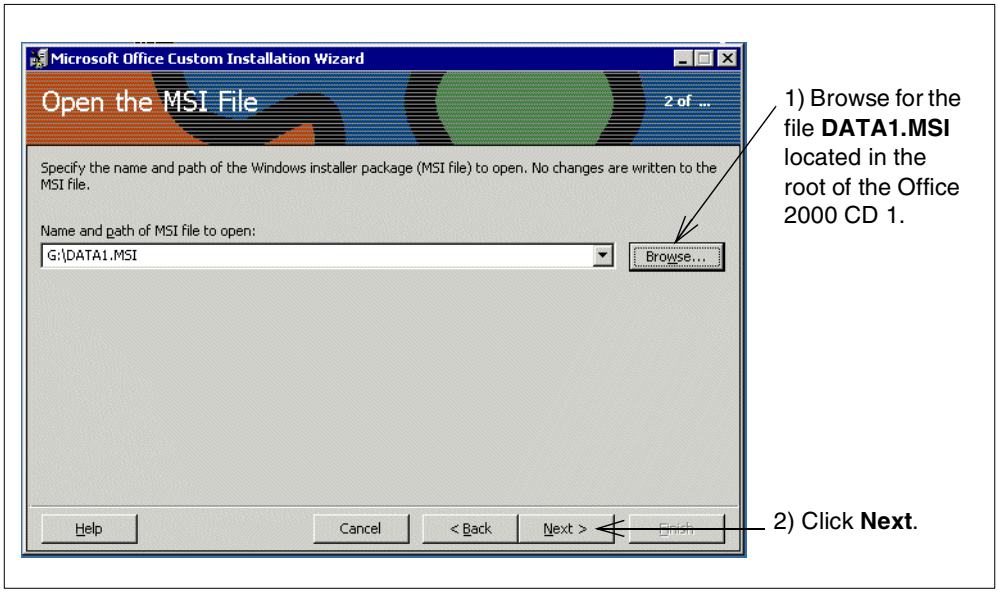

Figure 141. Opening the MSI file

Open the MST file as shown in Figure 142.

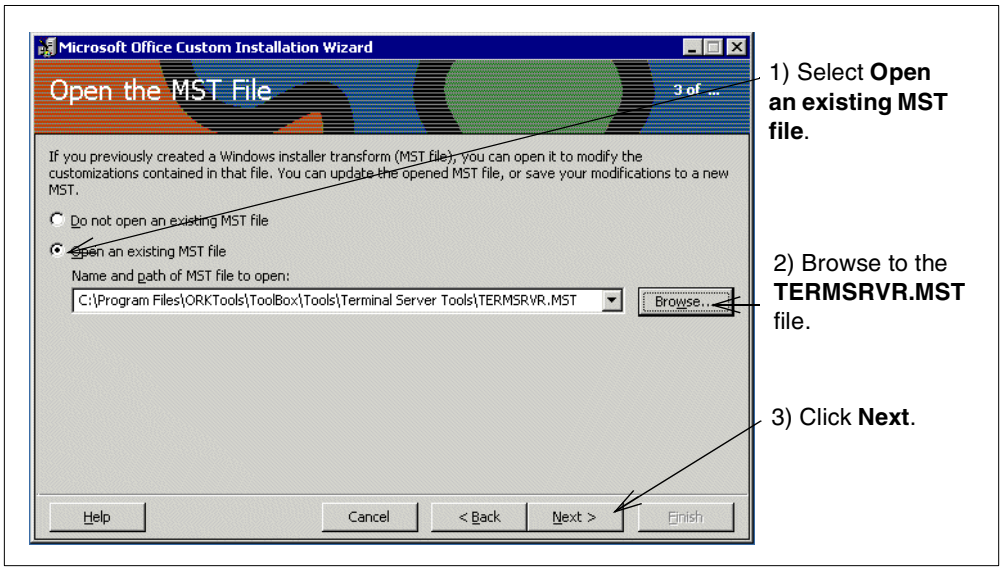

Figure 142. Opening the MST file

Next, save the MST file with the changes to a temporary folder, for example:

```
C:\temp\TERMSRVR.MST
```

Follow the instructions on the displays that follow. Because they are specific to your organization and installation, we don't show examples here.

Click the **Finish** button to save your customized MST file. Then, the wizard shows you the command line to use when you want to install Microsoft Office 2000. Copy the command line into the clipboard, or write it down.

Open the Control Panel, and double-click **Add/Remove Software**. In the window that appears, click **Add New Programs**, and then click the CD or floppy disk. The Office 2000 CD 1 should still be in the CD-ROM drive. Now, click **Next**.

Now the installation wizard asks for the command line to run. First type the drive letter for your CD-ROM drive. Then, paste the content from the clipboard in the field as shown in Figure 143. Click **Next** to start the installation.

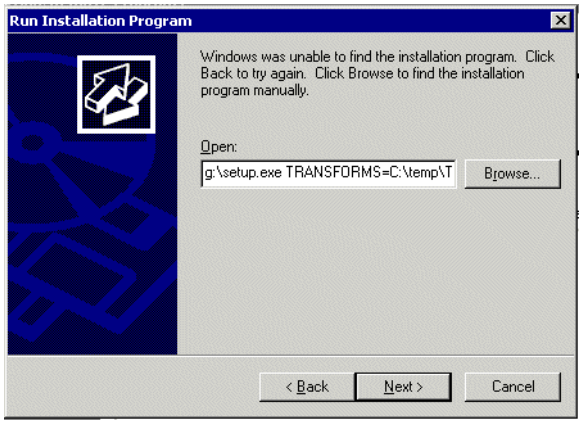

Figure 143. Office 2000 installation command

The Microsoft Office 2000 installation program starts. Follow the instructions that are given by the installation program.

While the Microsoft Office installation is running, the window in Figure 144 appears.

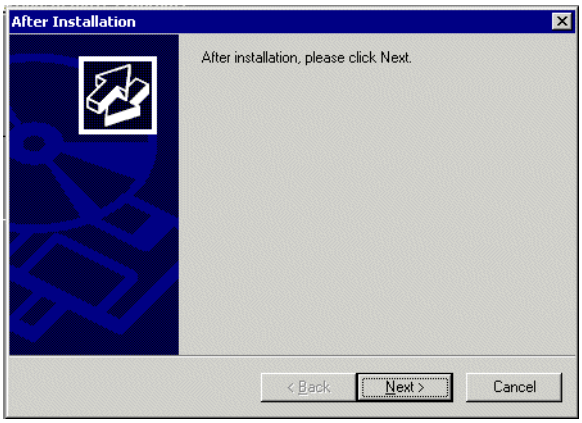

Figure 144. Administrator Installation of Office 2000

Note

Leave this window alone until Microsoft Office setup has completed.

When the Office Setup is completed, ensure the After Installation window is selected, and click **Next**. The window shown in Figure 145 appears.

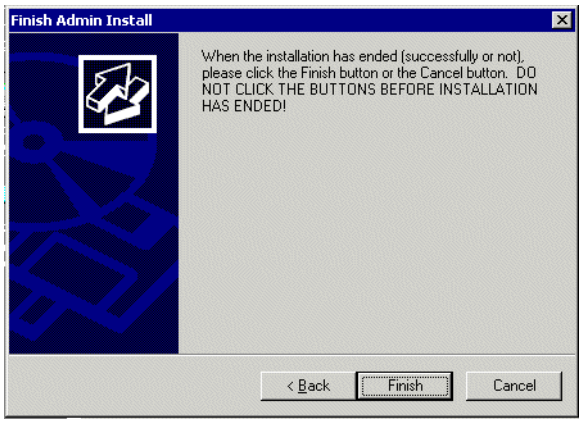

Figure 145. Finish Admin Install

Click **Finish** to end the installation. Microsoft Office 2000 can now be used by Terminal Services users.

12.7.2 IBM Client Access Express V4R5

This section focuses on primarily on the installation and basic configuration of Client Access Express V4R5 for Windows. For detailed information, refer to *OS/400 Client Access Express for Windows: Implementing V4R4M0*, SG24-5191.

For more information about potential problems and a work-around when using Client Access Express with a Microsoft Windows Terminal Server, refer to Informational APAR II11373.

12.7.2.1 Considerations

At the time this redbook was written, the following Client Access Express functions where supported:

- PC5250 Display Emulation
- ODBC
- Operations Navigator
- Data Transfer
- PC5250 Printer Emulation
- AFP Viewer
- Data Queue APIs
- Database APIs
- Remote Command APIs
- NLS APIs
- Distributed Program Call APIs
- Policies
- OLE DB
- ActiveX APIs
- Command Line Remote Command

Incoming Remote Command is an unsupported function of Client Access Express.

To map Network Drives or use Network Printers, the clients can use AS/400 NetServer. Refer to Informational APAR II11435 for tips about NetServer and Terminal Services.

12.7.2.2 Installing Client Access Express

You can install Client Access Express on a Windows 2000 Server Terminal Server using Add/Remove Programs from the Control Panel. Click **Start-> Settings-> Control Panel**. Then, follow the steps shown in Figure 146 through Figure 148.

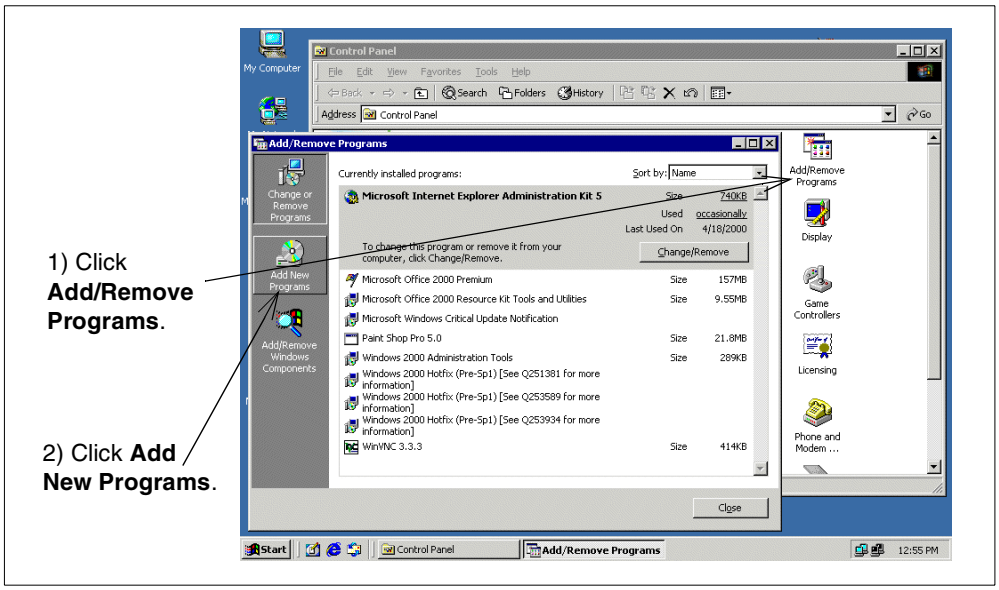

Figure 146. Installing Client Access Express (Part 1 of 3)

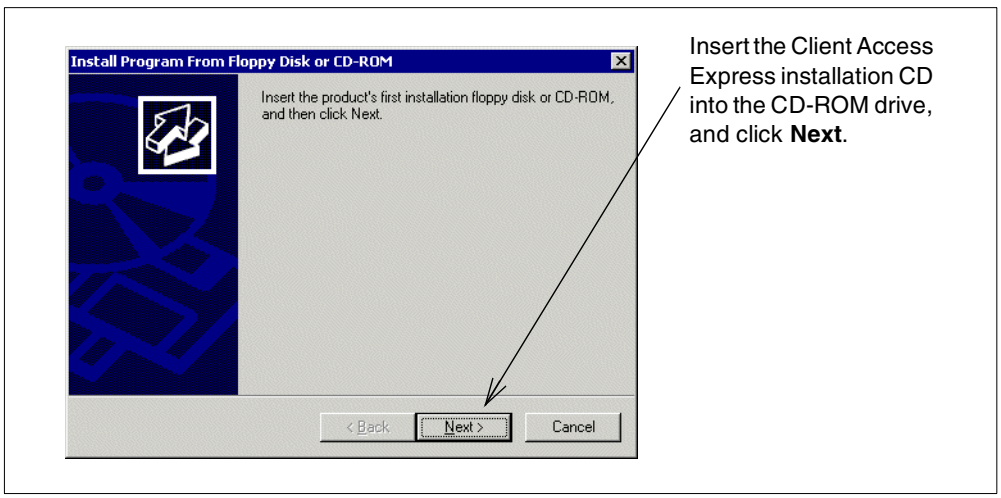

Figure 147. Installing Client Access Express (Part 2 of 3)

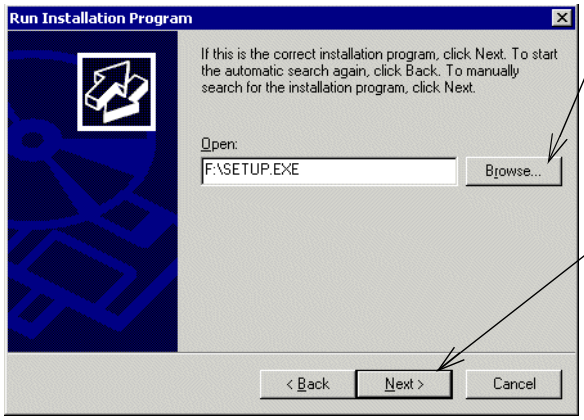

Figure 148. Installing Client Access Express (Part 3 of 3)

The Client Access Installation program starts. Follow the steps provided by the installation program.

Note

During setup, Client Access Express asks you if you want to reboot your PC now or later. Select **No, I will restart my computer later** as shown in Figure 149.

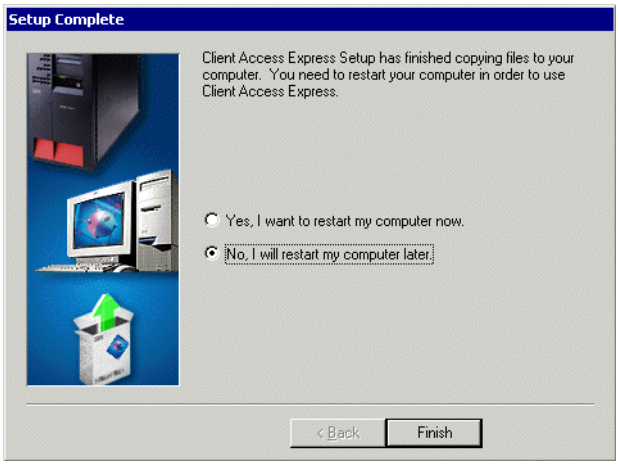

Figure 149. Client Access Express Setup Complete

After the Client Access Express installation is finished, the After Installation display appears as shown in Figure 150 on page 302.

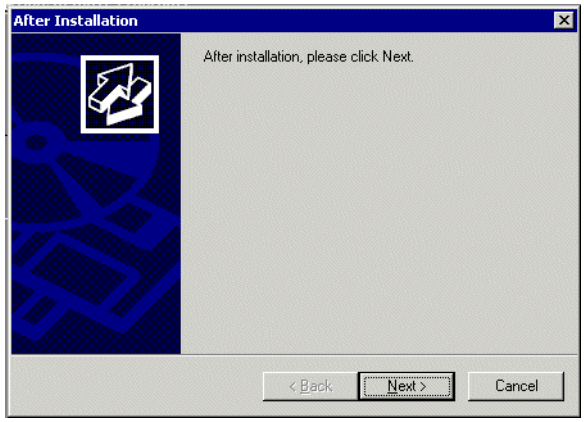

Figure 150. Client Access Express Administrator Installation

On this display, click **Next**. Then, the Finish Admin Install display appears as shown in Figure 151. Click **Finish** to end the installation.

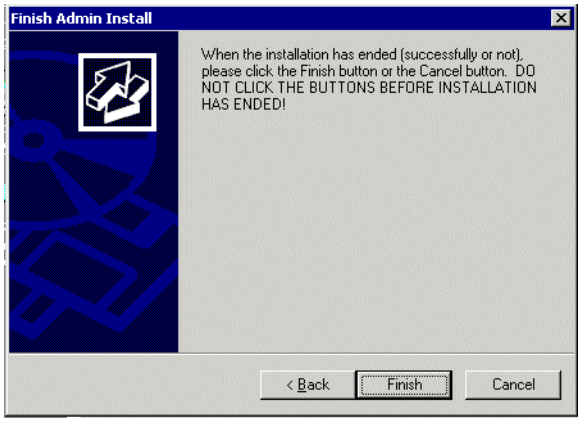

Figure 151. Finishing Client Access Express Installation

Client Access Express is now installed on your Terminal Server.

Note

After Client Access Express is installed, there may be some files in the Temp directory, with DAGTMPxx as names. Do not delete these files. This is a requirement of a Microsoft program. If they are deleted, parts of Client Access Express that access the OS/400 database may not function properly.

12.7.2.3 Service pack installation

The Client Access Express product and its service packs can be installed in the usual manner as described in the *Client Access Express Setup Guide* (such as double-clicking the SETUP.EXE file). We recommend that you use the Check Version function.

12.7.2.4 Configuration

It is important to always keep in mind that users that are connected to a Terminal Server share the same instance of Windows NT, with the same set of installed

applications, on the same hardware. This has some implications when it comes to configuring Client Access Express for Windows on a Terminal Server.

12.7.2.5 Connections

Every user who uses Client Access Express for Windows on a Terminal Server has their own set of connections. Depending on your environment, this can be an advantage or a disadvantage.

If you are an administrator and want to pre-configure a couple of OS/400 connections, follow these steps:

1. Log on to Terminal Server as administrator.
2. Create the connections wanted in Operations Navigator.
3. Open a command prompt session.
4. Switch to the installation mode by entering:

   ```
   change user /install
   ```

5. Use the Client Access CWBCFG command line utility to propagate the connections to the other users:

   ```
   CWBCFG /HOST AS400 /UID *WINLOGON /S
   ```

   The connections use the Windows logon user name.

6. End the installation mode by entering:

   ```
   change user /execute
   ```

From now on, the connections show up when another user opens Operations Navigator.

12.7.2.6 PC5250 sessions

PC5250 sessions save a session profile per default when you exit the session. The profile is stored, by default, in the PRIVATE subdirectory under EMULATOR. Every user who starts a PC5250 session with the option “Start or Configure Session” or from Operations Navigator uses the same profile. If one user makes changes to the profile, the changes impact every user. You may prefer to make these files *read only* to the users.

If you want every user to use their own PC5250 profile, follow these steps:

1. Create and configure a session.
2. Save it by selecting **File->Save as...** in the emulator.
3. Save the Work Station session definition in the user’s root drive mapping.
4. When you see the option to add an icon for it to a folder, click **Yes**.
5. A Browse for Folder dialog opens.
6. Select one of the following directories:
   - Profiles/<user name>/Desktop to place the icon on a users desktop
   - Profiles/<user name>/Start Menu to place it in the users Start menu
7. Tell the user to *always* start their session with this icon.

Note: PC5250 sessions that are configured to use a workstation ID can only be used by one user at a time!

Note

To reduce network traffic in a Terminal Server and MetaFrame environment, do not change the cursor to blink. Every time a visible blinking cursor is turned on and off, this information has to be transmitted to the client.

12.7.2.7 Service Tools

When using Client Access Detail Trace, each user can have their own separate trace. The trace can be turned on by each user separately. However, if you allow the trace to default, the results for each user will go into the same trace file and be mixed together. Therefore, the default trace properties should not be used. For each user, the properties for that user should be updated to use a unique trace file name (go to the **Diagnostic Tools** tab under **Client Access Properties**).

One other point is that the history log is still only a single, hard-coded file per system and cannot be changed to be unique for each user. Therefore, the history file will contain all of the messages mixed together from multiple users.

12.7.2.8 ODBC data source

You can store ODBC data sources on a client, or using Operations Navigator, you can manage them from OS/400 (they are then stored on the iSeries server). When you use the Client Access Express for Windows ODBC driver on a Terminal Server, you can use both methods.

You can also configure the user, system, or file data sources. If you want all your users to use a data source, make sure you configure the data source as System Data Source.

However, make sure that you specify either **Use Windows user name and password, no prompting** or **Prompt every time** in the ODBC Connection Options (see Figure 152) to make sure that the correct user name is used when you make the ODBC connection.

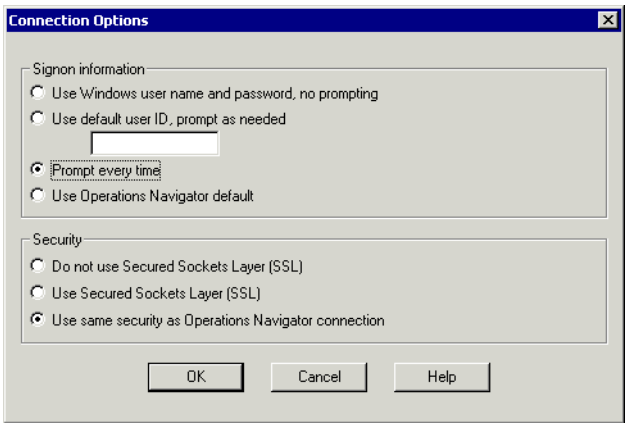

Figure 152. ODBC connection

12.8 Security

Reviewing security on a Terminal Server server is a significant exercise on its own. This section only highlights some aspects that you need to consider.

12.8.1 File security

By default, most files installed on the Terminal Server have security attributes that permit all users to do anything to the files. Be sure to review your security attributes to restrict the majority of files to read only for the majority of users. This will cut down the risk of accidental deletion. The security that can be applied to files will vary from application to application. Therefore, you can't define a strict rule for all applications. To protect even further, user data and application programs should be logically split into separate storage spaces and saved regularly. Therefore, if a problem occurs, it is a matter of restoring the application program storage space and restart the Windows 2000 server.

12.8.2 Policies

One way to implement uniform desktop control across some or all of your users is through the use of policy files. A policy can control access to the Control Panel, an MS-DOS prompt, and whether you can change your desktop characteristics. It is essential to review the security structures and implement the following standards as a minimum:

- Implement a standard desktop format.
- Restrict access to the MS-DOS prompt.
- Restrict access to the Control Panel.
- Restrict use of the Run command.
- Remove any games.
- Do not allow screen savers to be run from the server.

12.8.3 C: and D: drive exposure

As mentioned previously, when a Windows 2000 server is set up on an iSeries server, two drives are created—the C: and D: drives. The format of the C: drive can be controlled. However, the D: drive is fixed as FAT. This presents a potential security exposure because the contents of this drive can be damaged in many ways including through the use of Windows Explorer. If the D: drive is damaged, this affects the installation of additional software because it is primarily designed as an installation software storage bucket.

These two drives should be backed up and stored in a readily accessible position on tape or in a save file on the system. If the C: drive is damaged, the server may fail to boot. If this is a concern, it is a simple procedure to save the contents of the C: drive into a save file contained in a secure location and to write a CL program to restore the C: drive before you vary on the network server description.

12.9 Citrix MetaFrame

This section describes how to install Citrix MetaFrame 1.8 on a Windows 2000 server and set up an ICA client from a PC workstation. Citrix MetaFrame is the recommended solution to connect via WAN connections to Windows 2000 Terminal Services and to make a Windows desktop available to users of Network

Stations. Setting up an ICA client on a Network Station is described in 12.10, “Network Station” on page 321.

12.9.1 Installing Citrix MetaFrame on the Windows 2000 server

Installing Citrix MetaFrame on a Windows 2000 server requires you to first complete a Windows 2000 server installation and enable Terminal Services. Once you finish these tasks, you can continue the process by simply inserting the Citrix MetaFrame CD in the iSeries CD-ROM drive. The display shown in Figure 153 automatically appears. On this display, click **MetaFrame Setup**.

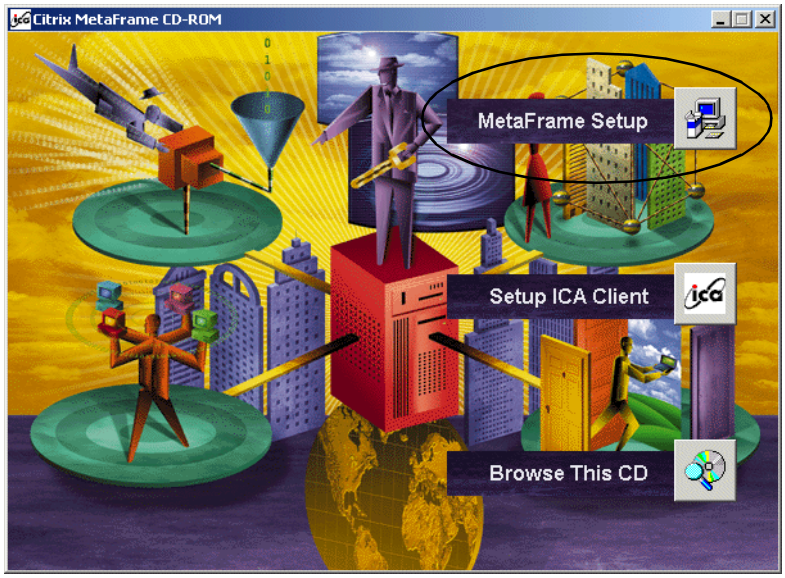

Figure 153. Citrix MetaFrame autorun display

Then, the installation starts. Click **I Agree** to accept the license agreement and to continue, as shown in Figure 154.

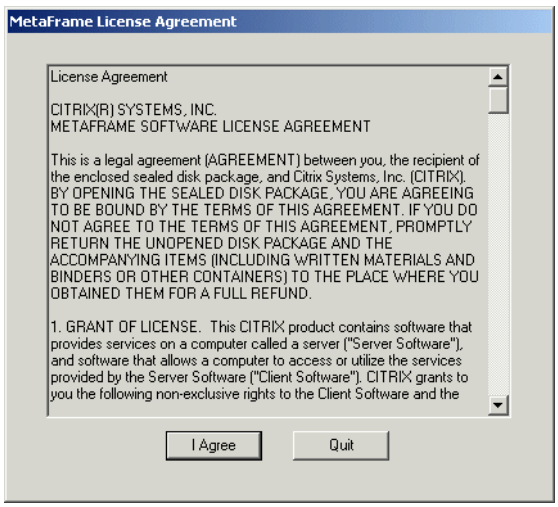

Figure 154. Citrix MetaFrame License Agreement

After you accept the license terms, the installation starts. First the Welcome display appears, and then the Setting Up MetaFrame display appears. See Figure 155. Click **Next** on both displays.

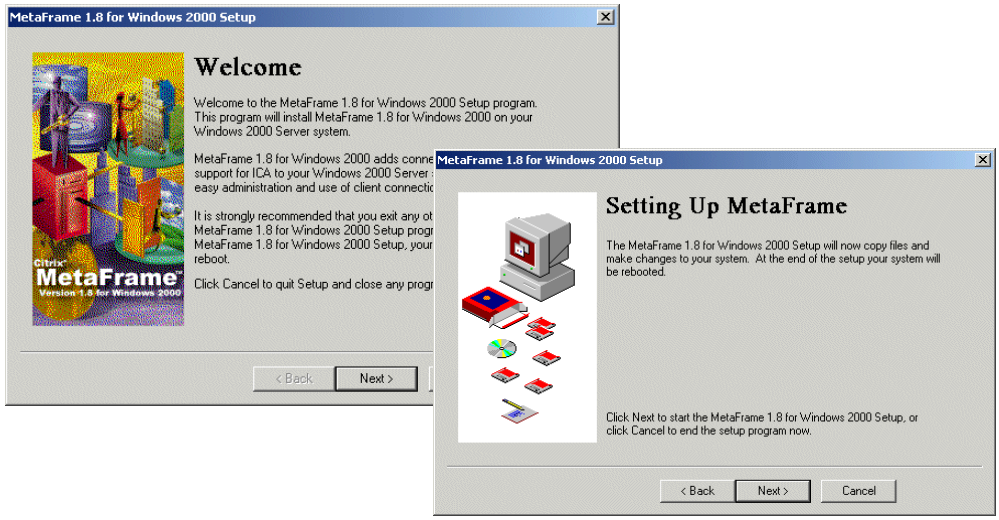

Figure 155. Citrix MetaFrame Welcome and Setting Up displays

Next, the installation process runs and finishes with the display shown in Figure 156. On this display, click **Add License Packs** to add your license information.

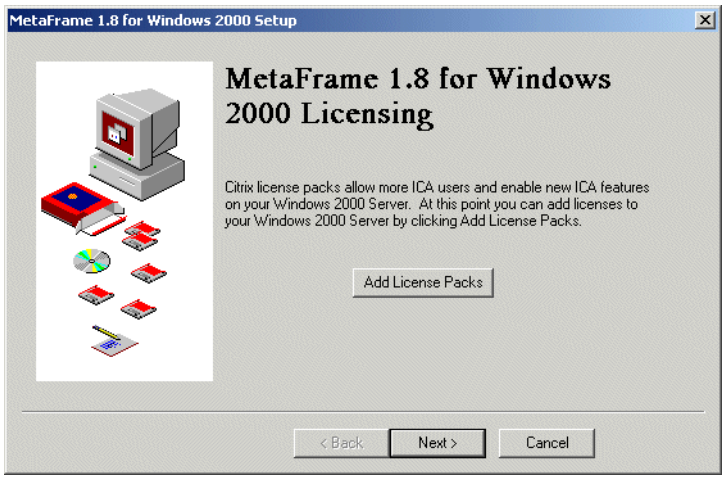

Figure 156. Citrix MetaFrame installation process

To connect to your Citrix MetaFrame server, you must have client licenses. One license pack comes with your CD. You must now add them to the Citrix Licensing Server. The Citrix Licensing process starts, and you are prompted to add the license. See Figure 157 on page 308. Enter your license key, including the dashes, and click **OK** to successfully add your pack to Citrix.

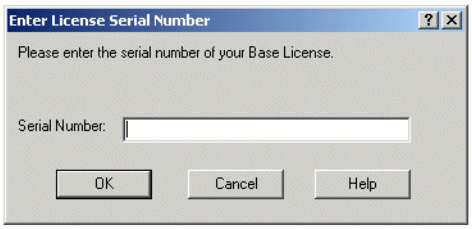

Figure 157. Citrix MetaFrame license key input window

Citrix MetaFrame shows a window that indicates that you successfully added new licenses. Then, it asks if you want to add more licenses as shown in Figure 158.

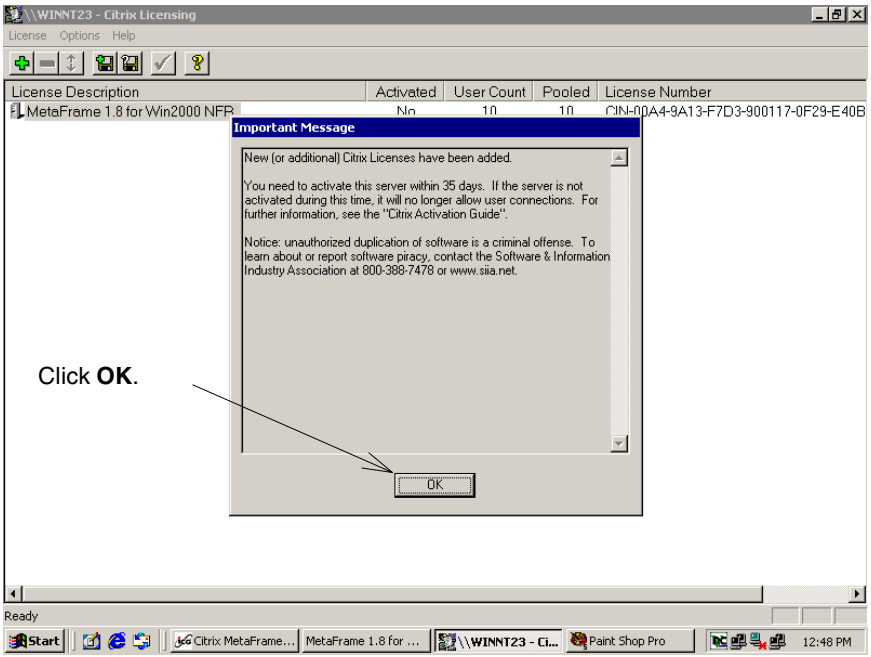

Figure 158. Citrix MetaFrame license administration

Now the Citrix Licensing program is automatically closed, and you return to the installation procedure as shown in Figure 159. Click **Next** on this display.

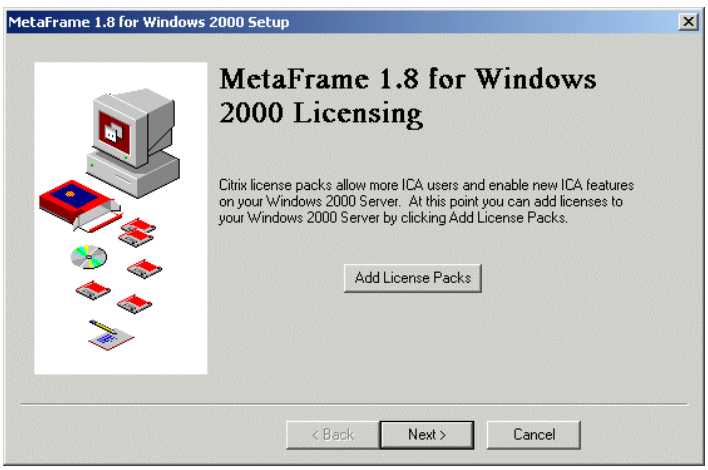

Figure 159. Citrix MetaFrame installation window

In the displays that follow, special parameters for Citrix MetaFrame are set. It starts with an informational window for the supported network protocols. On the Network ICA Connections display (Figure 160), click **Next**.

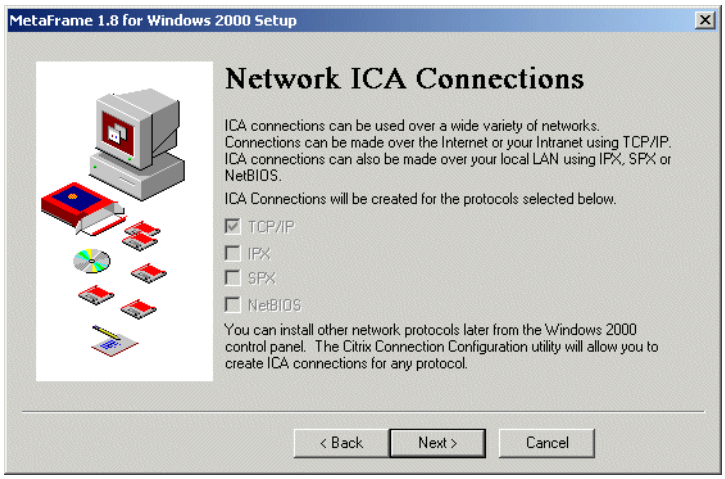

Figure 160. Citrix MetaFrame network protocol configuration

During the installation, you can select only the Microsoft Windows 2000 server installed network protocols. If you need support for any other protocols, such as IPX, you have to configure these using the Windows 2000 network configuration tools and add them to Citrix MetaFrame by the Citrix MetaFrame Administration. The next step is to set up the Citrix TAPI support, starting with the display shown in Figure 161. On this display, click **Next**.

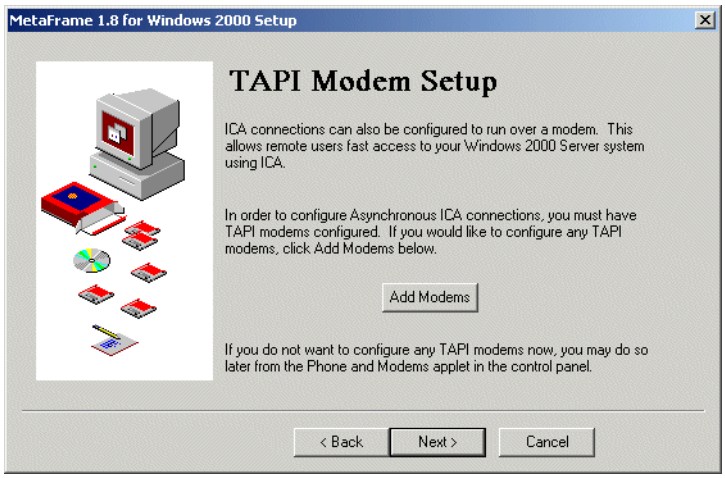

Figure 161. Citrix MetaFrame TAPI configuration

For the simple setup in our scenario, you do not have to configure anything here. If you want to make Windows sessions available for dial-in connections, you can add this support later in the Citrix MetaFrame administration. The next session (Figure 162 on page 310) deals with MetaFrame's drive mapping features.

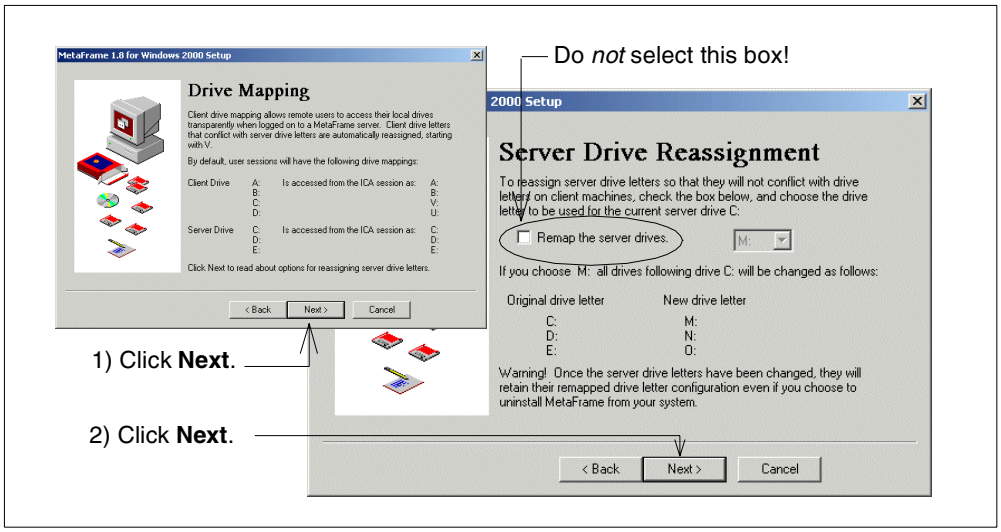

Figure 162. Citrix MetaFrame drive mapping

Enabling the drive mapping would only change the drive letters on the server. Client connections with local disk drives are automatically mapped server disk drives. Now you successfully configured your Citrix MetaFrame server. You have to reboot Microsoft Windows 2000 to allow the changes to become active. Click **Finish** on the System Reboot display (Figure 163).

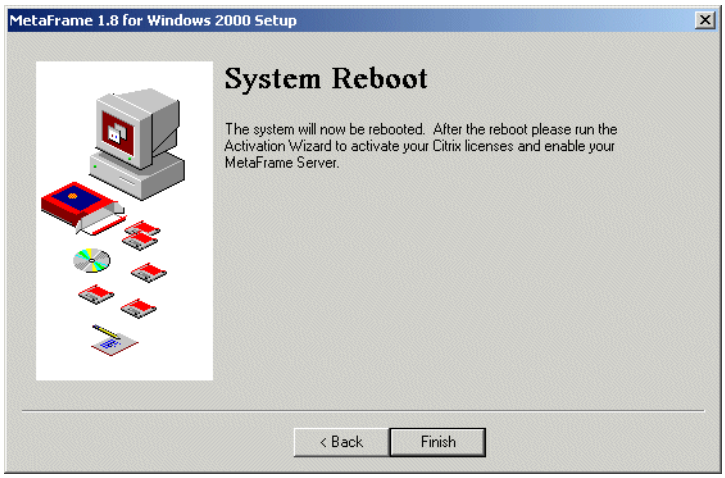

Figure 163. Citrix MetaFrame: System Reboot display

When you log on the next time, you are informed that your license is not yet activated. To activate your license, follow the steps in 12.9.2, “Activating your Citrix MetaFrame server” on page 313. Two icons and the taskbar for Citrix MetaFrame are added to your desktop as shown in Figure 164.

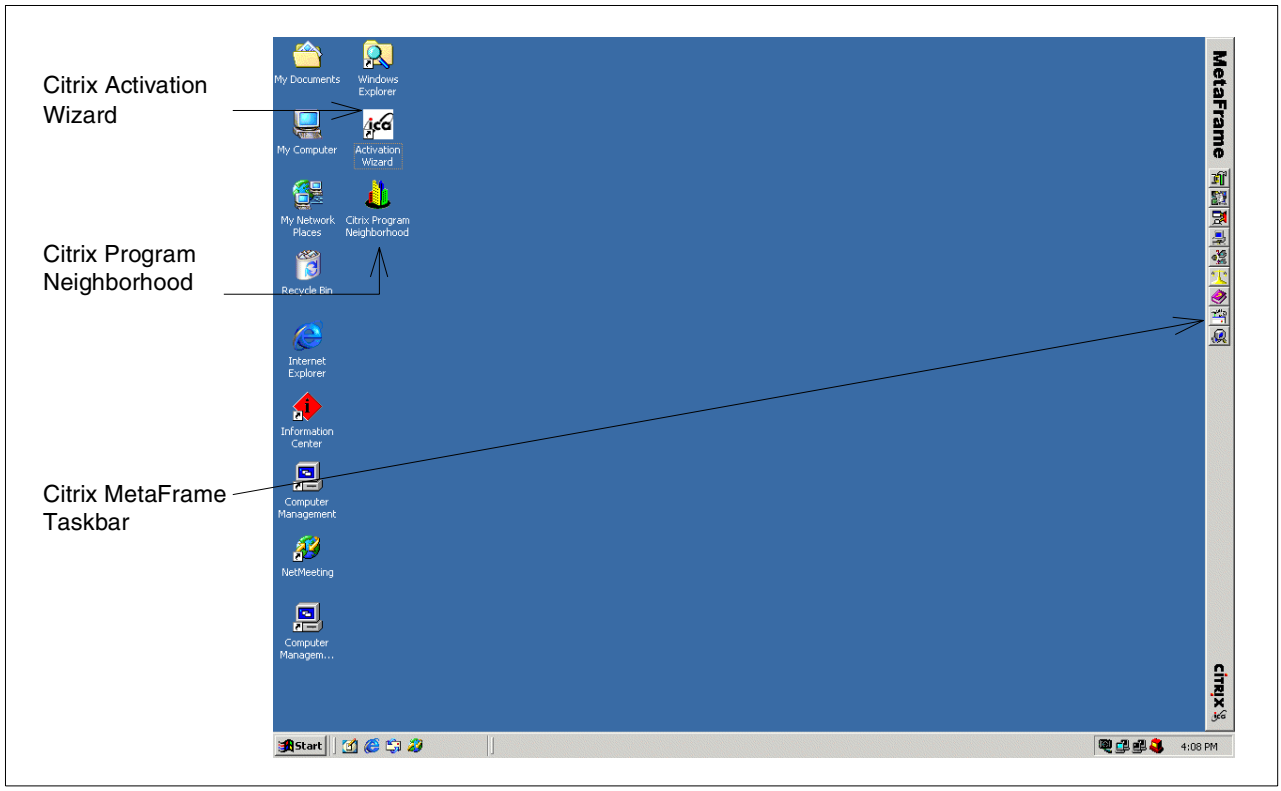

Figure 164. Citrix MetaFrame server desktop

The Citrix MetaFrame Taskbar contains links to the following tools (ordered from upper to lower):

- **Citrix Connection Configuration**

  Citrix Connection Configuration is used to manage the connections that enable clients to log on to the server.

  With Citrix Connection Configuration, you can specify how different types of incoming connections are handled and set properties for sessions launched using those connection types.

  Use this tool to:

  - Configure new connections
  - Restrict the number of sessions allowed by a connection
  - Enable and disable logons through a connection
  - Set a connection timeout
  - Set the level of encryption
  - Log on to a server automatically
  - Specify a program to run automatically when a user logs on
  - Override user profile settings for wallpaper
  - Set whether to disconnect broken connections
  - Allow reconnection to disconnected sessions from any client
  - Enable or disable session shadowing
  - Manage permissions for a connection
  - Add users and groups to permissions lists
  - Modify the settings of the ICA and RDP connections installed with MetaFrame and Terminal Server

- **Citrix Licensing**

  Citrix Licensing is separate from Microsoft licensing. There are two types of Citrix licenses:

  - ***Base licenses***: The base license enables the multi-user features of your Citrix server and may add a number of user counts. If the base license is not present, ICA connections are not supported, and server extension licenses cannot be added. Every Citrix server comes with a base license.
  - ***Server extension licenses***: Citrix server extension licenses add additional user counts or enable additional functionality, for example, load balancing.

  A Citrix license is obtained by entering the serial number supplied by Citrix using the Citrix Licensing utility. When you enter the serial number, an 8-character code is appended to the serial number, which makes it a license number that is unique to that particular server.

  Each Citrix license must be activated by entering an activation code. An activation code is a number that validates and enables a Citrix license. Until a license is activated, it is not completely installed. Some licenses have a grace period after installation, where they will work for a time with periodic reminder messages. If the license is not activated during the grace period, the license is automatically disabled at the end of the grace period.

  Citrix server user counts are pooled by default. If server A has 15 user counts and server B has 15 user counts, a total of 30 (15+15) are available for use by either server. For example, server A could use up to 20 user counts as long as server B is using no more than 10. You can adjust the number of licenses that are allowed to be pooled on a given server. MetaFrame and WinFrame servers use the same license pool. Citrix servers that pool licenses must be on the same network subnet. However, you can pool licenses between two network subnets using an ICA Gateway.

- **Citrix Server Administration**

  Citrix Server Administration is a tool that you can use to manage and monitor users, sessions, and processes on any Citrix server or Terminal Server on the network. With Citrix Server Administration, you can:

  - Display information about servers, sessions, published applications, users, and processes
  - Connect and disconnect sessions
  - Log off users from a session
  - Shadow Citrix ICA sessions
  - Send messages to users
  - Reset sessions
  - Display status information about a session
  - Terminate processes

- **ICA Client Creator**

  A helpful tool to create ICA client installation disks for different platforms.

- **ICA Client Printer Configuration**

  Shows the available local printers attached to the clients. You can connect and disconnect them, depending on whether you want to allow their usage.

- **ICA Client Update Configuration**

  Use the ICA Client Update Configuration utility to manage the client update database.

  The ICA Client Update Configuration functions include:

  - Adding or removing Citrix ICA Clients from the update database
  - Configuring client update options
  - Creating a new client update database
  - Configuring the Citrix server to use a default client update database
  - Configuring client update database options

- **Load Balancing Administration**

  Enables you to change the configuration of the Load Balancing feature when you have at least two Citrix MetaFrame servers and an activated license for Load Balancing.

- **MetaFrame Books Online**

  Leads you to the Citrix Administrator Handbook using the Windows 2000 online help.

- **Published Application Manager**

  Published Application Manager is the Citrix utility used to publish and maintain applications. Application publishing is a method of making specific applications available to ICA Client users as ICA connections. Published application ICA connections contain only the specified application in the ICA session and do not involve the ICA Client user in the mechanics of the Windows 2000 server environment hosting the session.

  You can use Published Application Manager to configure applications that can be accessed by specific Windows 2000 users or anonymous users. If you installed Citrix Load Balancing Services, you can configure applications that run on the least busy server in a group of servers.

  Published Application Manager includes powerful ICA session configuring abilities with its support for server farms and Program Neighborhood.

  You can create published applications that are automatically available to Program Neighborhood users to free them from client-side configuration of their ICA sessions. You can determine which applications a user sees in their Program Neighborhood and how those applications appear on the desktop.

- **Shadow Taskbar**

  Hides the Citrix Taskbar from the desktop.

12.9.2 Activating your Citrix MetaFrame server

Citrix uses a similar process to protect against illegal software usage like Microsoft does with the licenses for Windows 2000 Server Terminal Services. After you install the software and add the licenses, you have 35 days to activate these licenses by entering an additional activation key. Microsoft Citrix, on the other hand, offers activation only via the World Wide Web.

If your Citrix server that needs activation has direct access to the Internet, you can use the Citrix Activation Wizard link that was created during the installation on your desktop. Otherwise, you can use any PC that has Internet access and go to: `http:\\www.citrix.com\activate\login.htm`

Due to the dynamic of the Web pages, the process of activation is only described in general. We don't include examples of the Web pages because these might have completely changed by the time this redbook was published.

The activation process varies for first-time users and already registered users. If you are a first-time user, follow these instructions:

1. Click **Follow this link to activate any Citrix Product**.
2. Scroll to the bottom of the page, and click **Register for a Login ID/Password**.
3. Enter search criteria to find your company. Go to J if the search comes up negative.
4. Select your company, and click **Continue**.
5. Select your name, and click **Submit**.
6. Verify and update **Contact Information**, and click **Continue**.
7. Create your login ID and password, and click **Submit**.
8. Click **Web Self Service**.
9. Click **Citrix Activation System**.
10. If the search comes up negative, click **Enter Information for a new Company**.
11. Enter your company information.
12. Enter your personal information.
13. Create your login ID and password, and click **Submit**.
14. Click **Web Self Service**.
15. Click **Citrix Activation System**.
16. Click **New License** to enter a new license number and machine code, or click **Reactivate** to enter a new machine code for a previously activated license.

> **Note**
>
> Previously activated licenses will not appear under a newly created company. Only select this option if your company has never activated a license with Citrix before.

If you are an existing user, follow these instructions:

1. Click **Follow this link to activate any Citrix Product**.
2. Enter a login ID and password.
3. Click **Citrix Activation System**.
4. Click **New License** to enter a new license number and machine code, or click **Reactivate** to enter a new machine code for a previously activated license.

After you receive the activation key, you must enter it into the Citrix Licensing. To do this, start Citrix Licensing from the Citrix Taskbar, and follow the steps shown in Figure 165.

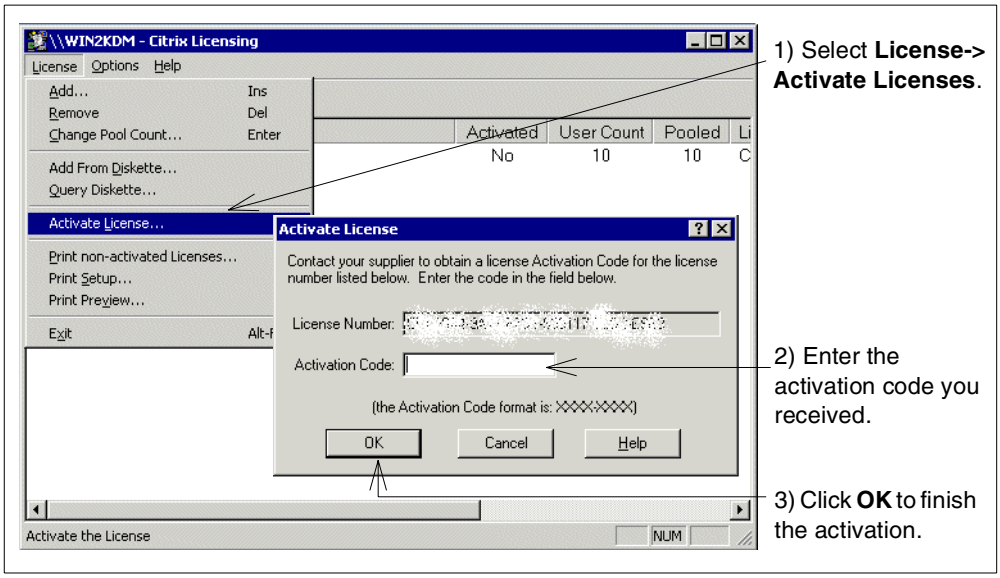

Figure 165. Citrix Licensing activation

After you finish this procedure, you will never receive the message window on logon again, except if you add a new license pack. Your Citrix MetaFrame Server is now completely configured, and you can start working on it.

12.9.3 Installing an ICA client on a PC

In this section, you learn how to set up an ICA client connection using a PC with any Microsoft Windows operating system. The configuration for an IBM Network Station is covered in 12.10, “Network Station” on page 321.

Connecting to a Citrix MetaFrame server from a PC makes sense in an environment where you have PCs with very small disks or little memory, so that these cannot run today’s large applications. It is an advantage from an administration point of view, because you only need to setup the client one time on the PC. Then, afterwards, all changes to the users’ applications can be made on the centralized server. This saves a lot of time in maintaining the distributed PC environment.

There are several ways to install an ICA client on a PC:

- Installing from the Citrix CD-ROM
- Installing from the network
- Installing from a disk generated by the ICA Client Creator

In the following scenario, we expect that you have configured your PC so that it has a LAN connection to your Citrix MetaFrame server. We recommend that you use TCP/IP for the connection because it is the fastest protocol. Later, we describe how to install the ICA client using the Citrix CD-ROM.

The beginning of this process is the same as it is for the server. Insert your Citrix MetaFrame CD into your CD-ROM drive. The autorun starts automatically and brings up the first menu (Figure 166 on page 316), on which you click **Setup ICA Client**.

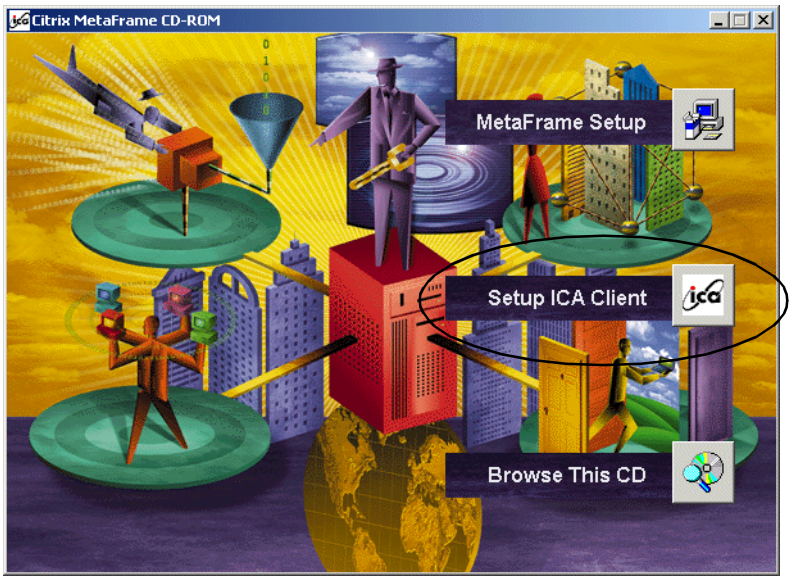

Figure 166. Citrix MetaFrame autorun display

Be sure to close all running applications before you walk through the installation process. On the Welcome display that appears, click **Next**. Then the Citrix License Agreement display appears, on which you click **Yes** to confirm that you agree. See Figure 167.

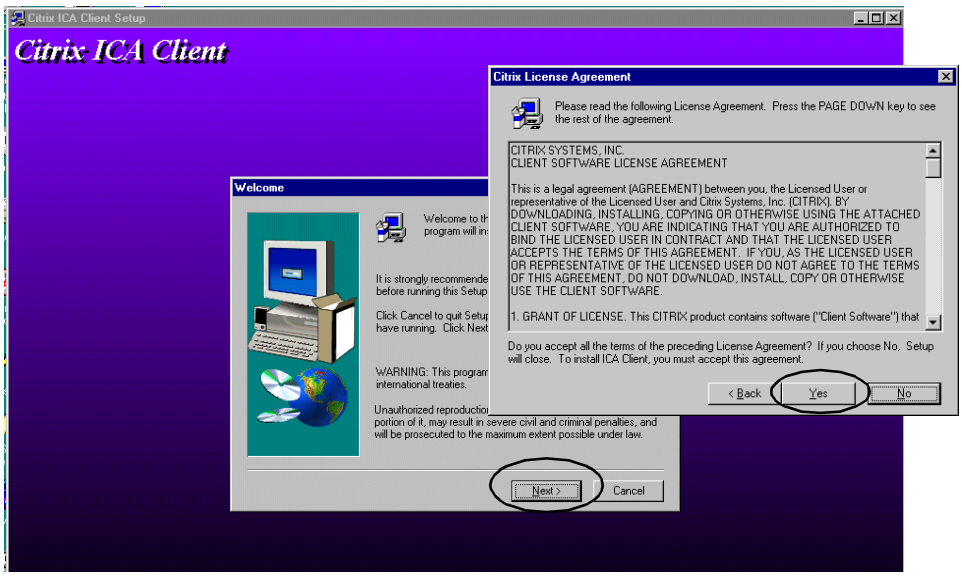

Figure 167. Citrix ICA Client Welcome and License Agreement displays

Next, the setup program asks you to enter a path that specifies where to install the client and to place the link into the start menu. Follow the steps in Figure 168.

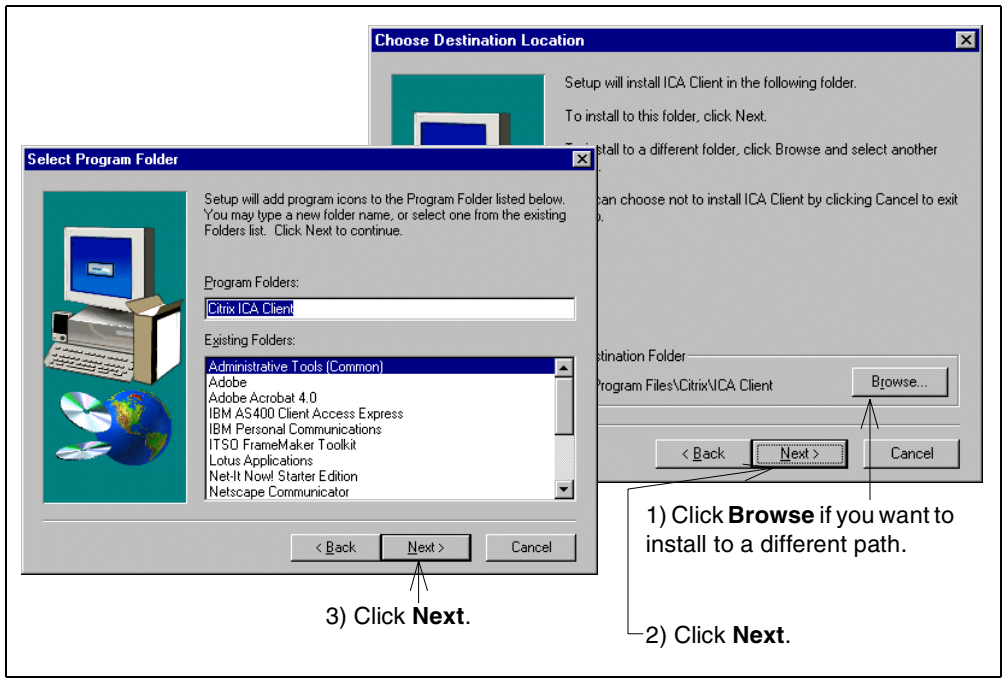

Figure 168. Citrix ICA Client installation path and program folder selection

To identify your computer on the MetaFrame server, you must use a unique identifier. Follow the steps in Figure 169.

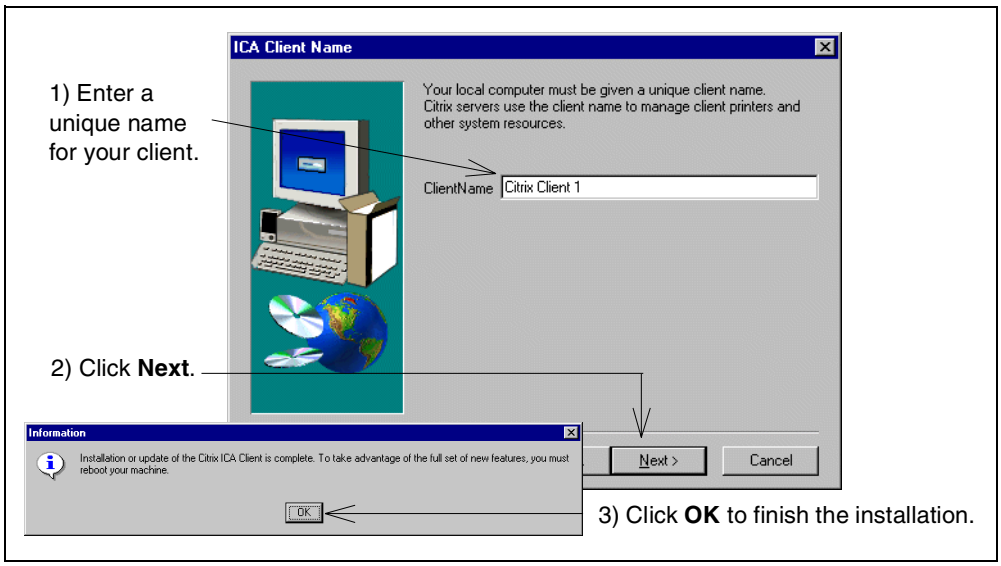

Figure 169. Citrix ICA Client entitlement and reboot information

Reboot your PC to take advantage of the just installed ICA Client. After you reboot, the Citrix Program Neighborhood icon (Figure 170 on page 318) appears on your desktop. Double-click the icon to configure new connections or to run existing connections.

Figure 170. Citrix Program Neighborhood icon

Then, the Citrix Program Neighborhood opens, and you can define your connections to the MetaFrame server as shown in Figure 171.

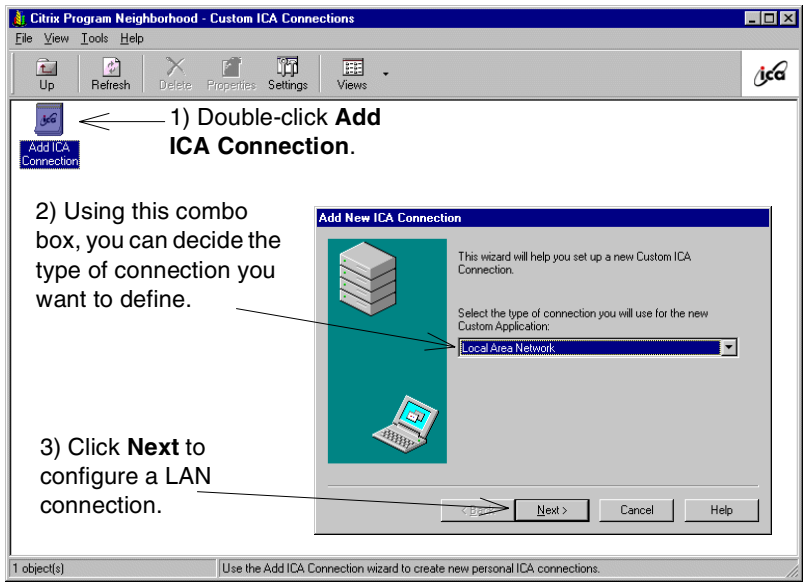

Figure 171. Citrix Program Neighborhood connection addition

Now, you must reference a name for your connection and the server to which you want to connect. Figure 172 shows you how to do this.

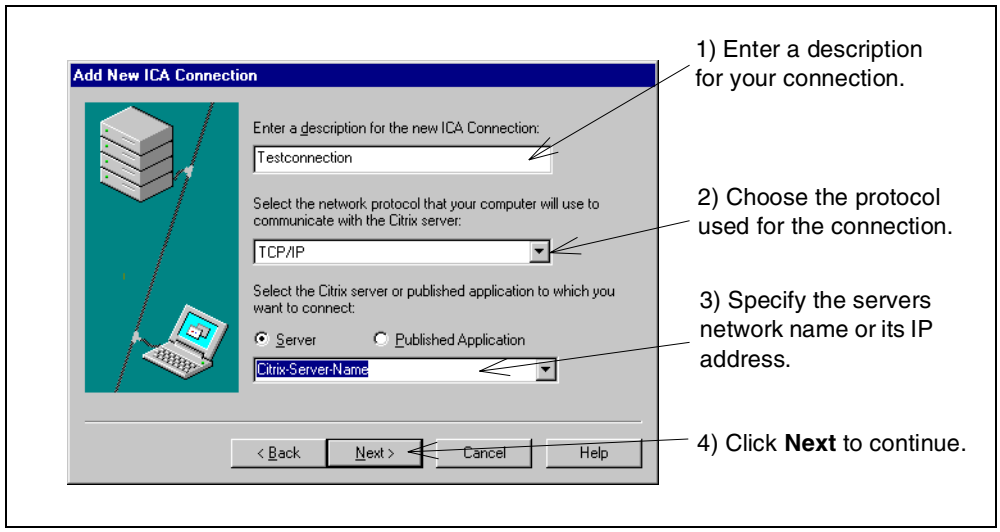

Figure 172. Citrix ICA Client connection definition

You can define additional parameters for the connection, which automates the log on to the Windows 2000 MetaFrame server. To do this, follow the steps shown in Figure 173.

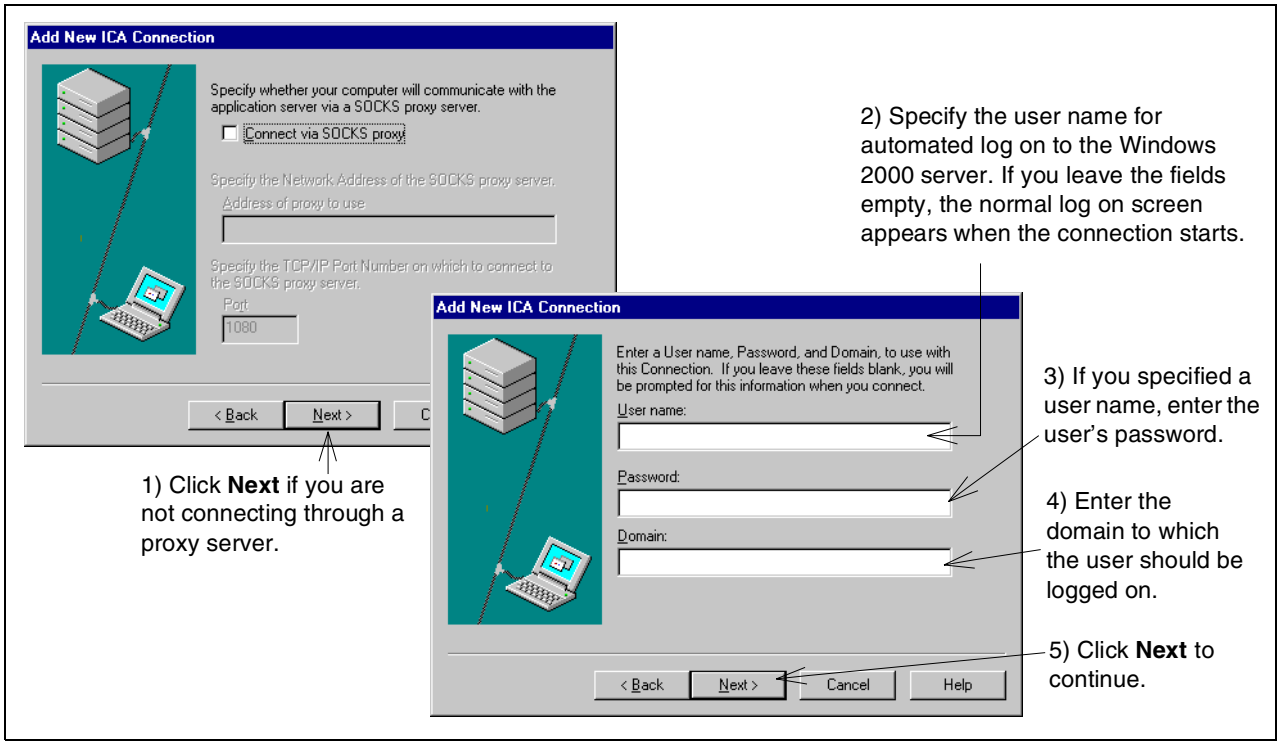

Figure 173. Citrix ICA Client proxy definition and auto logon

Define the display options for the connection. We recommend that you use a resolution of 800 x 600 pixels with 256 colors (which is the default). Follow the steps shown in Figure 174.

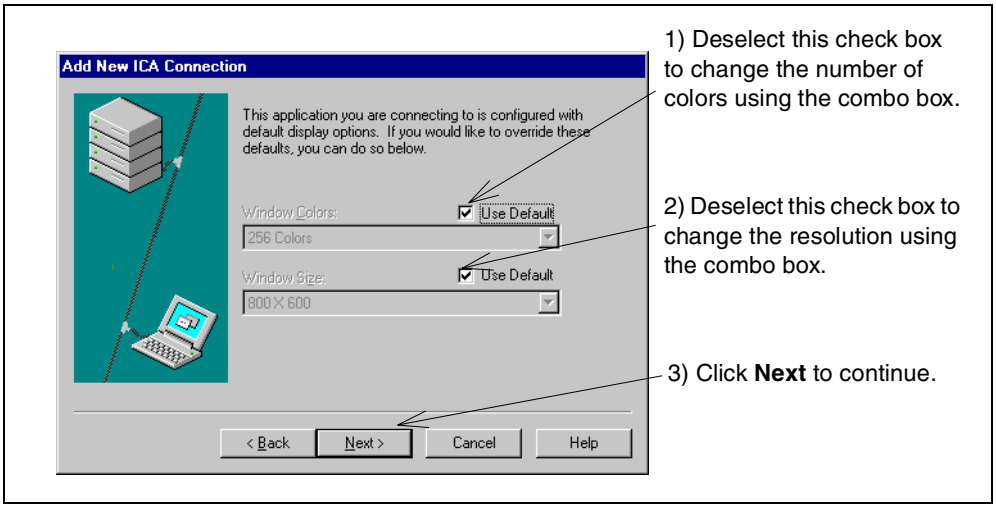

Figure 174. Citrix ICA Client display options

In some cases, you may want to run an application, such as Client Access Express, directly when the user connects to the server. This makes sense when the user only needs this application and is not familiar with the Windows desktop. You can achieve this by filling out the last configuration window (see the display and follow the steps in Figure 175 on page 320). If you leave the fields empty in

this windows, a normal Microsoft Windows desktop display appears to the user after they log on.

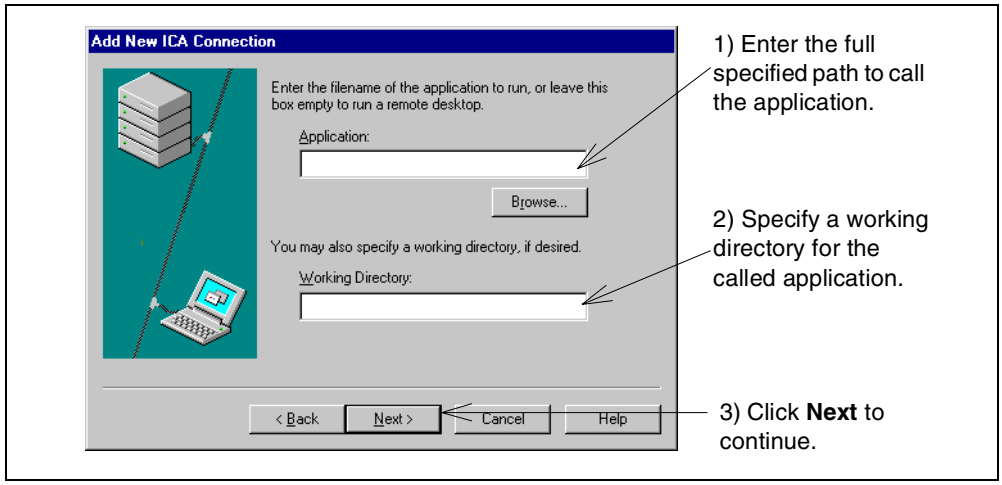

Figure 175. Citrix ICA Client application autostart

The connection definition is now complete. On the last display (Figure 176), click **Finish** to exit the configuration.

Figure 176. ICA Client configuration exit display

A new icon representing this configuration is added to the Citrix Program Neighborhood window. Double-click this icon to start the connection. If you did not specify any user data or applications to run, you should see a window like the example in Figure 177.

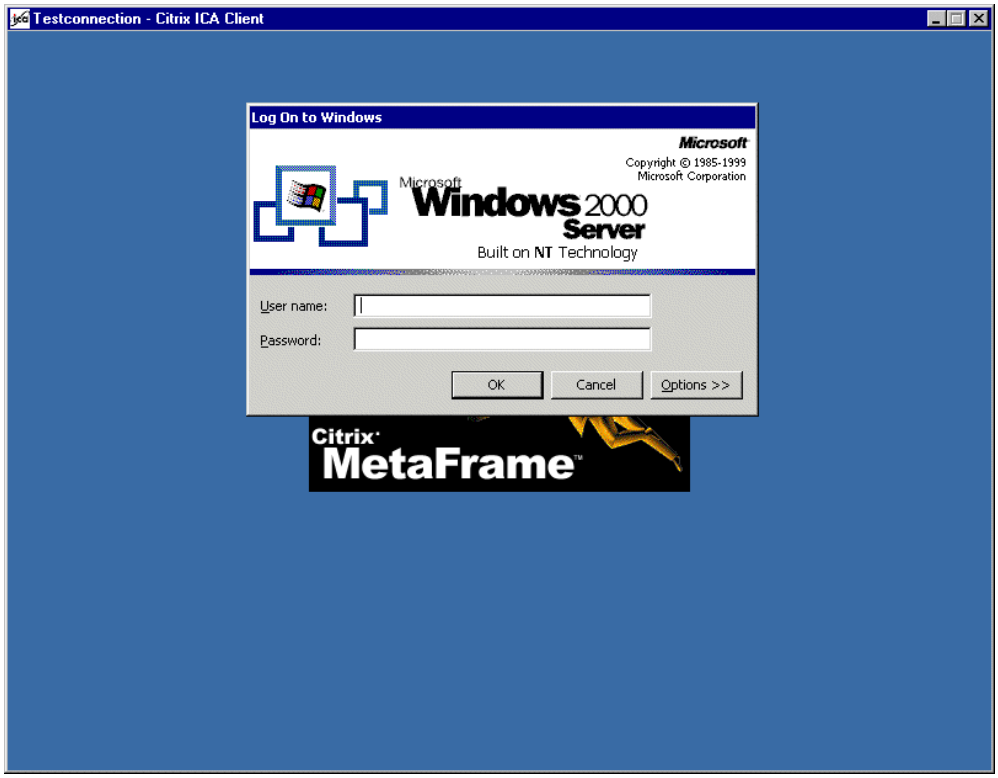

Figure 177. Citrix ICA Client Microsoft Windows log on display

You can now work in this window exactly the same way as you were working on a local PC. However, the software runs on the server. Therefore, your PC presents only the display and sound data and transceives the keyboard and mouse events to the server.

12.10 Network Station

Traditionally, the user's interface with the server has been either the non-programmable workstation or the personal computer (PC). The IBM Network Station network computer (referred to as Network Station here) offers an attractive alternative to traditional methods of network computing. Individual diskless workstations connect to a server (or series of servers), and you can manage them centrally with the IBM Network Station Manager program. Especially today where server consolidation is a highly discussed topic, due to the high cost to maintain "fat clients", Network Station is a good alternative to centralize the administration of a large number of clients. It allows you to perform every administration task on the end user's desktop from a central site.

Using a Network Station is similar to using a PC. Network Station uses a keyboard, mouse, and display. Due to the fact that Network Station is a thin client, the difference is that the Network Station files reside on a network server, rather than on a hard drive inside each user's machine. Network Station presents a graphical user interface (GUI), which provides the user access to many resources. The actual Network Station 2200 and 2800 have the following applications built in:

- 5250 emulator
- 3270 emulator
- VT emulator
- Netscape Navigator V4.5
- ICA Connection Manager (for running for example Windows sessions)
- Audio Player
- Calculator
- Calendar
- File Manager
- Paint
- Real Player
- Text Editor
- Video Player
- Advanced Diagnostics
- Print Monitor

You can access the following resources:

- Local and remote printers
- Sound card with speaker, head-phone, and microphone socket

Network Station communicates using TCP/IP over a token-ring or Ethernet connection to the server. The former twinaxial connection type is no longer available. Each Network Station runs the common client program, and the server runs the IBM Network Station Manager program and several other application programs.

12.10.1 How Network Stations work

Figure 178 shows the boot sequence of Network Station.

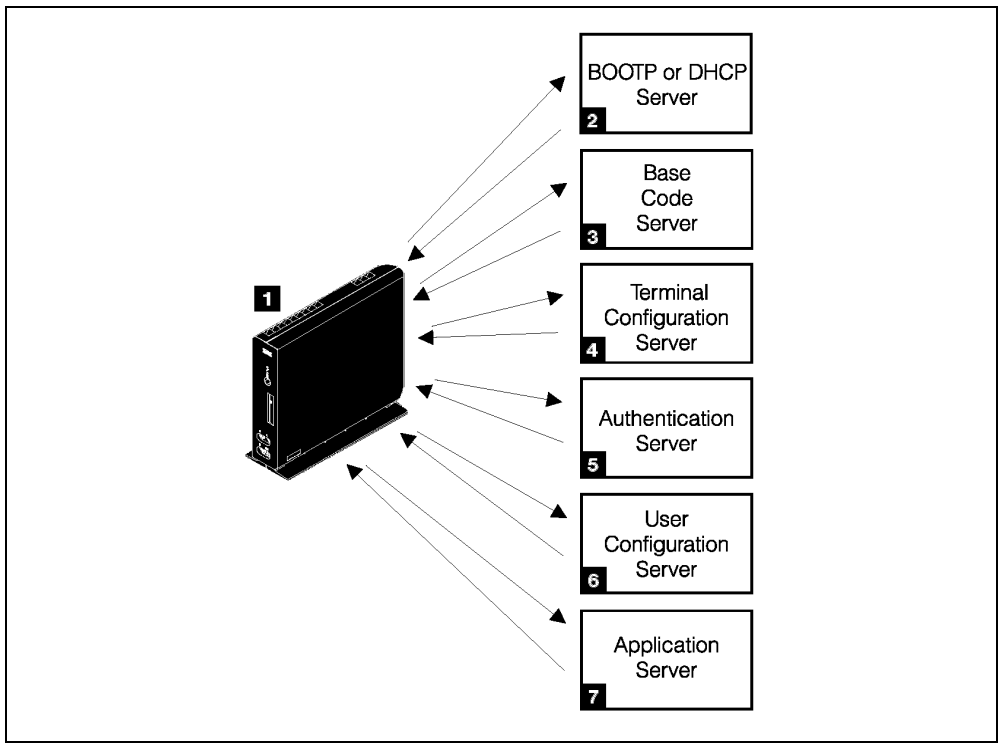

Figure 178. Network Station power-on sequence

A description of each of these steps follows (the numbers correspond to those in Figure 178):

1. A non-volatile random access memory (NVRAM) resident boot monitor program is started. Network Station automatically runs a series of power-on self tests (POST).
2. Network Station contacts a BOOTP or DHCP boot server. Network Station exchanges its media access control (MAC) address for the IP address that is provided by the server. The boot server also provides the address or path of the base code server. Network Station may alternatively retrieve this information from values that are stored in its NVRAM.
3. Network Station downloads the base code from the base code server using trivial transfer file protocol (TFTP) or network file system (NFS). Network Station Model 1000 and higher can only access their boot code via NFS.
4. Network Station downloads the terminal-based configuration information from the terminal configuration server.
5. Network Station presents a logon display. When the user enters a user ID and password, the authentication server verifies the user's identification.
6. The user's configuration server downloads and initiates the personalized environment preferences of the user.
7. Network Station displays the personalized desktop of the user. The user accesses applications on the servers where they reside.

The IBM Network Station Manager program allows you to set and change configurations for Network Stations and Network Station users. Your HTTP server makes the IBM Network Station Manager program available to your Web browser. Each Network Station contains a simple network management protocol (SNMP) agent as part of its operating system. An SNMP manager at a central location can communicate and exchange information with the agent on a Network Station. You can use this information to manage your network environment. SNMP is an industry-standard protocol for network management.

Each Network Station can display the IBM Network Station Setup Utility. The IBM Network Station Setup Utility allows you to view or set (change) configuration settings on a particular Network Station. For example, you can view the MAC address or set the monitor resolution of Network Station.

After Network Station base code is loaded, the User Services programs become available. User Services are programs that provide users with tools to manage Network Station's operational environment.

12.10.2 Installation overview

The installation process of IBM Network Station Manager depends on the version of the program you have to install and is not a trivial procedure. However, it has become easier with Network Station Manager V2.1. It involves some planning to ensure that the installation goes smoothly and is scalable. It includes the following steps:

1. Verify PTFs on your OS/400.
2. Install the licensed program.
3. Configure TCP/IP.

4. Configure DHCP.
5. Configure the Network Station Manager software.

Important

Be aware of the fact that there are currently two versions of IBM Network Station Manager, Version 1.3 and Version 2.1. Depending on the models of Network Stations you want to use, you have to install the matching version or versions of IBM Network Station Manager.

To use Model 300 or older Network Station models, you need IBM Network Station Manager V1.3. To support Network Station Models 1000, 2200, and 2800, you must have IBM Network Station Manager V2.1. If you plan to use a mixture of the older and newer models, you have to install *both* versions of IBM Network Station Manager.

Details are in the *IBM Network Station Manager Installation and Use* manual, available from the Web site at: `http://www.ibm.com/nc/pubs`

The installation of Network Station Manager V2R1 is different from V1R3 and is explicitly described in the redbook *IBM Network Station Manager V2R1*, SG24-5844.

12.10.3 Using the IBM Network Station Manager program

You can access Network Station Manager via a browser. This program allows the administrator to control the desktop that the user has, while using Network Station. The features include:

- Programs available from the desktop
- Screen layout
- Keyboard mappings
- Emulators available
- ICA Client Connections available for the user
- Single logon mechanisms
- Applications automatically started with logon (like Microsoft Windows “Autostart” program group)

All the attributes can be set for individuals, groups, or system wide to help with administration.

Important

The address to access the Network Station Manager program depends on the version of IBM Network Station Manager. For IBM Network Station Manager V1R3, the URL is:

`http://<IP-address of your iSeries>:2001/networkstation/nsmgr.htm`

For IBM Network Station Manager V2R1, the address has changed to:

`http://<IP address of your iSeries>/networkstationv2/nsmgr.htm`

12.10.4 ICA client

One item that is controlled from the Network Station Manager is the ICA client that used to access the Citrix MetaFrame Server. To configure an ICA client session, follow these steps:

1. Start your Web browser.
2. Enter the corresponding address indicated in the box above for your version of the IBM Network Station Manager software.
3. Sign on to the IBM Network Station Manager software using a user account that has *QSECOFR privileges.

Now you are ready to configure a new ICA client session. Follow the steps in Figure 179 to do this.

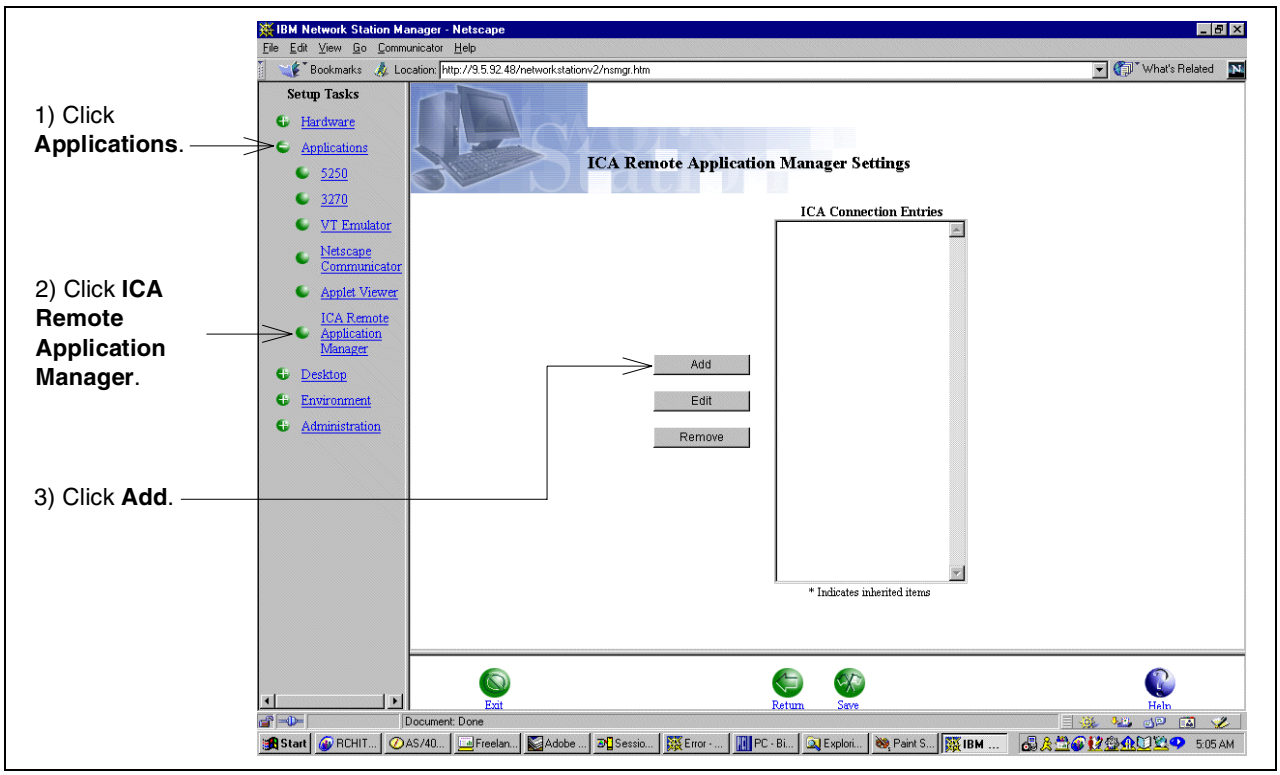

Figure 179. IBM Network Station Manger V2R1 ICA configuration

Then, the ICA configuration window appears. On this window, you configure the properties of your ICA client session. To set up a simple connection to a Citrix MetaFrame server, follow the steps in Figure 180 on page 326 to specify the settings.

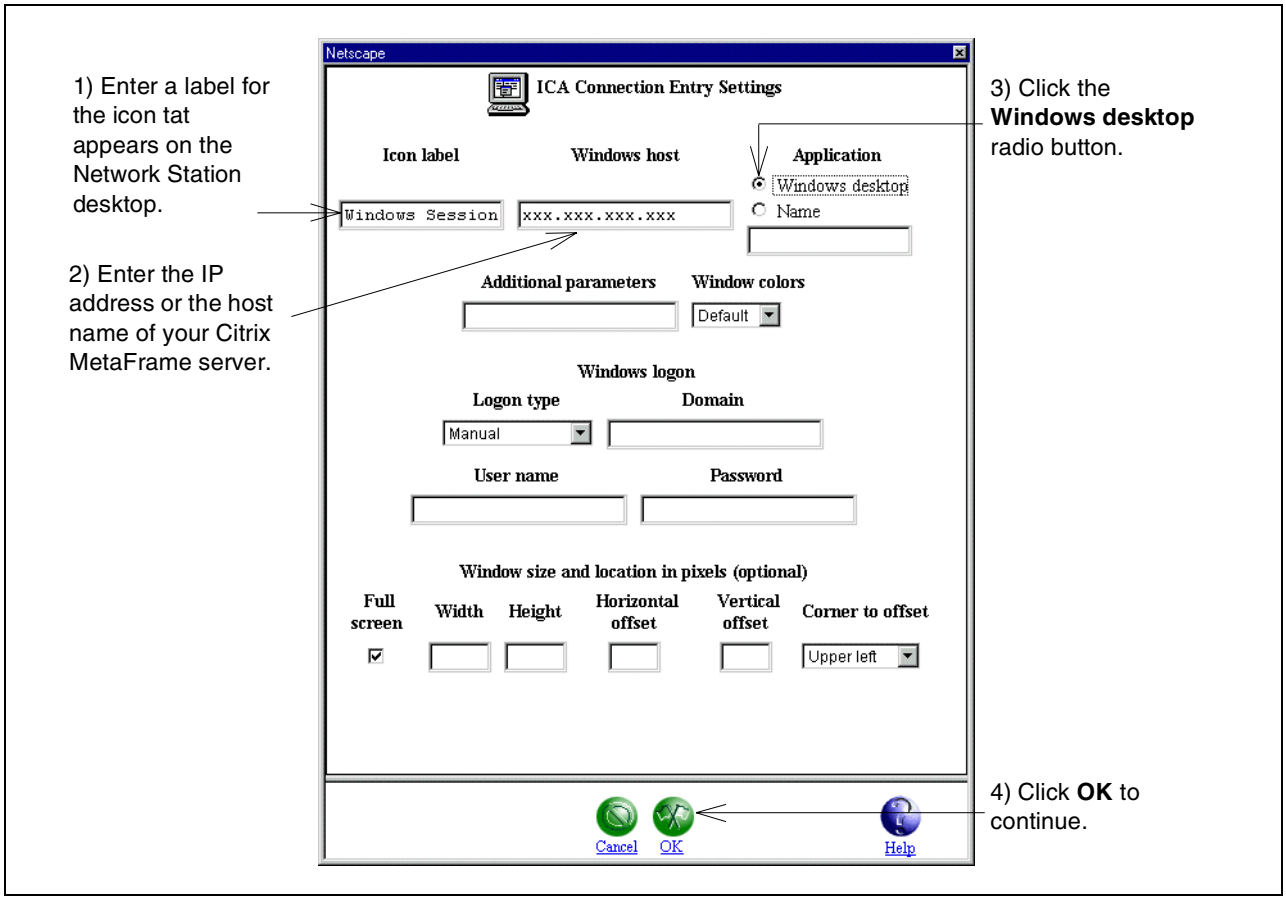

Figure 180. ICA Connection Entry Settings

Using the other fields, you can specify additional parameters for the client session. The parameters are explained in the following list:

- **Additional parameters**

  The following parameters are allowed:

  – ***-quiet***

    -quiet means that connection dialogs are not presented to the user. If -quiet is not specified, a dialog indicating a connection attempt and a connection complete are presented to the user. The dialogs are informational, and no response is required by the user.

  – **-desc(ription) (string)**

    -desc(ription) means that the full text from the description field is presented to the user.

  – ***-file (name)***

    -file (name) is the fully qualified file name of the file that contains the connection description to be used.

    If the HOME environment variable is defined, the default file name is $HOME/.ICAClient/appsrv.ini. Otherwise, the default file name is /usr/lib/ICAClient/config/appsrv.ini.

– ***-en(cryption) (level)***

-en(cryption) (level) specifies the level of encryption used between the ICA client and the ICA application server. The supported encryption levels are:

- *basic*: Simple encryption provided by the host is used.
- *login*: 128-bit RSA encryption for login only is used.
- *40*: 40-bit RSA encryption is used.
- *56*: 56-bit RSA encryption is used.
- *128*: 128-bit RSA encryption is used.

- **Window colors**

  Determines the number of colors the ICA application server uses when applications present graphics. Possible values are:

  – 16 (the default)
  – 256

- **Windows logon - Logon type**

  You must choose one of the following logon types:

  – ***Manual***

  The PC server prompts the user for their login information (PC server User ID, password, and domain name) when the Windows-based session is launched on Network Station.

  – ***Automatic***

  The PC server does not prompt the user for their login information when the Windows-based session is launched on Network Station.

  You must complete the login information (Domain, User name, and Password) fields if you select Automatic. The login information that is specified will be passed to the PC server, and the user will automatically be logged in.

  – ***Network Station***

  The PC server does not prompt the user for their login information when the Windows-based session is launched on Network Station.

  You may specify the domain name (optional) if you select Network Station. The user ID and password used to log into the network station will be passed to the PC server (along with the domain name if one was specified), and the user will automatically be logged in.

  Note: The password is not stored or transmitted to the PC server in clear text.

- **Windows logon - Domain**

  Type the domain name of the PC server.

- **Windows logon - User name**

  Type the name of the user for whom you want to automatically log on.

- **Windows logon - Password**

  Type the password for the user listed in the User Name field.

- **Window size and location in pixels (optional)**

  This function, if used, allows you to specify the size and location of the window for a Windows-based session. The following fields define the size of the window (Width and Height) and the window's position on the monitor (Horizontal and Vertical offset and Corner to offset from):

  – ***Full screen***

    When you select this box, you enable the Windows-based application to use the entire display on Network Station. Full screen does not include the Launch Bar area.

  – ***Width***

    This value determines the horizontal width of the window.

  – ***Height***

    This value determines the vertical height of the window.

  – ***Horizontal offset***

    This value determines the horizontal distance from the corner that is specified as the Corner to offset value (for example, Upper left).

  – ***Vertical offset***

    This value determines the vertical distance from the corner that is specified as the Corner to offset value (for example, Upper left).

  – ***Corner to offset***

    This value determines from which corner (Upper left, upper right, lower left, or lower right) the values from the Horizontal and Vertical offset fields are applied.

When you have completed the settings, the newly configured connection appears in a list on the display. There is one more task to perform to make the configuration work. On the ICA Remote Application Manager Settings – System Defaults page (Figure 181), click **Save** to make the configuration available for the Network Station Manager.

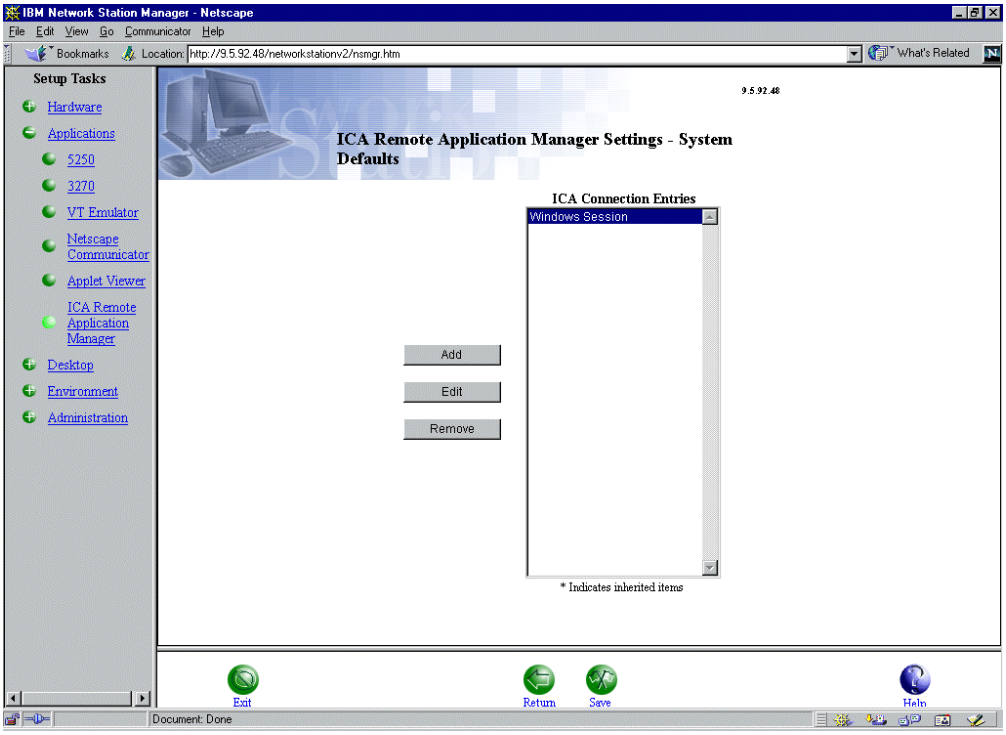

Figure 181. ICA Client connection setup save page

After you complete this step, the entry page is shown again, indicating that you successfully configured an ICA Client Connection. You can start this session on a Network Station by clicking **Host Access** and choosing **ICA Remote Application Manager**. Then, double-click the name of the session you just configured in the list in the ICA Remote Application Manager.

12.11 Capacity planning

Capacity planning in the world of PCs has been far from an exact science. Utilities with the precision of Performance Tools for the OS/400 are not available. Consequently, there is a heavy dependence on subjective estimates as to what a user is and what adequate performance is. Unfortunately, this only causes guidelines to be drawn up.

One point is clear. This environment is *not* designed for very high end users, such as heavy CAD, desktop publishing, or mathematical modeling. These applications are typically CPU intensive and require large amounts of memory to operate efficiently.

12.11.1 Categorizing users

It is essential that you categorize the users to build a performance picture. The categories that are used are general, such as light, medium, and heavy users. The definition of each category can also vary significantly depending on your environment. To try and find some clarity, we use the following definitions in our discussion:

- **Light user**: Single application, highly repetitive, low complexity (small Visual Basic Client Server application). A single, more complex application is used infrequently.
- **Medium user**: Two applications are active (word processor or spread sheet and mail) with a focus on one of the applications.
- **Heavy user**: Multiple applications (word processor, spread sheet, mail) with work across all applications using some advanced functionality.

12.11.2 Broad CPU and memory estimates

As with all Windows environments, memory is important to maintain good performance. Large amounts of RAM will keep down the level of paging and improve response times. To maintain effective performance, consider 256 MB as the minimum for even a small number of users. Performance measures done by several companies, including IBM and Microsoft, have indicated significantly different performance results due to different client workload measurements, server hardware, and server software.

Table 25 offers a *guide* to the number of users that can concurrently use a Windows 2000 Server Terminal Services server.

Table 25. User capacities by CPU

CPU	Number of users		
	Light	**Medium**	**Heavy**
Pentium Pro/200	37-	25-30	15-20
Pentium II/333	50-	33-40	20-25
Pentium III/700			

Table 26 provides an *indication* of the amount of memory required by Windows 2000 Server Terminal Services for each user by type. In addition, add 128 MB for the operating system.

Table 26. Memory requirements per user type

User type	Memory required per user
Light	4-6 MB
Medium	6-12 MB
Heavy	12-16 MB

Disclaimer

As you can see from the recommendations, there is a significant variation from the lower to upper ranges, which may vary even further in your environment. To see a more accurate estimate of the CPU capacity/memory requirements of such a server in your environment, it would be ideal to model the environment with five to eight users and scale up the results.

Microsoft offers information about capacity planning that you can locate at:
`http://www.microsoft.com/windows2000/library/technologies/terminal/tscaling.asp`

12.12 Important information

The products that we used to produce the information this chapter are rapidly evolving. As time passes, new function and features will be made available that can improve this environment. It is important to watch for such updates to ensure that you have the most up-to-date information that is available when you set up your Windows 2000 Server Terminal Services on an Integrated xSeries Server environment.

The following list is not exhaustive, but highlights some of the key areas to watch:

- AS/400 Windows NT Integration home page:
  `http://www.iseries.ibm.com/windowsintegration/index.htm`
- II11373 Terminal Server and Client Access Support:

  Gives the latest information regarding support for Client Access when it is installed on Terminal Server.
- II11435 - AS/400 NetServer and Terminal Server Integration:

  Provides the latest information on using Terminal Server with AS/400 NetServer. Changes to the limitation on connections between Terminal Server and NetServer are highlighted here first.
- Microsoft Web page for Windows NT Server Terminal Server Edition:
  `http://www.microsoft.com/ntserver/terminalserver/default.asp`
- Home page for Citrix Systems, suppliers of Citrix MetaFrame:
  `http://www.citrix.com`
- Home page for Network Computing Devices, suppliers of WinFrame for MetaFrame: `http://www.ncd.com`
- *IBM Network Station Manager Installation and Use* publication:
  `http://www.ibm.com/nc/pubs`

Chapter 13. QNTC file system

This chapter explains how the QNTC file system works, how you access it, and the role it has in an Integrated xSeries Server environment.

Why QNTC?

The QNTC file system is important in the context of Windows 2000 on the Integrated xSeries Server because it provides file-level backup and restore of a Windows NT or 2000 server from OS/400.

This chapter assumes that you are familiar with the concepts and basic implementation of the integrated file system (IFS) on the iSeries server. For more information on this subject, refer to *OS/400 Integrated File System Introduction*, SC41-3711.

13.1 Overview of the QNTC file system

With each PC operating system that can be installed on the Integrated xSeries Server, there is an associated OS/400 file system in the integrated file system (IFS) that enables file-level access to the data residing on the PC server. In Version 4 Release 2, the iSeries began supporting Windows NT. However, there was no support for an associated file system in the IFS. In Version 4 Release 3, the QNTC file system was introduced to provide this support. Figure 182 shows how the integrated file system fits into the architecture of the iSeries server.

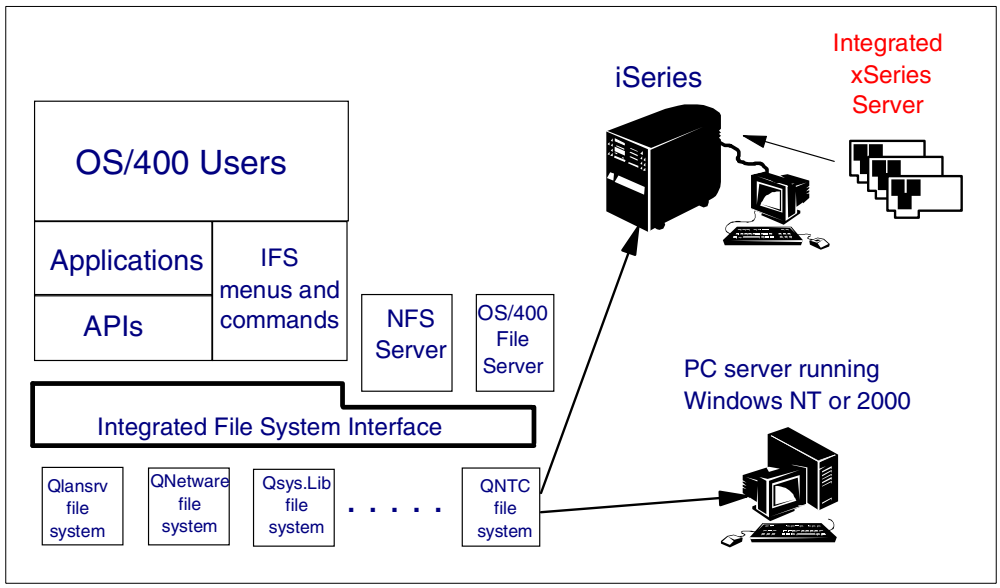

Figure 182. The integrated file system with QNTC

Through the QNTC file system, the iSeries server has the ability to access data that resides on any Windows NT or 2000 server or Windows NT or 2000 client in the network. This function is called *Server Message Block (SMB) network client*, or simply *QNTC on the iSeries*. You can think of QNTC as an implementation of

Windows Network Neighborhood on the iSeries server. It enables you to move files between Windows computers in the network and file systems in the IFS.

QNTC does not require an Integrated xSeries Server for its operation.

QNTC effectively allows the iSeries to function as an SMB client in the network, which can gain access to SMB servers in the network. SMB servers can be other iSeries servers running Windows NT or 2000 on Integrated xSeries Servers and external PCs running Windows NT or 2000 server or client operating systems. AS/400 NetServer provides the communications stack that QNTC uses to connect with these Windows servers and clients. Refer to Chapter 14, “AS/400 NetServer” on page 345, for detailed information about AS/400 NetServer.

An AS/400 NetServer server can be part of a Windows NetBIOS domain. By default, AS/400 NetServer can only communicate with Windows computers (servers or clients) that are in the same Windows (NetBIOS) domain as itself and on the same TCP/IP subnet. For Windows clients on other TCP/IP subnets, or for other Windows domains to communicate with AS/400 NetServer, you need to use a name resolution technique such as LMHOSTS, DNS, or WINS. These techniques are discussed in 14.3, “Finding AS/400 NetServer in the network” on page 352. Therefore, by default, QNTC can only access SMB servers in the same Windows domain and on the same TCP/IP subnet as itself, unless you use a name resolution technique such as LMHOSTS, DNS, or WINS.

Figure 183 shows the Windows computer systems that QNTC can access in the network.

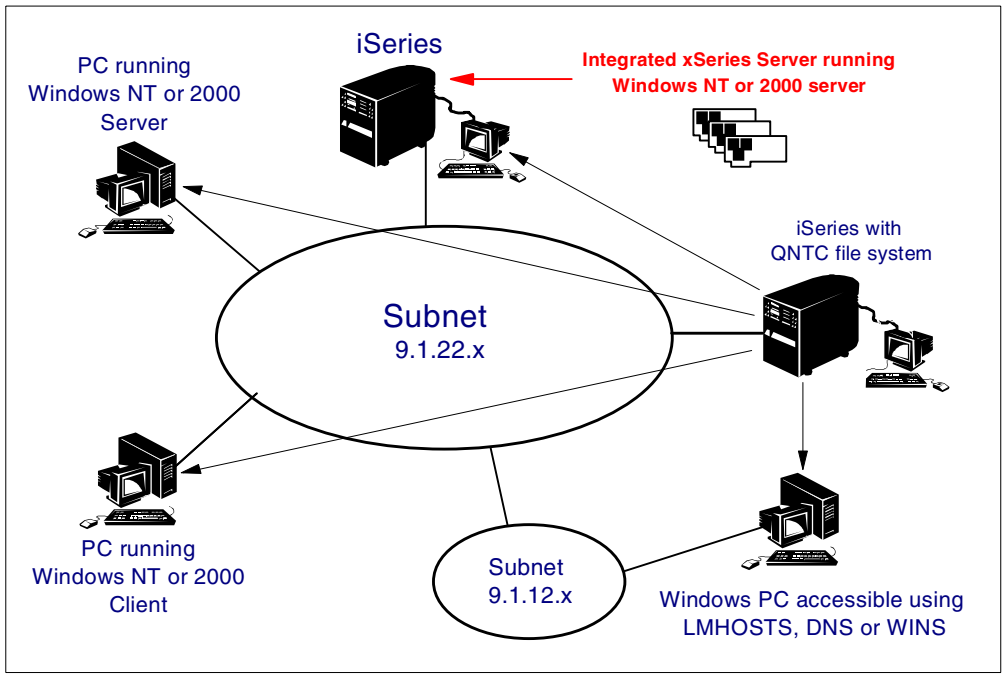

Figure 183. QNTC access capabilities

13.1.1 File-level backup

In terms of running Windows NT or 2000 on the Integrated xSeries Server, QNTC, as implemented through the QNTC file system, is important because it

enables file-level backup and restore of a Windows server from the OS/400 side. This capability is new with the release of V4R5. In V4R3 and V4R4, you could view files in shared Windows directories through the QNTC file system and copy them to other file systems.

However, to truly back up a file, you need to preserve its attributes. Until V4R5, you could not save a file through QNTC and preserve its NTFS attributes. File-level backup from the OS/400 side enables a backup of Windows NT or 2000 servers running on Integrated xSeries Servers to be performed as part of an OS/400 backup operation. Without this capability, you must perform a file-level backup from the Windows side using a Windows backup application. There are restrictions on saving Windows files to iSeries tape drives. Therefore, file-level backup through QNTC is an important enhancement to the implementation of Windows NT and 2000 on the Integrated xSeries Server.

For detailed information about file-level backup, go to 7.4, “File-level backup from the iSeries side” on page 174.

13.1.2 QNTC path format

The QNTC file system has a hierarchical directory structure like Windows Explorer. A path to a file in QNTC must contain the server name, the share name, the directory names below the share, and the file name. The generic format of the path to access a file in the QNTC file system is shown in the following example:

```
/QNTC/xxxxx/yyyyy/zzzzz/filename.ext
```

Each element of the path name is defined as follows:

xxxxx 15 character server name
yyyyy 12 character share name
zzzzz 256 character path name

13.1.3 Connecting to SMB servers through QNTC

Connecting to SMB servers through the QNTC file system is similar to the mechanism that PCs use. From the iSeries server, you access QNTC using standard IFS commands such as Work Link (WRKLNK) and Create Directory (MKDIR). The command to connect to an SMB server is issued to QNTC and must be translated for Windows NT or 2000 to understand it. The communications protocol that Windows understands is known as *common Internet file system* (CIFS). CIFS defines a standard remote file-system access protocol for use over the Internet and is based on the SMB protocol that is widely used by personal computers running Windows. SMB is a specific interface architecture that enables file sharing, print sharing, and user-based messaging.

QNTC translates the commands that have been issued into CIFS building blocks known as SMBs. The SMBs are sent to the Windows SMB server by encapsulating NetBIOS packets inside TCP/IP packets. Windows processes the SMBs and responds appropriately. NetBIOS over TCP/IP is used to allow packets to be transmitted across network bridges and routers. This enables QNTC to reach a greater range of Windows computers in a network than pure NetBIOS alone would allow.

For QNTC to properly authenticate the user on the iSeries server to Windows, both systems must have matching user profiles and passwords. If you are using QNTC to sign on to a Windows server or workstation, you must be authenticated.

QNTC cannot prompt you for a user ID and password, so you must sign on to the iSeries with a user ID and password that match with a corresponding user account on the Windows computer.

NetServer is essential to the implementation of QNTC because it provides native SMB communications support for the iSeries server. QNTC requires this support for name resolution and browsing services. AS/400 NetServer also provides QNTC with an interface to WINS NetBIOS name resolution, DNS and LMHOSTS. After the NetBIOS name is resolved, AS/400 NetServer communications facilities are used to send NetBIOS packets encapsulated in TCP/IP to the Windows server.

13.2 Setting up QNTC

The QNTC file system and QNTC function are packaged with the base OS/400 operating system, without any additional installation requirements. However, there are several steps required to make QNTC work correctly on your iSeries. The following sections provide an overview of the setup requirements for the iSeries and Windows NT or 2000 servers.

13.2.1 iSeries setup

To complete the iSeries setup, follow these steps:

1. Set up AS/400 NetServer, and start it. We recommend that you perform the entire AS/400 NetServer configuration using Operations Navigator. For full configuration support of AS/400 NetServer, you must use Operations Navigator Version 4 Release 4 or later, which is shipped with OS/400 Client Access Express.

   Refer to Chapter 14, “AS/400 NetServer” on page 345, for a description of how to set up AS/400 NetServer.

2. By default, QNTC can only see Windows servers and workstations that reside on the same Windows domain and the same TCP/IP subnet as AS/400 NetServer. If you have Windows computers that are on a different Windows domain or a different TCP/IP subnet, you must perform additional steps to see these servers through the QNTC file system as follows:

   - One method is to use the OS/400 Create Directory (MD) command from the OS/400 command line. There are two options you can use:

     – To access a Windows computer directly using its IP address, create a QNTC directory as follows:

     ```
     MD '/QNTC/ip-address'
     ```

     – To access a Windows computer using its Windows name, create a QNTC directory as follows:

     ```
     MD '/QNTC/Windows-name'
     ```

     Here, *Windows-name* is the name of the Windows computer you are trying to reach. In this case, you also need to set up Windows name resolution using the OS/400 HOSTS file, a DNS server, or a WINS server.

     You can also use the AS/400 NetServer proxy function to point to a WINS server on another subnet.

QNTC directories

Notice that the QNTC directories that you create using the Create Directory command are lost at the next IPL. Therefore, you need to include the Create Directory commands in your OS/400 startup program.

- For Windows servers and workstations that reside on the same Windows domain as AS/400 NetServer, but outside the local subnet, you can configure AS/400 NetServer to use Windows Internet Name Service (WINS) Proxy. WINS returns a list of Windows computers on the AS/400 NetServer domain to QNTC for display through the QNTC file system. In this case, you do not need to use the Create Directory command, but you can only access Windows computers in the AS/400 NetServer domain. You will not see Windows computers in other domains or workgroups through QNTC.

3. Set up OS/400 Integration for Windows Server user profile propagation (optional).

   If you set up user enrollment and propagation on the iSeries server, you can automatically synchronize OS/400 profiles with the user account in the Windows domain. In this case, you do not need to maintain user accounts manually on Windows servers that you need to access through the QNTC file system. Therefore, you are unlikely to have authentication problems when you access shares on the Windows NT and 2000 servers in the domain. Notice that you must maintain user accounts manually on Windows workstations, if you need to access them through QNTC.

13.2.2 Windows setup

To set up a Windows PC for access by QNTC, perform the following steps:

1. Install TCP/IP networking protocol on the PC.

   You do not need to have NetBIOS configured on the PC because QNTC takes advantage of Windows' ability to handle the encapsulation of NetBIOS packets within TCP/IP packets. To see your configured protocols, follow these steps:

   a. On Windows NT, right-click and select **Network Neighborhood->Properties**. You should see a display similar to the example in Figure 184 on page 338. On this display, you can add, delete, and configure communications protocols.

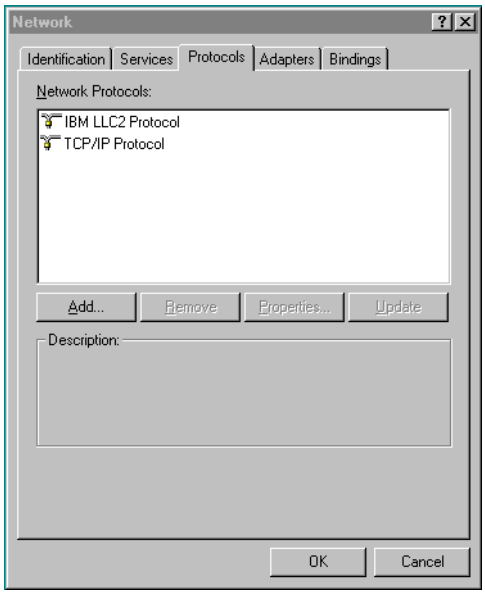

Figure 184. Windows NT Network properties

b. On Windows 2000, right-click **My Network Places**, and then select **Properties->Local Area Connection->Properties**. You should see a display similar to the example in Figure 185. On this display, you can add, delete, and configure protocols.

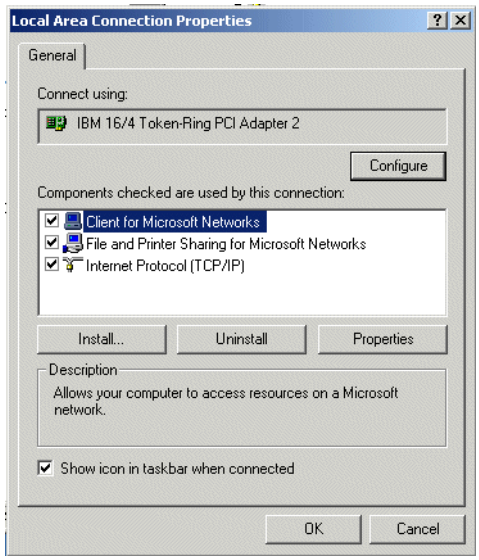

Figure 185. Windows 2000 network properties

2. Create Windows user accounts. To add a user account to Windows, follow these steps:

   a. For Windows 2000, refer to Chapter 6, “User administration” on page 121, if you need help creating a Windows 2000 user profile.

   b. For Windows NT, you can use the User Manager tool to manage your users from Windows NT. Selecting **Start-> Programs-> Administrative Tools-> User Manager**. Then the display shown in Figure 186 appears.

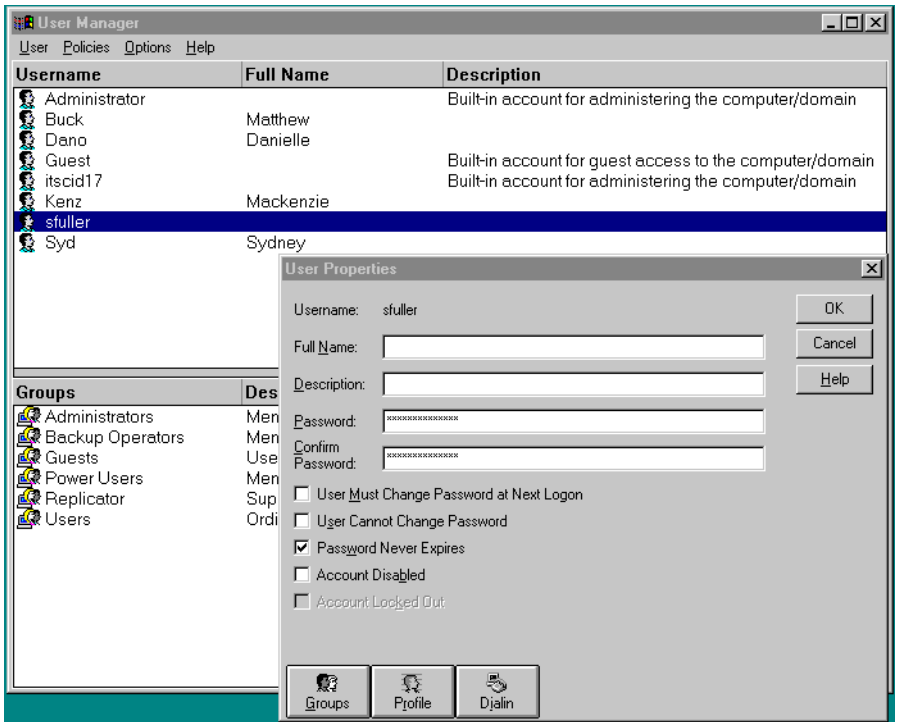

Figure 186. Creating a user account on Windows NT

3. Create shares on Windows computers.

   By sharing their resources, Windows computers expose them to the network. To access a directory on a Windows computer through the QNTC file system, you need to share that directory on the Windows computer where it resides. To setup sharing, right-click the file or directory from Windows Explorer, and select **Sharing**.

4. Configure the PC in the same domain as AS/400 NetServer (optional, but recommended).

   Configuring the PC in the same Windows domain as AS/400 NetServer will simplify name resolution, as long as the PC and iSeries are on the same TCP/IP subnet. If they are not, or if you do not want to configure the PC to be in the same Windows domain as AS/400 NetServer, you need to use a name resolution technique. Refer to 13.2.1, “iSeries setup” on page 336.

5. Configure at least one Windows NT or 2000 domain controller to be the master browser for the domain (optional).

   The Windows browsing service allows other computers to determine the computer member list for a given Windows domain. QNTC uses the browsing service to obtain a list of computers in the Windows domain to which it can talk. This list is limited to the TCP/IP subnet on which the iSeries and Windows domain controller (or backup domain controller in the case of Windows NT) reside.

6. Configure one PC in the Windows domain as a WINS proxy (optional).

   This should match the WINS proxy configuration in AS/400 NetServer. This is not necessary if all computers reside on the same subnet, because QNTC can perform IP address resolution using NetBIOS name broadcasts.

13.3 QNTC examples

This section shows you a couple of examples to help you understand how QNTC works and how it can optimize your environment.

13.3.1 Accessing files using QNTC and AS/400 NetServer

In this example, an iSeries server is on one TCP/IP subnet, and a Windows NT workstation is on another TCP/IP subnet. AS/400 NetServer has been configured in Windows domain1, while the PC has been configured in Windows domain2. The scenario is shown in Figure 187.

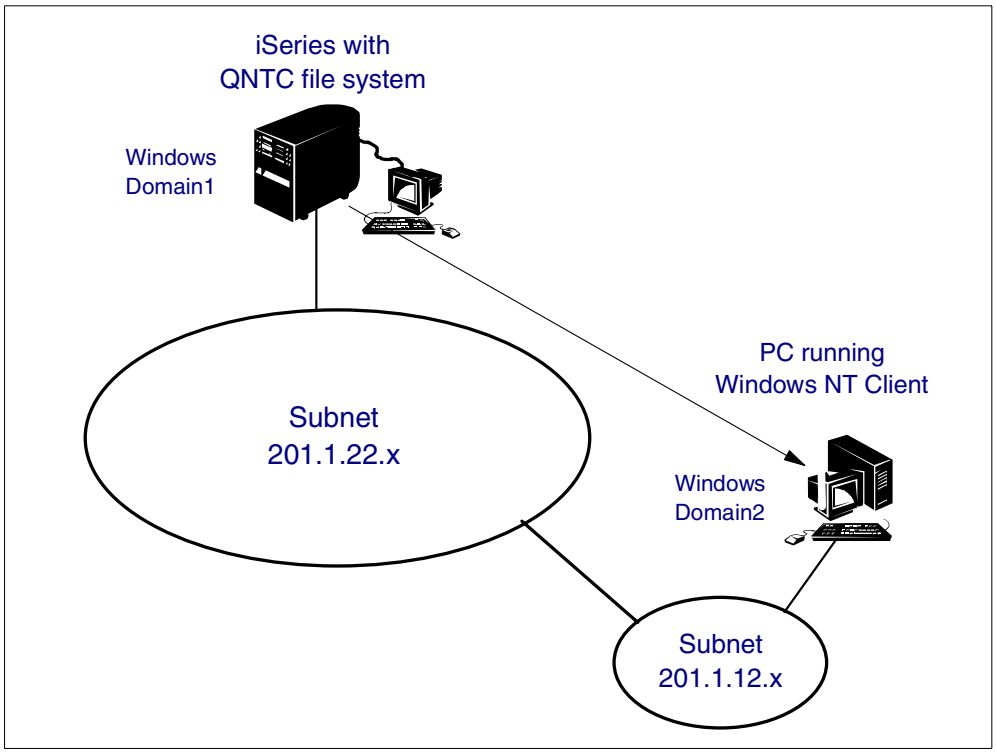

Figure 187. QNTC file system sample scenario

In order for directory shares on the PC to be accessible through the QNTC file system on the iSeries server, we completed the following tasks:

1. The PC was set up to use TCP/IP. The PC can ping the iSeries server and vice versa.
2. Matching user profiles were set up on the iSeries and PC. We signed on to the iSeries and Windows PC using this profile.
3. A directory was created in the QNTC file system as follows:

   ```
   MD '/QNTC/philains'
   ```

4. An entry was added to the iSeries's HOSTS file (CFGTCP option 10), using the TCP/IP host name *philains* and IP address of the PC. Notice that you should use fixed IP addresses on Windows PCs you are trying to access through QNTC. If you use DHCP, you cannot use a static configuration file (such as HOSTS or LMHOSTS). DCHP would require the use of a technique such as dynamic DNS (DDNS).

5. We ran the WRKNLK command as follows:

```
WRKLNK '/QNTC/philains'
```

From the iSeries, we accessed files in a shared directory on the PC as shown in Figure 188.

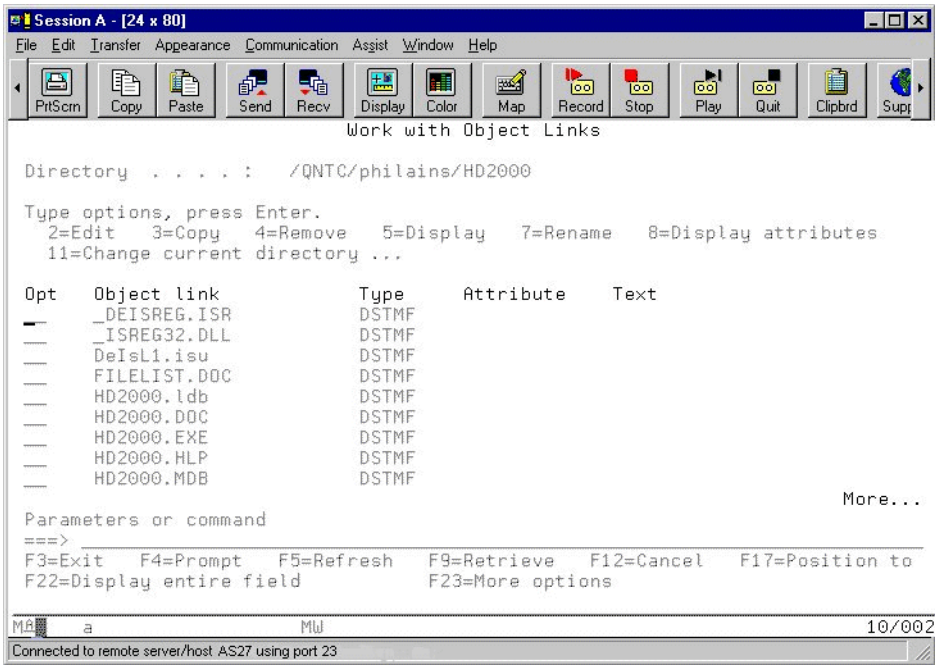

Figure 188. Accessing files on a PC through QNTC

From a PC (can be any PC in the network), we then accessed the iSeries using AS/400 NetServer. We drilled down through the IFS and accessed the same files shown in Figure 188. Accessing these files using AS/400 NetServer from a PC in the network is shown in Figure 189 on page 342.

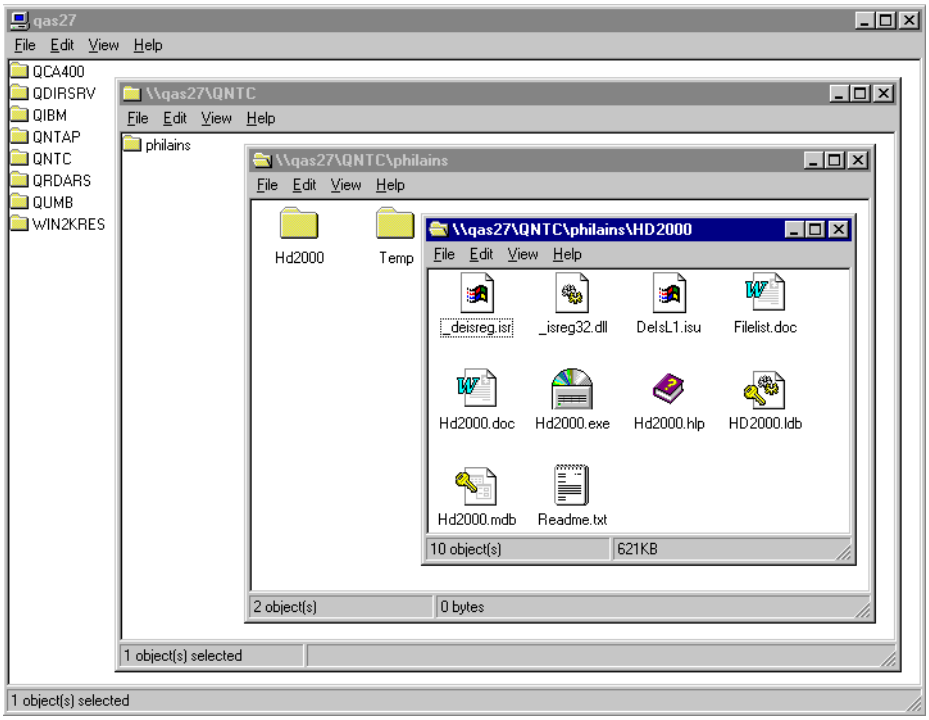

Figure 189. Accessing files on a PC through AS/400 NetServer

This example is a simple demonstration of the high level of integration between the iSeries and Windows computers in a network, using AS/400 NetServer and QNTC. You could use this integration to transfer files between the iSeries and PCs in your network and access their contents. For example, you could copy files located in shared PC directories to different file systems in the IFS and vice versa.

13.3.2 Using QNTC from an OS/400 application

QNTC is a means by which OS/400 applications can access files stored on Windows 2000 and NT servers running on Integrated xSeries Servers or PCs.

In this example, we show you how to set up a Web server on the iSeries to serve Web pages stored on a Windows server. Follow these steps:

1. Set up your HTTP server on the iSeries server.
2. Add an HTTP directive to MAP or PASS a share in the QNTC file system:

   ```
   MAP  /alias/*  /QNTC/system-name/share-name
   PASS  /QNTC/system-name/share-name
   ```

3. Use the Change Network Server User Attributes (CHGNWSUSRA) command to enroll the QSECOFR and QTMHHTTP user profiles, and propagate them to the server. Make sure that you maintain the passwords for these user profiles from the iSeries server.
4. Add these users to the Administrators and Domain Admins groups on the server.
5. You should now be able to access the Web pages on the Windows server from a browser, for example:

   ```
   http://web-server/alias/web-page
   ```

13.4 Limitations of QNTC

Notice the following QNTC file system limitations:

- Connection to shared print resources is not available.
- File-level save and restore capability is not available through QTNC prior to V4R5.
- The QNTC file system supports the majority of the integrated file system APIs. However, because of the lack of a translation mechanism from the OS/400 to Windows, the following exceptions exist:
  - chown()
  - fchown()
  - givedescriptor()
  - link()
  - qp01GetPathFromFileID()
  - readlink()
  - symlink()
  - takedescriptor()
- The following IFS commands are not supported:
  - ADDLNK
  - CHGOWN
  - CHGAUT
  - CHGPGP
  - CHKIN
  - CHKOUT
  - DSPAUT
  - WRKAUT
  - WRKOBJOWN
  - WRKOBJPGP

Chapter 14. AS/400 NetServer

In OS/400 Version 4 Release 2, IBM AS/400 Support for Windows Network Neighborhood (also called AS/400 NetServer) was added. AS/400 NetServer allows Windows PCs to access OS/400 file and print resources without the need for Client Access.

AS/400 NetServer is discussed in this redbook because it is required for certain integration functions of Windows 2000 running on the Integrated xSeries Server.

Although this chapter does not offer an exhaustive discussion of AS/400 NetServer, it provides enough information for you to set up AS/400 NetServer so that you can use all the functions of Windows 2000 on the Integrated xSeries Server. The integration functions for which you require AS/400 NetServer are:

- Updating the OS/400 Integration for Windows Server (5769-WSV) files that reside on the Windows 2000 server
- Backing up from, and restoring Windows 2000 files to, the iSeries server through the QNTC file system

Notice that you do not need either Windows 2000 or an Integrated xSeries Server to set up and use AS/400 NetServer.

How much AS/400 NetServer do you need?

If you only want to use AS/400 NetServer to apply service packs to OS/400 Integration for Windows Server, you only need to read 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358.

If you want to perform file-level backup and restore through the QNTC file system or use the full function of AS/400 NetServer, read this entire chapter.

For more detailed information on AS/400 NetServer, refer to *The AS/400 NetServer Advantage,* SG24-5196.

You can also access the latest AS/400 NetServer information from the Web site:
`http://www.as400.ibm.com/netserver`

14.1 What’s new for V4R5

The following enhancements are new for AS/400 NetServer with V4R5:

- AS/400 NetServer now supports Microsoft Windows NT Server 4.0, Terminal Server Edition, and Windows 2000 Terminal Services. This enhancement already delivered as a PTF for V4R3 and V4R4. Multiple users, including guests, can now access the same AS/400 NetServer share on a multi-user Windows server from multiple Windows clients.
- AS/400 NetServer sessions end when the idle timeout value expires. This now occurs even if there are open files for that session.
- You can enable or disable AS/400 NetServer’s support for WINS proxy.

14.2 Product overview

AS/400 NetServer is an OS/400 function, introduced in Version 4 Release 2, that enables Windows clients to connect to OS/400 shared directories and output queues using TCP/IP. AS/400 NetServer capability is part of, or integrated with, the OS/400 operating system. It is installed automatically.

AS/400 NetServer also provides the connectivity support for the QNTC file system that was introduced in Version 4 Release 3. QNTC gives the iSeries server the ability to participate in a Windows network as a Server Message Block (SMB) client. QNTC can be thought of as client for Microsoft Networks for the iSeries.

Windows PCs on the network use the file and print sharing capabilities that are built into their operating systems to access AS/400 NetServer resources on the iSeries server. For example, you can use Network Neighborhood on a Windows 95 PC to access file and print resources on an iSeries server without loading any additional software on the PC.

AS/400 NetServer uses NetBIOS over TCP/IP to communicate with its clients. Therefore, TCP/IP must be configured on those iSeries servers and PCs that use AS/400 NetServer. The TCP/IP configuration on the iSeries server does not require any specific changes to support AS/400 NetServer.

14.2.1 AS/400 NetServer scenarios

There are two scenarios in which you can use AS/400 NetServer:

- **Direct access**: The most common scenario for using AS/400 NetServer is where Windows clients access AS/400 NetServer file and printer resources directly, as shown in Figure 190.

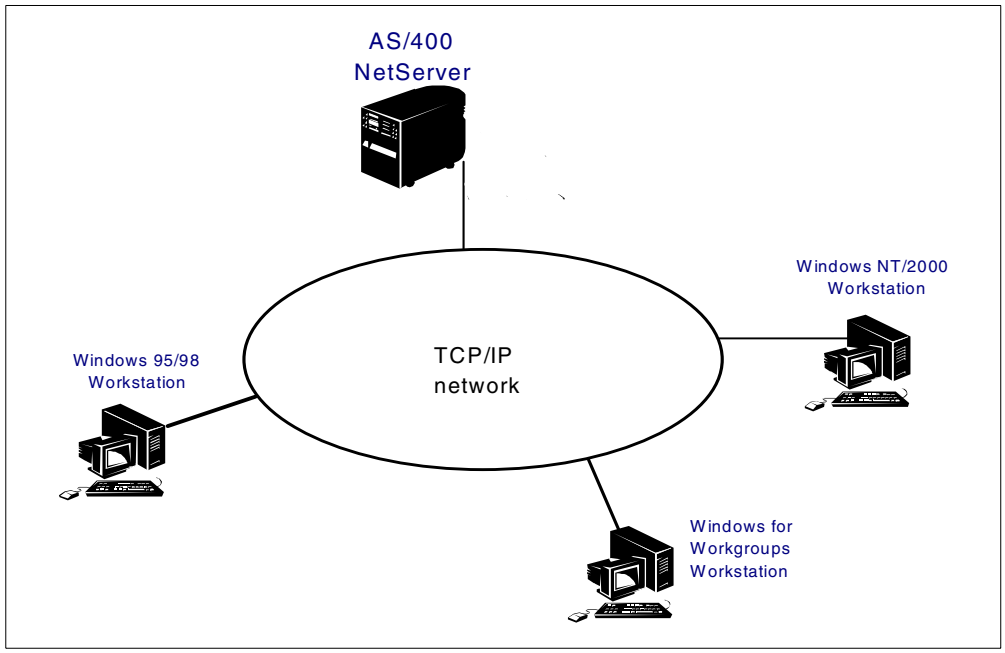

Figure 190. AS/400 NetServer direct access scenario

For example, you can connect to AS/400 NetServer resources using one of the following methods, depending on your network topology:

- Using Windows Network Neighborhood
- Clicking **Start->Find->Computer->server-name** for Windows 95, 98, and NT
- Clicking **Start-> Search-> For files or folders...-> Computers-> and typing** `server-name` for Windows 2000
- Clicking **Start->Run** and typing `\\server-name`

server-name is the name of the AS/400 NetServer server. Each of these methods is described in greater detail later in this chapter.

Direct access is in contrast to indirect access where you route requests to access AS/400 NetServer shares through a multi-user Windows server.

- **Indirect access**: The other common scenario, shown in Figure 191, is when you use the Terminal Services capabilities of a Windows 2000 server or a Windows NT server installed with Windows NT Server 4.0, Terminal Server Edition (TSE). In both cases, the server can be used as a gateway between end-user workstations and the iSeries server. This enables AS/400 NetServer to interoperate with a multi-user Windows environment.

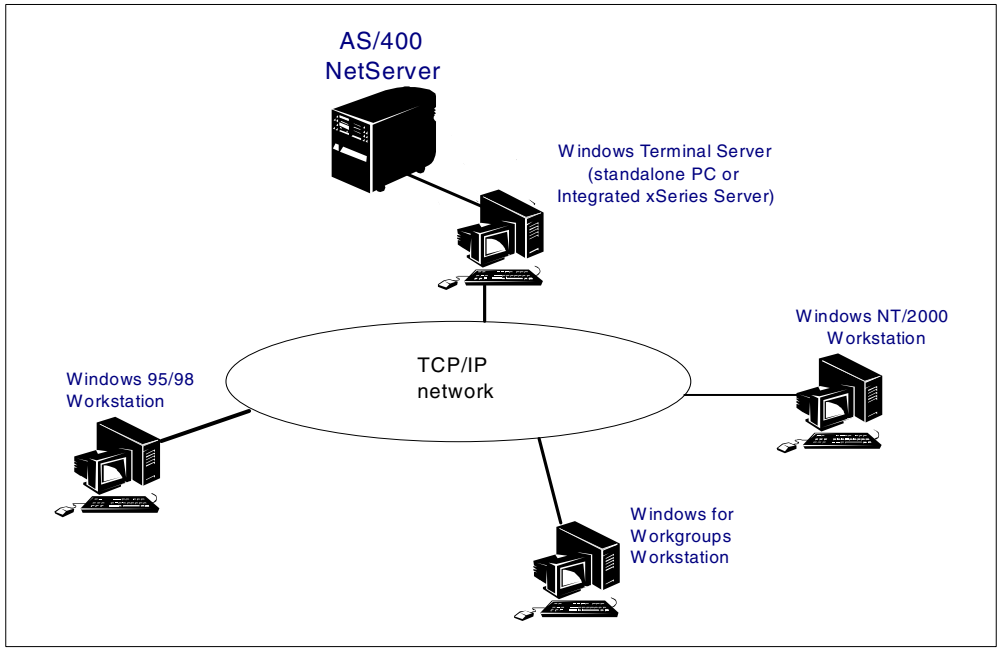

Figure 191. AS/400 NetServer indirect access scenario

You can map AS/400 NetServer file shares to drives on the multi-user Windows server. These drives, in turn, can be accessed by Windows clients on the network running terminal services clients. AS/400 NetServer now allows multiple users, signed on to the same AS/400 NetServer client (in this case the Terminal Services server), to access a shared directory on the iSeries server.

Support for the multi-user Windows environment, provided by Windows 2000 Terminal Services and Windows NT 4.0 Terminal Server Edition, is integrated into V4R5 and added to V4R3 and V4R4 by applying a PTF.

14.2.2 Definition of terms

This section defines some technical terms that are used in this chapter:

- **NetBEUI**: NetBEUI is a network protocol that can be used in a Windows networking environment. It is often used interchangeably with NetBIOS and is the foundation on which the resource sharing capability in Windows networks is built. Windows machines use NetBEUI to talk to each other in the network to announce their presence and exchange resource sharing information.
- **NetBIOS**: NetBIOS is a programming interface to which applications can be written using the NetBEUI protocol. Another way of looking at it is that NetBIOS is a higher layer in the protocol stack than NetBEUI.

  You can draw an analogy between NetBIOS and NetBEUI, and Winsock and TCP/IP, where Winsock is a Windows programming interface that uses the TCP/IP protocol for communications.
- **Share**: A share is a resource, either a directory or printer, that has been made available for use by clients in the network. You can share a resource on Windows 95, 98, NT, and 2000 and make it available to the network. You can also share iSeries resources, either IFS directories or output queues, using AS/400 NetServer. Shares can be used to selectively make resources available to other computers in the network.

  Clients can use shared resources by searching the computers on which the resources are stored and then accessing the resources as if they were stored locally, on the client's hard disk.
- **Server Message Block (SMB)**: SMB is a client/server architecture that can be used to share file and print resources in a network using the NetBEUI protocol.

  SMB has been around since the early days of IBM and Microsoft PC networking and is still used extensively by Windows machines to share resources.

  PCs can act as SMB servers and SMB clients, depending on whether they share resources to the network or access shared resources on the network. For example, using the peer resource sharing capabilities provided by SMB, a Windows 95, 98, NT, or 2000 PC can share its file and print resources with other Windows 95, 98, NT, and 2000 PCs. AS/400 NetServer is an implementation of the SMB architecture and uses this capability to share directories and printers to Windows computers in the network.

The OS/400 QNTC file system is an implementation of the SMB (client) architecture and uses this capability to access shared directories on SMB servers in the network. For more information on QNTC, refer to Chapter 13, "QNTC file system" on page 333.

14.2.3 Comparing AS/400 NetServer with OS/400 Client Access

> **Note**
>
> The information in this section applies only to Client Access for Windows 95 and NT, because this product also provides access to OS/400 directories and printers using a function called *Network drives* and *Network printers*. This function is removed in Client Access Express, because the file and printer sharing functions are provided natively by AS/400 NetServer. If you are running the Client Access Express client, you must use AS/400 NetServer for OS/400 file and print serving.

Both AS/400 NetServer and OS/400 Client Access for Windows 95 and NT provide file and printer sharing capability across a network. However, they differ in the following ways:

- **AS/400 NetServer**

  AS/400 NetServer has the following characteristics:

  - It does not require any proprietary software to be installed on the PC client. Windows provides all of the software that is required to access AS/400 NetServer. However, you may want to install Client Access Operations Navigator on at least one PC to administer AS/400 NetServer.
  - You can selectively share individual directories and output queues.
  - You can share a directory with read-only access.
  - You can hide a share from the network.
  - You can hide AS/400 NetServer from Windows Network Neighborhood.

- **Client Access for Windows 95 and NT**

  Client Access has the following characteristics:

  - With OS/400 Client Access for Windows 95 and NT, you see all integrated file system (IFS) root-level directories and printer output queues by default. That is, there is no concept of shares. With AS/400 NetServer, you only see OS/400 IFS directories and output queues that were shared by the AS/400 NetServer administrator. The exception to this rule is the /QCA400 directory, which AS/400 NetServer shares by default with a share name of QCA400. This is so that Client Access for Windows 95 and NT can always be installed on an AS/400 NetServer client. Another exception is the /QIBM IFS directory that is automatically shared as QIBM when 5769-WSV is installed. You can use QIBM to install Client Access Express.
  - AS/400 NetServer on the iSeries server only provides access to file and print resources. Client Access includes this same capability, but provides an additional range of rich client/server functions.
  - OS/400 Client Access requires the installation of proprietary software on the Windows PCs to provide file and printer sharing. NetServer clients do not.

14.2.3.1 AS/400 NetServer and OS/400 Client Access name coexistence

A naming conflict can occur on a Windows client if the same network server name is used for both AS/400 NetServer and Client Access for Windows 95 or NT, because the client cannot distinguish between the two servers. This problem

does not occur with Client Access Express, because there is no file and print server component. Client Access Express uses AS/400 NetServer.

By default, OS/400 Client Access uses the iSeries *local control point* name from the network attributes as its network server name. By default, AS/400 NetServer uses the iSeries server's current system name from the network attributes. In most installations, these two network attributes are the same. To avoid a potential conflict, a *Q* is inserted in front of the AS/400 NetServer server name, by default, to distinguish it from the OS/400 Client Access for Windows 95 or NT network server name. For example, an iSeries called SYSTEM1, acting as a Client Access for Windows 95/NT network server, normally appears in the Windows Network Neighborhood as System1. The same iSeries server acting as an AS/400 NetServer network server appears, by default, in Network Neighborhood as Qsystem1. However, notice that you can change the default name of the AS/400 NetServer server using Operations Navigator. This is described later in this chapter.

We recommend that you use the *current system name*, preceded by the letter *Q*, as specified for the iSeries in the network attributes.

14.2.4 AS/400 NetServer file shares

The following list contains information that you need to be aware of when creating file shares:

- An AS/400 NetServer file share is a directory path within the IFS that AS/400 NetServer shares with PC clients in the network. File shares are configured using Client Access Operations Navigator.
- AS/400 NetServer now supports Microsoft Windows NT Server 4.0, Terminal Server Edition, and Windows 2000 Terminal Services. Multiple users, including guests, can now access the same AS/400 NetServer share on a multi-user Windows Server from multiple Windows clients.
- The only directory that is automatically shared by AS/400 NetServer is the /QCA400 IFS directory, which can be used to install Client Access for Windows 95 and NT. Certain program products cause other directories to be shared. If OS/400 Integration for Windows Servers (5769-WSV) is installed, you will see the following shared directories:
  - /QNTAP
  - /QIBM

  Notice that Client Access Express can be installed from /QIBM.
- You can designate that a file share can be accessed in either *Read only* mode or *Read/Write* mode.
- If you stop file sharing on a particular share, the share is still available to clients that are already using the share. New client requests to access the share will fail.
- All Windows clients that are supported by AS/400 NetServer (Windows for Workgroups, Windows 95, 98, NT, and 2000) are case *insensitive*. All IFS file systems, except QOpenSys and Network File System (NFS), are also case insensitive. A user-defined file system (UDFS) can be defined as case sensitive or case insensitive at the time of creation. Therefore, be careful when using AS/400 NetServer to access case sensitive file systems. Notice,

however, that you can configure QOpenSys, UDFS, and NFS to be case insensitive.

- You must enroll users who are working with shared objects within the QDLS file system into the iSeries server distribution directory (SDD) using the Add Directory Entry (ADDDIRE) command. Users who are not enrolled in the SDD cannot gain access to QDLS shares.

14.2.5 AS/400 NetServer printer shares

You need to be aware of the information in the following list when you create printer shares:

- Using AS/400 NetServer, you can share any OS/400 output queue with Windows clients in the network. These shares are configured using Client Access Operations Navigator.

  Printer sharing supports the following spooled file types:

  - User ASCII
  - Advanced Function Printing (AFP)
  - SNA Character String (SCS)
  - Auto-select

- The Network Print Server (NPS) requires a password for authentication (NPS does not prompt for a password) for any user profile (including the guest profile) that is used to access a shared output queue. The addition of a password does not affect access to file shares by guest users. Because the guest user profile now has a password and is enabled, set the initial menu parameter in the profile to automatically sign off any user who tries to access the iSeries interactively using this profile. Specify `INLMNU(*SIGNOFF)` in the guest user profile.

- You can find AFP and SCS printer drivers in the /QCA400/Win32/Install/Printer folder that AS/400 NetServer automatically shares with PC clients.

  AFP print drivers are also available for download from the IBM Printing Systems Company Web site: `http://www.printers.ibm.com`

- The TCP/IP loopback interface, which uses IP address 127.0.0.1, must be started so that AS/400 NetServer can communicate with the OS/400 Network Print Server. You can use option 1 on the Configure TCP/IP (CFGTCP) menu to verify that this interface is active and start it if necessary.

14.2.6 Backup and recovery

AS/400 NetServer uses files in the IFS to store configuration and share information. You should back up these files as part of your normal OS/400 backup procedure. The AS/400 NetServer configuration and share information is stored in the /QIBM/UserData/OS400/NetServer directory.

14.2.7 Text conversion

Prior to Version 4 Release 4, AS/400 NetServer did not provide data conversion capabilities between ASCII and EBCDIC. This function was added in Version 4 Release 4. To configure the text conversion, you must run Client Access Express Operations Navigator on your administration PC. Using the Text Conversion tab in the AS/400 NetServer File Share properties dialog, you can specify OS/400 file types that are automatically converted from EBCDIC to ASCII and vice versa.

With text conversion enabled, OS/400 EBCDIC data is automatically translated to ASCII when it is transmitted to the PC to be viewed.

Text conversion is disabled when the Allow file text conversion option is deselected.

The Code page parameter defines the ASCII code page used for converting data for the share with which you are working. The default is to use the AS/400 NetServer code page.

Text conversion is triggered by file extensions. For example, an OS/400 file member is displayed in the Network Neighborhood with the file extension MBR. To enable automatic text conversion for file members with this extension, type the letters `MBR` in the entry field, and click the **Add** button next to it.

14.3 Finding AS/400 NetServer in the network

Before an AS/400 NetServer client can access AS/400 NetServer resources, the client must find the server in the network. SMB clients find their servers using a TCP/IP broadcast protocol called User Datagram Protocol (UDP). However, in most TCP/IP networks, routers and gateways in the network filter out UDP broadcast frames when the iSeries and PC clients are not in the same TCP/IP subnet.

If AS/400 NetServer and its SMB clients are in the same Windows workgroup or domain and in the same TCP/IP subnetwork, you do not need to do anything more. AS/400 NetServer will appear in the Windows Network Neighborhood window. Clients can find the server because the UDP broadcast frames do not have to cross a subnet boundary or go through a gateway. Therefore, they are not filtered out of the network. However, if AS/400 NetServer and its clients are not in the same Windows workgroup or domain or TCP/IP subnetwork, AS/400 NetServer and its clients may not find each other. In this case, you must use one of the following methods to resolve AS/400 NetServer names to IP addresses. In each case, you must add an entry that specifies the AS/400 NetServer name and its TCP/IP address, for example:

```
10.10.10.1 QSYSTEM1
```

There are three methods you can use:

- **Domain Name Service (DNS)**

  There are many different types of computers that can function as a DNS server including the iSeries server starting with release Version 4 Release 2.

  You may already have an entry in the DNS for the iSeries server. The entry contains the OS/400 TCP/IP host name, TCP/IP domain name, and the TCP/IP address of the iSeries server. The OS/400 host name is usually the same as the current system name entered in the network attributes (DSPNETA).

  DNS is the most common method used for resolving computer names to IP addresses in larger networks. You need to add an entry into the DNS server for the AS/400 NetServer server and make sure that the DNS server address is known to your PC clients. Notice that PC clients can use the same TCP/IP address to access AS/400 NetServer as they use to access the iSeries server using, for example, Client Access Telnet 5250. We recommend that you use

an alias for the AS/400 NetServer name instead of making an additional entry in the DNS. This means that both the TCP/IP host name and AS/400 NetServer names point to the same TCP/IP address.

- **Windows Internet Name Service (WINS)**

  A Microsoft WINS server provides a dynamic naming service that resolves NetBIOS computer names to IP addresses. Although the iSeries server cannot act as a WINS server, it can act as a WINS proxy that forwards the NetBIOS name resolution requests it receives from SMB clients to a WINS server. You can configure AS/400 NetServer with the address of the WINS server by accessing the AS/400 NetServer properties through Operations Navigator. AS/400 NetServer also allows you to turn WINS proxy support on and off, but the default is off.

  You also need to configure all the PC clients to use WINS and point them to the WINS server's IP address.

- **Client static configuration file (LMHOSTS)**

  Where a HOSTS file maps TCP/IP host names to TCP/IP addresses, the Windows LMHOSTS file can contain entries that map NetBIOS names to TCP/IP addresses. SMB clients can use entries in the LMHOSTS file to try and resolve the name of the AS/400 NetServer to an IP address.

  The disadvantage of using static configuration files, such as LMHOSTS, is that they are more difficult to manage than the DNS or WINS approach, because each client PC must be maintained individually.

  Adding an entry in the HOSTS file on a PC also enables an SMB client to resolve the TCP/IP address of an SMB server. However, we recommend that you use LMHOSTS, rather than the HOSTS file.

  To add an entry to the LMHOSTS file, follow these steps:

  a. On a Windows 95 or 98 PC, type:

     ```
     cd\windows
     ```

     On a Windows NT or 2000 PC, type:

     ```
     cd\winnt\system32\drivers\etc
     ```

  b. Rename the LMHOSTS.SAM file to LMHOSTS (if it has not been done already):

     ```
     ren lmhosts.sam lmhosts
     ```

  c. Edit the LMHOSTS file and add an entry as follows:

     ```
     TCP/IP-address AS/400-NetServer-name #PRE
     ```

     #PRE preloads the entry into cache and is only required on pre-OSR2 Windows 95 PCs, for example:

     ```
     10.10.10.1 qsystem1 #PRE
     ```

14.4 AS/400 NetServer security

Before AS/400 NetServer clients can gain access to OS/400 file and print resources, the resources must be shared by the AS/400 NetServer administrator. This sharing process is similar in concept to the way that you share a Windows network file or print resource. The OS/400 administrator can define shares in the IFS using Operations Navigator.

The AS/400 NetServer administrator cannot modify the security of an object in the IFS or an OS/400 output queue when sharing the object. However, AS/400 NetServer uses the authority associated with the IFS object or OS/400 output queue to validate a client request for access. Therefore, the iSeries needs some way to authenticate requests for access to shared resources submitted by SMB clients to AS/400 NetServer. This can be accomplished in one of the following two ways:

- **Guest access**: A guest user profile is a normal OS/400 user profile and is required to apply service packs to the Windows 2000 side of the OS/400 Integration for Windows Server code (5769-WSV).

  A guest user profile is also required if you want anonymous-type access to AS/400 NetServer from PC clients. Anonymous access is where a user can gain access to AS/400 NetServer shares without signing on to Windows with an OS/400 user profile. Otherwise, Windows passes the logon user ID and password to AS/400 NetServer for authentication. If the user ID and password match an OS/400 profile, the user is granted access to OS/400 files according to the authorities that the user has on the iSeries server.

  If the PC user does not have a matching OS/400 user ID, but a guest user profile is configured, AS/400 NetServer allows the user to access shared directories and files that have *PUBLIC authority, assuming that the guest user profile was created with a security level of *USER (strongly recommended).

  When you set up a guest user profile, make sure that sensitive material on the iSeries server is secured using object-level security.

  You can set the guest user profile in the NetServer properties using Operations Navigator.

- **OS/400 user profile access**: If you have a valid OS/400 user profile and use it to sign on to Windows, the profile is passed to the iSeries server and is used to authenticate your access to AS/400 NetServer shared resources.

Table 27 summarizes the way in which AS/400 NetServer authenticates access to OS/400 shared resources.

Table 27. User profile authentication

OS/400 and Windows user names	OS/400 and Windows passwords	Guest user enabled?	Log on to AS/400 NetServer allowed?
Same	Same	No	Yes, as user
Same	Different	No	Password prompt
Different	Same or different	No	No [1]
Same	Same	Yes	Yes, as user
Same	Different	Yes	Password prompt [2]
Different	Same or different	Yes	Yes, as guest

OS/400 and Windows user names	OS/400 and Windows passwords	Guest user enabled?	Log on to AS/400 NetServer allowed?

1. For Windows 95 and 98 clients, you *must* sign on with your OS/400 user profile because Windows 95 and 98 do not prompt for a user ID. They can only prompt for a password. You are prompted for a password if the password you used to sign on to Windows 95 or 98 is not the same as your password on the iSeries server. For Windows NT and 2000 clients, you can sign on with any profile because Windows NT and 2000 prompt for both a user ID and password.
2. Signon is possible with the correct OS/400 password for Windows 95, 98, NT, and 2000. Guest user access will not be used.

14.5 AS/400 NetServer properties

You can gain access to some AS/400 NetServer properties using the API commands described in 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358. However, the best way to view and change these properties is to use Operations Navigator from Client Access for Windows 95 and NT or Client Access Express (preferred).

Here is a description of the AS/400 NetServer properties:

- **Server name**: The server name is the name by which AS/400 NetServer is known to the network. By default, AS/400 NetServer uses the Current system name entry specified in the iSeries network attributes (DSPNETA) as its server name, prefixed by the letter *Q*. You can change the default name as described later in this chapter.

  We recommend that you use the current system name, as specified for the iSeries server in the network attributes, and precede it with the letter *Q*.

- **Domain name**: The domain name is the Windows (NetBIOS) domain name to which you want to this AS/400 NetServer server to join.

  By default, AS/400 NetServer uses the *Network server domain* entry specified in the iSeries network attributes as its domain name. This is the same domain name that LAN Server/400 and Warp Server for AS/400 use. You can change the default name as described later in this chapter.

  PCs that you want to access AS/400 NetServer do not need to be part of the same NetBIOS domain to find the AS/400 NetServer. However, if both AS/400 NetServer and PCs are in the same NetBIOS domain, AS/400 NetServer should appear in the Windows Network Neighborhood on the PCs.

  We recommend that the AS/400 NetServer domain name match the domain of those Windows clients that you want to access AS/400 NetServer.

  QNTC requirement

  If you want to backup and restore Windows NT or 2000 files stored on an Integrated xSeries Server at a file level through QNTC, AS/400 NetServer needs to be in the same domain as the Windows server you are backing up or restoring.

- **Guest user profile**: You need to set up a guest user profile to use the update function of OS/400 Integration for Windows Server.

You can set the guest user profile in the NetServer properties using Operations Navigator.

Refer to 14.4, “AS/400 NetServer security” on page 353, for more information about the guest user profile.

- **Allow AS/400 NetServer access using OS/400 name**: This parameter is only valid if you *do not* have Client Access for Windows 95 or NT installed on the PCs you will use to access AS/400 NetServer.

  If you activate this function, you can call your AS/400 NetServer the same name as your iSeries server, as specified by the Current system name parameter in the Display Network Attributes (DSPNETA) screen.

- **Start when TCP/IP is started**: If this parameter is selected, it causes AS/400 NetServer to be started when TCP/IP is started. Activation of this function is recommended and is the default setting at V4R5.

- **Idle time-out for inactive sessions**: Specifies whether a connection stays open once activity on that connection has stopped. The possible values are:

  - *Automatically disconnect inactive sessions*: Specify the amount of time, in seconds, that a session stays open, once activity on that connection stops.
  - *Leave inactive sessions connected*: Specify that a session stays open, even if activity on that connection stops.

- **Scope ID**: You do not need to use a scope ID, nor we do not recommend it unless you have a specific reason.

  The scope ID is a way to segment a network or to group SMB hosts and clients into the same logical unit. Any clients that are not configured with the same scope ID specified in the AS/400 NetServer properties cannot access shared resources. Therefore, if you decide to use scope IDs, you must be careful to configure every AS/400 NetServer client with the correct ID.

- **Browsing announcement interval**: You can hide AS/400 NetServer from Windows Network Neighborhood by changing the Browsing announcement interval parameter to `0` in the AS/400 NetServer properties using Operations Navigator. This stops AS/400 NetServer from announcing its presence to the network.

14.6 AS/400 NetServer setup

The prerequisites for setting up AS/400 NetServer are:

- The iSeries server must have TCP/IP configured. Refer to 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358, for a brief description of how to do this.
- The PC clients that will use AS/400 NetServer must also have TCP/IP configured. In addition, the file sharing component, Client for Microsoft Windows Network, must be installed on Windows 95 and 98 PCs. This is described in the next section.

14.6.1 Setting up the Windows PC clients

Complete the following tasks to set up your PCs to use AS/400 NetServer:

1. Verify Windows networking support.

   a. For Windows 95 and 98**,** select **Control Panel-> Network-> Configuration**.

      Make sure that *Client for Microsoft networks* is installed.

      When you are using an Integrated xSeries Server, you may also want to enable *Logon validation to a Windows NT domain*, which you can select by clicking the **Client for Microsoft Networks** icon.

   b. For Windows 95, 98, and NT, select **Control Panel->Network**.

      For Windows 2000, select **Control Panel-> System-> Network Identification**.

      Make sure that the PC is a member of a workgroup or domain, preferably the same one as AS/400 NetServer. You can determine the domain name from the AS/400 NetServer Properties dialog box under Operations Navigator, which is described in 14.8, “Setup and administration using Operations Navigator” on page 360.

2. Verify TCP/IP support.

   Make sure that TCP/IP support has been configured on the PC. Test this by Pinging the iSeries server from a DOS window.

3. Set up NetBIOS name to IP address resolution.

   If AS/400 NetServer and the Windows PC are in the same workgroup or Windows domain and in the same TCP/IP subnet, no additional setup on the client is necessary. AS/400 NetServer should automatically appear in the Windows Network Neighborhood display. If this is not the case, proceed with the following instructions.

   The quickest way to set up NetBIOS name to IP address resolution is to add an entry to the LMHOSTS file that is located in the \Windows directory on a Windows 95 or 98 PC or in the \WINNT\system32\drivers\etc directory on a Windows NT or 2000 PC. Refer to 14.3, “Finding AS/400 NetServer in the network” on page 352, for instructions on using LMHOSTS.

   You can also resolve addresses by adding an entry to a DNS server or setting up a WINS server to resolve the NetBIOS name of the AS/400 NetServer server to its IP address. Notice that you need to configure your PC to use a DNS or WINS server. Refer to 14.3, “Finding AS/400 NetServer in the network” on page 352, for instructions on using DNS and WINS.

14.6.2 Choosing a setup method

You now need to decide which method you want to use to set up AS/400 NetServer:

- **Fastpath method**: This method is recommended if you only want to set up AS/400 NetServer to enable the OS/400 Integration for Windows Server update function.

  Refer to 14.7, “Setting up AS/400 NetServer: Fastpath” on page 358.

- **Full setup method**: This method is recommended if you want to access Windows 2000 running on the Integrated xSeries Server at a file level through

the QNTC file system (for OS/400 file-level backup of the server) or use the full function of AS/400 NetServer.

Refer to 14.8, “Setup and administration using Operations Navigator” on page 360.

14.7 Setting up AS/400 NetServer: Fastpath

If you only want to set up AS/400 NetServer to apply service packs to OS/400 Integration for Windows Server, and you do not have AS/400 Operations Navigator installed on a PC connected to the iSeries server, complete this section.

To complete the fastpath setup from an interactive session, follow these steps:

1. Verify that TCP/IP support is configured on your iSeries server. You must have at least one external TCP/IP interface configured and active to use AS/400 NetServer.

   As a minimum, complete the following tasks to set up TCP/IP on your iSeries server. For a detailed description of how to configure TCP/IP, refer to *TCP/IP Configuration and Reference*, SC41-5420.

   a. Go to the Use the Configure TCP (CFGTCP) menu.

   b. Select option `1` to configure a TCP/IP interface on a LAN adapter in the iSeries server.

   c. To configure a default gateway, if required, select option `2`.

   d. Select option `12`, to configure:

      - A host name
      - A TCP/IP domain name
      - DNS server TCP/IP addresses (if available)

   e. Use the Start TCP/IP (`STRTCP`) command to start TCP/IP.

   f. From a command line, ping another TCP/IP host on the network using the *Ping* command as follows:

      ```
      ping 'a.b.c.d'
      ```

      Here, *a.b.c.d* is the IP address of the TCP/IP host you are trying to reach.

2. Add a guest AS/400 NetServer user profile to the iSeries server.

   Users who require the file and print capabilities of AS/400 NetServer, but do not have an OS/400 user profile, need a guest user profile. AS/400 NetServer does not automatically configure guest support. Users without OS/400 user profiles will not be able to access AS/400 NetServer. You also need a guest user profile to update the OS/400 Integration for Windows Server code residing on the integrated Windows server.

   On the iSeries server, create a user profile with no special authorities. You need to have *SECADM special authority to perform this task.

   ```
   CRTUSRPRF USRPRF(guest-user-profile) PASSWORD(*NONE)
     TEXT('Guest user profile for AS/400 NetServer')
   ```

   Note: If you want to use the print sharing capabilities of AS/400 NetServer, you must specify a password. In this case, you would create a user profile as follows:

```
CRTUSRPRF USRPRF(GUEST) PASSWORD(password) INLMNU(*SIGNOFF) TEXT('Guest
   user profile for AS/400 NetServer')
```

The `INLMNU(*SIGNOFF)` parameter ensures that no one can use this profile to gain access to the iSeries interactively.

3. Enter the following command to register the guest user profile with AS/400 NetServer or to change it. You need *IOSYSCFG and *SECADM special authority to perform this task.

   ```
   CALL QZLSCHSG PARM(guest-user-profile X'00000000')
   ```

   Substitute your guest profile name for *guest-user-profile*.

4. Verify that the QSERVER subsystem is started.

   The QSERVER subsystem should start automatically. Confirm that it is started by entering the following OS/400 command:

   ```
   WRKSBS
   ```

   If the QSERVER subsystem is not started, you can start it by entering the command:

   ```
   STRSBS QSERVER
   ```

5. Change AS/400 NetServer properties from the iSeries server.

   You must have *IOSYSCFG authority to change any part of the AS/400 NetServer configuration.

   If you do not want to use the default values for the AS/400 NetServer name and domain, you can change them as shown in the following example:

   ```
   CALL QZLSCHSN PARM(server-name domain-name 'description' X'00000000')
   ```

   You do not need to change the name of AS/400 NetServer or the AS/400 NetServer domain name from their defaults to use the update function of OS/400 Integration for Windows Server.

   If you change the name of AS/400 NetServer, you should also change the corresponding entries in the DNS, WINS server, or LMHOSTS file.

   Notice that any changes you make do not take effect until you stop and then restart AS/400 NetServer.

   You have now set up AS/400 NetServer to apply service packs to the Windows 2000 side of OS/400 Integration for Windows Server. Refer to Chapter 8, “Updating the integration software” on page 219, for a description of how to do this.

6. Stop and restart AS/400 NetServer from the iSeries server.

   Starting at OS/400 Version 4 Release 4, you can use the following CL commands from the OS/400 command line to start and stop AS/400 NetServer file sharing:

   - To stop AS/400 NetServer, enter the command:

     ```
     ENDTCPSVR *NETSVR
     ```

   - To start AS/400 NetServer, enter the command:

     ```
     STRTCPSVR *NETSVR
     ```

For all releases beginning with Version 4 Release 2, you can use the following CL commands to start and stop AS/400 NetServer file sharing:

- To stop AS/400 NetServer, enter the command:

  ```
  CALL QZLSENDS PARM(X'00000000')
  ```

- To start AS/400 NetServer, enter the command:

  ```
  CALL QZLSSTRS PARM('0' X'00000000')
  ```

7. Confirm that AS/400 NetServer is running.

   If AS/400 NetServer is running, both of the following conditions must be true:

   a. There should be a QZLSSERVER job running in the QSERVER subsystem. Type `WRKACTJOB` and press Enter. Under subsystem QSERVER, a job called QZLSSERVER should be running.

   b. Type `NETSTAT *CNN` and press Enter. You should see the entries shown in Figure 192.

```
*               *          netbios >  003:13:46  Listen
*               *          netbios >  000:13:14  *UDP
*               *          netbios >  000:04:07  *UDP
*              *           netbios >  001:17:41  Listen
```

*Figure 192. NETSTAT *CNN entries for AS/400 NetServer*

8. Start AS/400 NetServer printer support.

   If you want to use the print serving capabilities of AS/400 NetServer, enter the following command to start the print server:

   ```
   STRHOSTSVR *NETPRT
   ```

   Use the `WRKACTJOB` command to ensure that there is a QNPSERVD job active in the QSYSWRK subsystem.

14.8 Setup and administration using Operations Navigator

To use the full capabilities of AS/400 NetServer, read this section. But, to gain all the benefits of using AS/400 NetServer, refer to *The AS/400 NetServer Advantage*, SG24-5196.

Operations Navigator is required to fully set up and administer AS/400 NetServer. Therefore, you must set up OS/400 Client Access on a PC that you use for administration. Client Access for Windows 95/NT Version 3 Release 1 Modification 3 was the first release to support AS/400 NetServer. You can still use this level of Operations Navigator or later levels of Client Access for Windows 95 and NT. However, we recommend the V4R5 version of Client Access Express Operations Navigator because it contains the latest enhancements to AS/400 NetServer.

Complete the following tasks to set up AS/400 NetServer using Operations Navigator:

1. Check TCP/IP support.

   Make sure that TCP/IP support has been configured and started on your iSeries server.

At least one external TCP/IP interface must be configured and active for AS/400 NetServer to use it. You can see which interfaces are configured and active by completing these steps:

a. Start Operations Navigator. Select the iSeries server that you want to use for AS/400 NetServer. Then, click **Network-> Protocols**.

b. Right-click **TCP/IP** in the right pane, and select **Interfaces**.

2. Add a guest AS/400 NetServer user profile to the iSeries server.

   You must have *SECADM special authority to perform this task. You can use any name you prefer for the guest user profile.

   Notice that you do not need to set up a guest user profile to use the full function of AS/400 NetServer if you sign on to Windows with your OS/400 user profile. However, when you apply service packs to the Windows 2000 side of the OS/400 Integration for Windows Server code, you are normally signed on to the Windows 2000 console as *Administrator* to perform this function. *Administrator* is not a valid OS/400 user profile name. Therefore, you need to set up a guest user profile on the iSeries to install the service packs. To set up a guest user profile follow these steps:

   a. Select your iSeries name from Operations Navigator.

   b. Right-click **Users and Groups**, and select **New User**.

   c. Type the user name and description.

   d. From the pull-down list at the Password prompt, select **No password (logon not allowed)**.

   > **Note**
   >
   > We recommend that you use an initial menu of *SIGNOFF, rather than selecting no password associated with the user profile. This still prevents the user ID from being used for signing on to OS/400, but allows the user to access AS/400 NetServer printer shares.

   e. Click **Add** to add the user profile.

3. Change the AS/400 NetServer properties:

   Notice that, if you want to perform file-level backup and restore of an integrated Windows server through QNTC, you need to make sure that AS/400 NetServer and the Windows server are in the same Windows domain. If you need to change the AS/400 NetServer domain, this step explains how to do it.

   You must have *IOSYSCFG authority to change any part of the AS/400 NetServer configuration.

   To view the AS/400 NetServer properties, select your iSeries server from the Operations Navigator panel. Then, follow these steps:

   a. Select **Network-> Servers-> TCP/IP**.
   b. Right-click the **AS/400 NetServer** icon.
   c. Click **Properties**. The window shown in Figure 193 on page 362 appears.

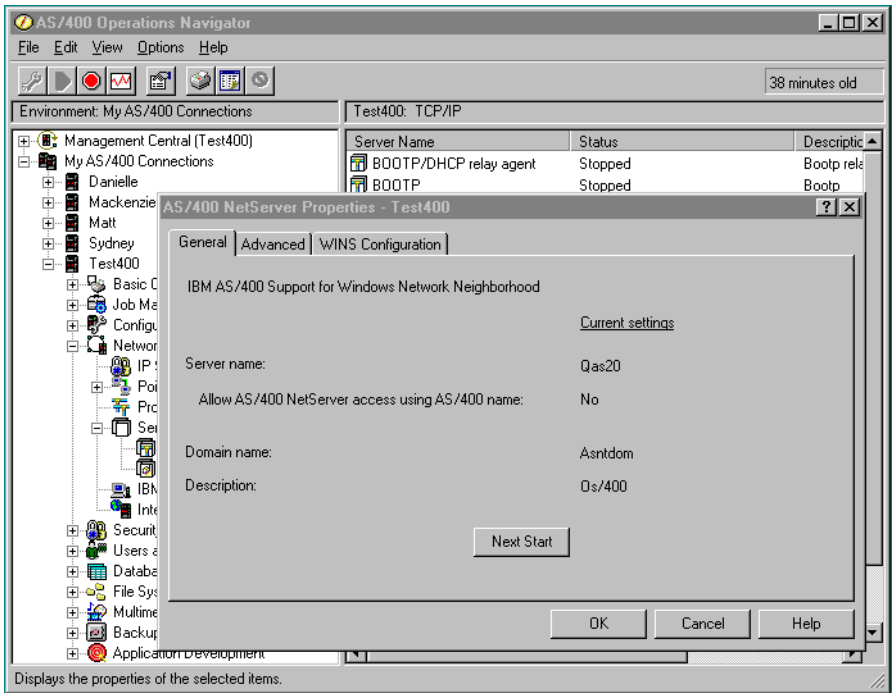

Figure 193. AS/400 NetServer properties

If you want to change the server name or domain name or set up AS/400 NetServer to automatically start when TCP/IP is started, follow these steps:

i. Click **Next Start**.

ii. Change the server name and domain name as required.

iii. Select the **Start when TCP/IP is started** box (optional but recommended).

iv. Click **OK**.

Notice that the option to start AS/400 NetServer automatically when TCP/IP is started is only available when using Operations Navigator from Client Access Express.

To change the guest user profile, follow these steps:

i. Select the **Advanced** tab.
ii. Click **Next Start**.
iii. Change the guest user profile.
iv. Click **OK**.

If you want to make any changes to the AS/400 NetServer guest user profile, you must have *SECADM and *IOSYSCFG special authorities.

d. Click **OK**.

Any changes you make *do not* take effect until you stop and then restart AS/400 NetServer.

4. Administer AS/400 NetServer shared objects.

To administer AS/400 NetServer shared objects, follow these steps:

a. Double-click the **AS/400 NetServer** icon in the Operations Navigator panel.

b. Double-click the **Shared Objects** icon. By default, you see at least the QCA400, QIBM, and QNTAP icons. QNTAP is the OS/400 IFS service directory (/QIBM/ProdData/NTAP), where service packs for OS/400 Integration with Windows NT Server reside.

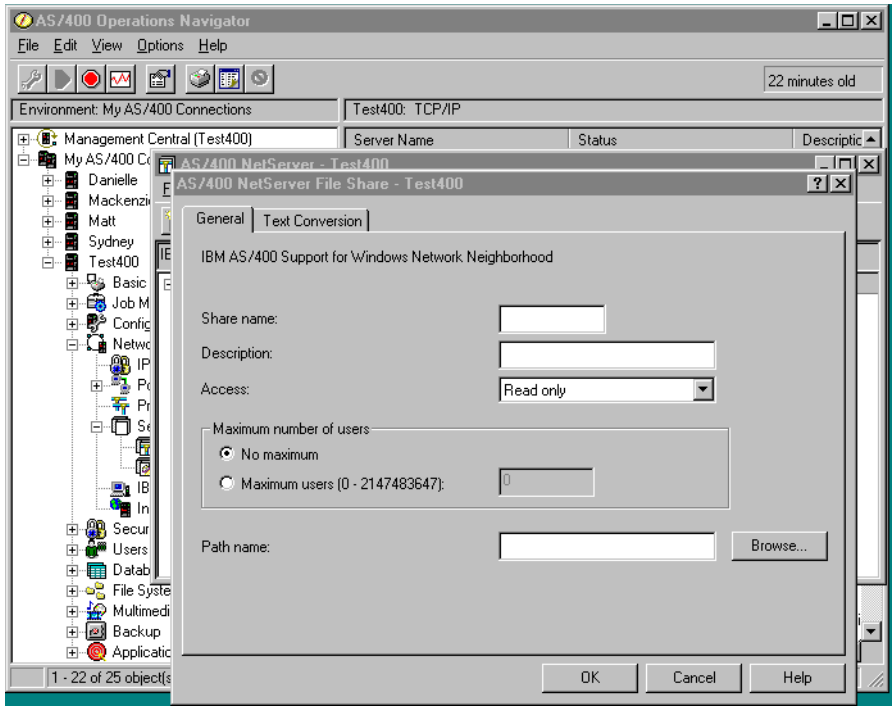

Figure 194. Administering AS/400 NetServer shares using Operations Navigator

c. Right-click an icon. You can end sharing or view the properties for the share.

d. To add additional shares to the list, highlight **Shared Objects**. Then, click **File-> New-> File** to create a new file or directory share, and click **File->New-> Print** to create a new printer share. Notice that the OS/400 user profile you are using must have *IOSYSCFG authority to add, change, or remove a share.

   Complete the information in the dialog that appears, as shown in Figure 194. Click **OK** to apply the changes.

   Notice that you can browse the OS/400 IFS to select the resource that you want to share.

5. Administer AS/400 NetServer sessions.

   To administer AS/400 NetServer sessions, follow these steps:

   a. Double-click the **AS/400 NetServer** icon in the Operations Navigator window.

   b. Double-click the **AS/400 NetServer Sessions** icon. You see the currently connected AS/400 NetServer clients, as shown in Figure 195 on page 364.

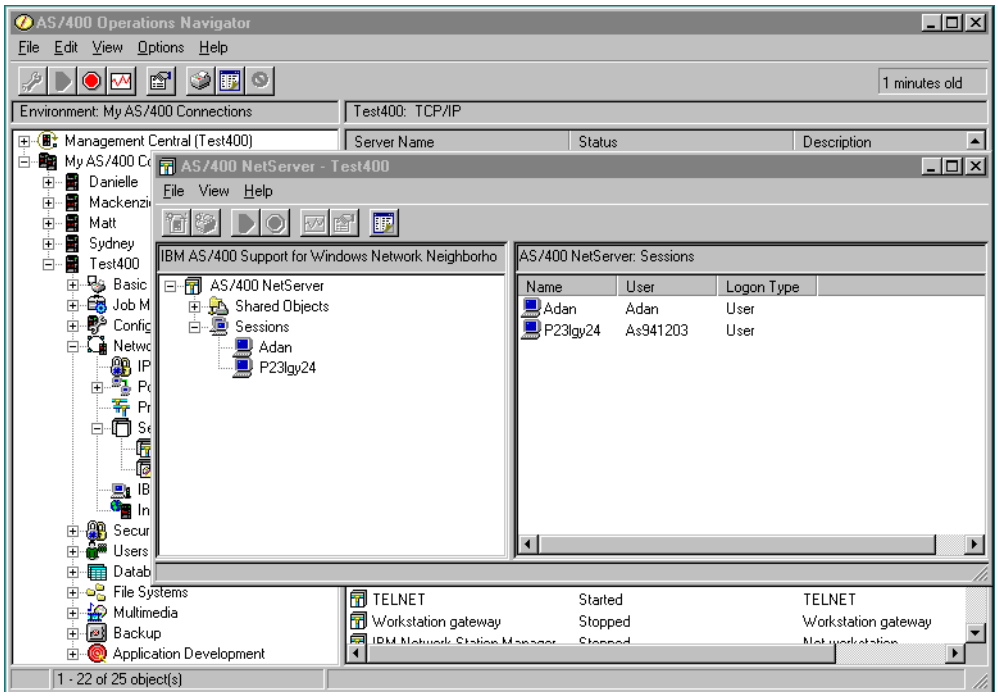

Figure 195. Active AS/400 NetServer sessions

c. Right-click a session icon to disconnect the session or view the properties for the session, as shown in Figure 196. Notice that stopping a client session does not stop the client from reconnecting to AS/400 NetServer again.

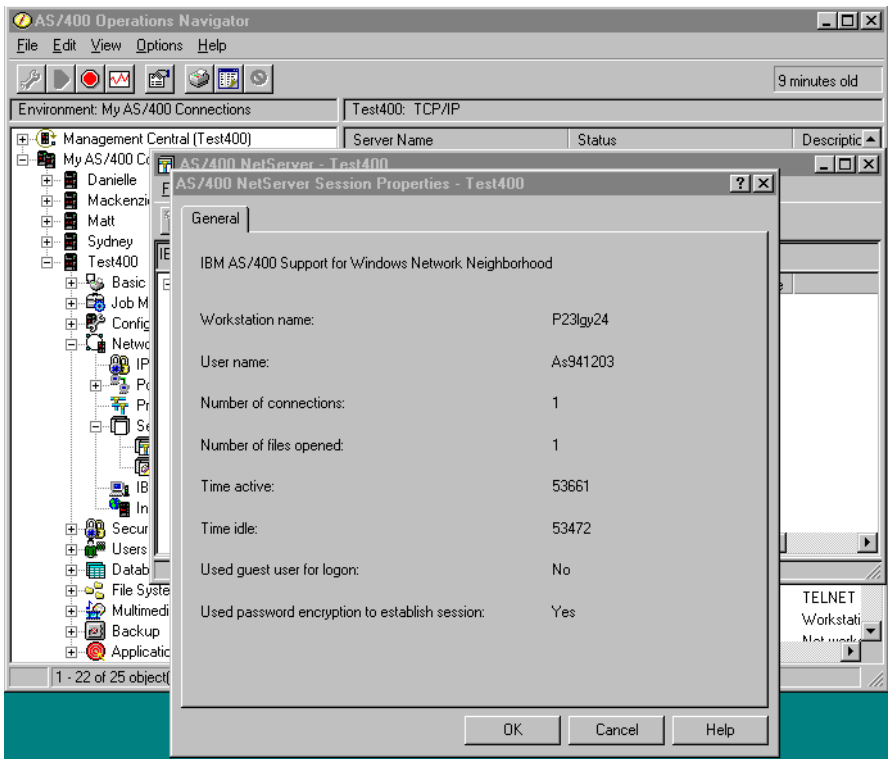

Figure 196. AS/400 NetServer Session Properties

6. Stop and restart AS/400 NetServer from Operations Navigator.

   To stop and restart AS/400 NetServer, follow these steps:

   a. Right-click the **AS/400 NetServer** icon in the right panel.

   b. Click **Stop** and then **Start**.

7. Verify that the QSERVER subsystem is started.

   The QSERVER subsystem should start automatically. To confirm that it is started, type:

   ```
   WRKSBS
   ```

   Press Enter.

   If necessary, start the QSERVER subsystem by typing:

   ```
   STRSBS QSERVER
   ```

   Press Enter.

8. Confirm that AS/400 NetServer is running.

   If AS/400 NetServer is running, both of the following conditions should be true:

   a. There should be a QZLSSERVER job running in the QSERVER subsystem. Type:

      ```
      WRKACTJOB
      ```

      Press Enter. Under subsystem QSERVER, a job called QZLSSERVER should be running.

   b. Type:

      ```
      NETSTAT *CNN
      ```

      Press Enter to see the entries shown in Figure 197.

```
*               *          netbios >  003:13:46  Listen
*               *          netbios >  000:13:14  *UDP
*               *          netbios >  000:04:07  *UDP
*               *          netbios >  001:17:41  Listen
```

*Figure 197. NETSTAT *CNN entries for AS/400 NetServer*

9. Start AS/400 NetServer printer support.

   If you want to use the print serving capabilities of AS/400 NetServer, enter the following command to start the print server:

   ```
   STRHOSTSVR *NETPRT
   ```

   Use the `WRKACTJOB` command to ensure that there is a QNPSERVD job active in the QSYSWRK subsystem.

14.9 Gaining access to AS/400 NetServer shares

To find AS/400 NetServer in the network, follow these steps:

1. Sign on to Windows networking.

   For Windows 95 and 98, you need to sign on to Windows networking with your OS/400 user profile. Otherwise you will not be able to access AS/400 NetServer shares (unless guest access is configured). The reason for this is

that Windows caches the user ID and password that you used to sign on and passes them to AS/400 NetServer for authentication. Windows 95 and 98 can only prompt for a password. Therefore, if your Windows networking user ID does not match an OS/400 user profile, there is no way to pass a new profile to AS/400 NetServer.

On the other hand, Windows NT and 2000 can prompt for both a user ID and password if you do not sign on with an OS/400 user profile.

2. Open up the Network Neighborhood panel on your desktop.

   This method works best if AS/400 NetServer and client PCs are all in the same Windows (NetBIOS) domain and TCP/IP subnet.

3. If you do not see an icon with the name of your AS/400 NetServer server, double-click **Entire Network**.

   Double-click the domain in which AS/400 NetServer resides. You can determine the domain name from the AS/400 NetServer Properties dialog box under Operations Navigator.

   You should see an icon with the name of your AS/400 NetServer.

4. If you do not see an icon with the name of the AS/400 NetServer server, you need to use one of the name resolution techniques (LMHOSTS file, DNS or WINS) described in 14.3, “Finding AS/400 NetServer in the network” on page 352. Once you implement a name resolution technique, continue with the next step.

5. Use one of the following methods to find AS/400 NetServer in the network:

   - For Windows 95, 98, and NT, click **Start-> Find-> Computer**.

     Enter the AS/400 NetServer name and click **OK**.

   - For Windows 2000, click **Start-> Search-> For files or folders...-> Computers**. Use one of the following options:

     – Enter the AS/400 NetServer name, and click **Search Now**.

     – Enter the fully qualified host name or IP address of AS/400 NetServer:

     ```
     \\qsystem1.mysite.com
     \\10.10.10.1
     ```

   - For Windows 95, 98, NT, and 2000, click **Start-> Run**. Enter:

     ```
     \\qsystem1
     ```

     Click **OK**.

     Or, enter the fully qualified host name or IP address of AS/400 NetServer:

     ```
     \\qsystem1.mysite.com
     \\10.10.10.1
     ```

   - For Windows 98 and NT, click **Start-> Find-> Computer**. Enter the fully qualified host name or IP address of AS/400 NetServer:

     ```
     \\qsystem1.mysite.com
     \\10.10.10.1
     ```

   An icon representing AS/400 NetServer is shown on the panel. An example is shown in Figure 198.

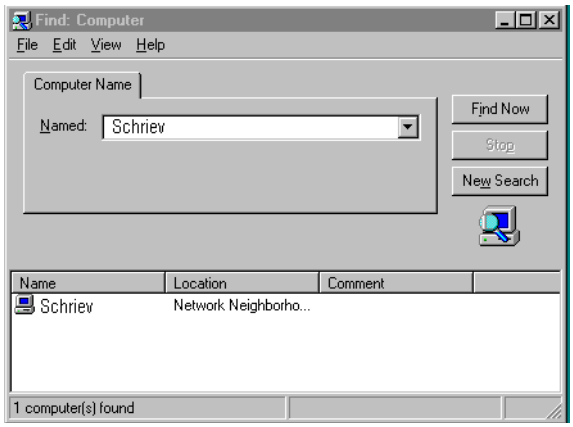

Figure 198. Finding AS/400 NetServer in the network

6. Double-click the server icon.

   You are prompted to enter security information when you try to access AS/400 NetServer if either of the following conditions are true:

   - The user name that you used to sign on to Windows exists on the iSeries server, but the passwords do not match.
   - The user name that you used to sign on to Windows does not exist on the iSeries, and a guest user profile has not been configured.

     Note: In this case, you cannot access the AS/400 NetServer server at all from Windows 95 or 98, because Windows 95 and 98 do not prompt for a user name.

   Once a valid user ID and password are entered, you see the shares (which point to directories and output queues) that were created by the AS/400 NetServer administrator and to which you are authorized, in addition to the default shares.

7. To access an AS/400 NetServer share, double-click the share. Alternatively, you can right-click the share and map a network drive to it.

   After you open the share, you can use the file or printer output queue as if it were located on your PC.

14.10 Positioning AS/400 NetServer as a file server

Using AS/400 NetServer, the iSeries can provide Windows file and printer sharing capabilities in your organization.

There are a number of reasons why you should consider AS/400 NetServer as the solution for file and printer sharing in your organization, including:

- Does not require proprietary client software
- Allows you to share directories with read only or read/write access
- Can share individual directories
- Can be hidden from Windows Network Neighborhood
- Can hide shares from the network
- Can be backed up as part of an OS/400 system save
- Adds OS/400 reliability to file and printer sharing operations
- Uses OS/400 native security

- Uses fast, reliable iSeries disk storage
- Does not require additional hardware or software on the client
- Provides a low cost alternative to a PC file server

Generally speaking, AS/400 NetServer is well positioned to satisfy the file and printer sharing requirements of many organizations. However, in heavy duty resource sharing environments, you need to model the performance of AS/400 NetServer to make sure that it scales to your requirements and does not adversely affect the performance of other OS/400 applications.

For more information on AS/400 NetServer positioning, refer to the redbook *The AS/400 NetServer Advantage,* SG24-5196.

Chapter 15. Managing Windows 2000 servers remotely

We anticipate that many Integrated xSeries Server are being implemented in locations that are remote from the central site and where you want to minimize the amount of work performed at the remote location. This includes updating the system software (either on the Windows 2000 server or the iSeries server), installing applications, modifying storage spaces, and administering the Windows 2000 server. Previously, you needed a special tool to implement remote control of the Windows NT server.

With Windows 2000, a default is set that allows you to run Windows 2000 Server Terminal Services for administration on the server. This gives you the opportunity to run up to two sessions remotely on the server without purchasing any additional license or software. The standard package includes everything you need to perform effective remote management, so you can eliminate most of the needed skills at the remote site.

This chapter looks at some of the techniques you can use to manage this environment.

15.1 A typical remote environment

Many established OS/400 users have a central location with one large iSeries server, a number of satellite locations that have smaller iSeries servers to provide local resources, and the ability to connect to the central site for company-wide requirements. Many of the satellite locations also have requirements for PC servers (for a wide variety of applications and file serving). The Integrated xSeries Server is an ideal solution for this environment because its integration into the iSeries provides many opportunities for managing remote systems from a central location.

Figure 199 on page 370 shows an example of the way in which many remote sites are set up. The diagram shows only one remote site, but there may be many similar sites administered from the same central location.

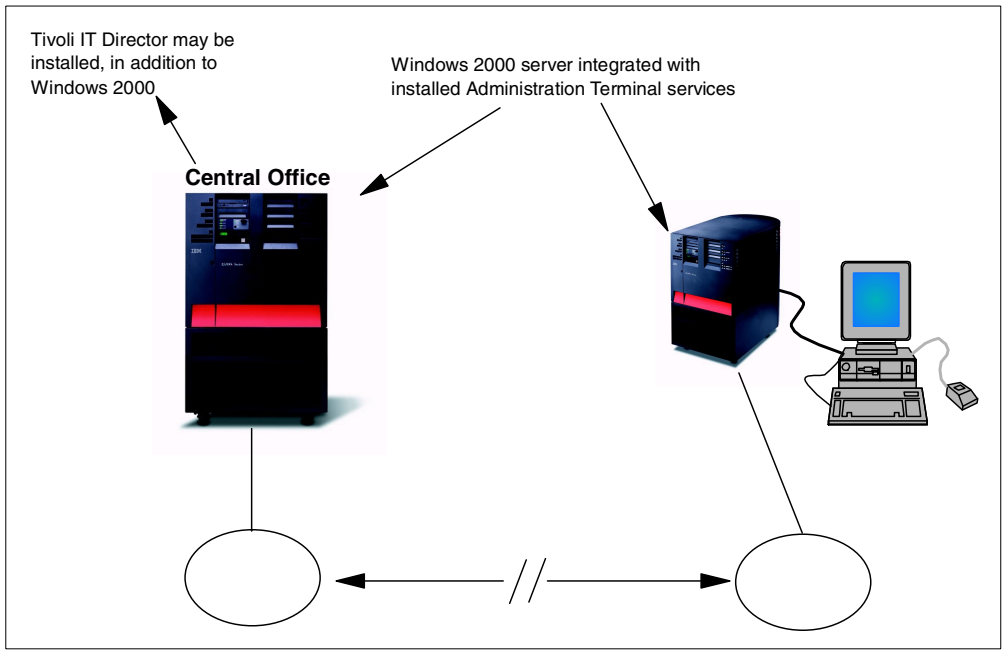

Figure 199. An example of a remote environment

Linking the remote iSeries servers to the central site allows the central operator to control the remote iSeries server. This is a common implementation. The addition of a PC server in the remote location adds a level of complexity for which a few organizations are prepared.

In this example, each iSeries has an Integrated xSeries Server running Windows 2000 attached to its LAN. The LANs are connected using routers using TCP/IP protocol. To enable remote control, Terminal Services, in Administration mode, is loaded on both Windows 2000 servers. In addition, you may install a systems management product, such as Tivoli IT Director, on your central Windows 2000 server or your central iSeries server. In this case, you do not have to install Terminal Services, because the Tivoli Agent on each workstation and server offers remote control.

15.2 Hardware and software requirements

To work with a system in a remote location, you need some hardware and infrastructure prerequisites that you may not normally implement on a local system.

15.2.1 Communications hardware

Although it seems obvious that you need to connect to the remote system to manage it remotely, there are some points that need to be highlighted.

Normally you use a LAN connection to link to the remote system to the central site, rather than a direct iSeries-to-iSeries link. We recommend that you use a LAN-to-LAN connection because it allows you to connect directly to the remote Windows 2000 server, rather than through other iSeries servers. However, you can use the iSeries server to route the TCP/IP traffic to the destination server

across an iSeries-to-iSeries link. In today's company networks, TCP/IP networks using routers are implemented anyway.

The Windows 2000 server that you are working with can share its LAN adapters with the iSeries server. This is supported only on the 333 MHz Integrated Netfinity Server.

Note: We recommend that you use separate LAN adapters for the Integrated xSeries Server and iSeries server, or, you will not be able to reach your iSeries server when the Windows 2000 server is down or has crashed.

LAN connection

For the rest of this chapter, we assume that you have TCP/IP company Intranet using routers for connection to the remote sites. We also assume that the iSeries server has a native LAN connection available. Every iSeries should have a dedicated LAN adapter as mentioned above.

15.2.2 Communications software

To connect from the central iSeries to the remote system or systems requires communication software. Everything you need is delivered with the iSeries server. If your LAN is set up correctly, you can use Operations Navigator to control the remote system, or you can use an 5250 emulation to sign on to your remote system. If you have not installed 5250 emulation, you can use standard Windows Telnet to access a session on your systems

Note: Generating a session on any iSeries server, requires you to set the system value AUTOCFG to on.

15.2.3 Enabling Remote Administration of the Windows 2000 server

Windows 2000 server offers you the possibility to install the Windows 2000 Terminal Services for administration tasks at no extra charge. This enables a server to run two remote sessions as an Administrator with only few system overhead on the server. To see how to install Windows 2000 Terminal Services, refer to 12.3, "Windows 2000 Server Terminal Services installation" on page 281. Be sure to choose the **Remote Administration** mode in the display shown in Figure 125 on page 285. Perform this installation for every one of your branch office implementations.

Important

Use the Remote Administration mode only for administration tasks, not to give any other user access to the server. That is why every user logged on to this sessions has full access to the server!

If your servers are set up for Remote Administration, you only have to install the Microsoft Terminal Services Client to connect to the server, and you can work on the server as if you were working directly on the server's own display. The installation of the client is described in 12.6.1, "Installing Terminal Services Client" on page 293.

15.3 Installing a Windows 2000 server on a remote iSeries server

The first problem you have with a remote site is how to install and configure the Integrated xSeries Server. For the purposes of this section, we assume the following points:

- An iSeries server is already installed.
- The iSeries server has a connection to the central site over a LAN using a native iSeries LAN adapter.
- TCP/IP is configured on this link.
- The Integrated xSeries Server hardware has been installed on the iSeries.
- The display, keyboard, and mouse have been connected and powered on.

The following two installation methods present different degrees of difficulty. The second method requires virtually no skills at the remote site. We included the first method for completeness. Since it is the *traditional* installation method, we do not necessarily recommend that you use it.

15.3.1 Installing the server remotely

With assistance from someone with Windows 2000 skills in the remote site, you can load the Windows 2000 CD-ROM into the iSeries server, run the Install Windows server (INSWNTSVR) command from the central site, and configure the TCP/IP connections on the iSeries and Windows 2000 servers. This involves a lot of preparation and requires that Windows 2000 skills are available at the remote site.

You need to load applications and data onto the server. You also have to give guidance on installing the Windows 2000 Terminal Services to enable remote control. This requires that copies of the CD-ROMs for these products are available at the remote site. Or you can use a network connection via the QNTC file system, which is even more difficult to handle for an unexperienced user.

In summary, while this is achievable, it requires a significant amount of planning and requires Windows 2000 skills at the remote site.

15.3.2 Installing the remote server from the central location

An alternative way to install a Windows 2000 server on a remote Integrated xSeries Server is to install it on a central Integrated xSeries Server. Then send the configuration objects to the remote system. This method has several advantages:

- You can install the system at the central site to make sure everything works correctly before you send it out.
- You can install applications and load data at the central site and make sure that they are installed correctly (correct drive, registry entries, and so on).
- You do not need Windows 2000 skills at the remote site.
- You do not need copies of the application software at the remote site.

To use this method, follow these steps:

1. Ensure the hardware is set up at the remote site (including the display and keyboard).

2. Ensure that the PTF levels of the two iSeries servers are the same. If you install the server on an iSeries that is at a different PTF level from the destination iSeries, you may encounter compatibility problems when you vary on the server at the remote site.
3. Because you are configuring TCP/IP addresses that may not be valid for the network segment to which your central system is attached, we suggest that you disconnect the central Integrated xSeries Server from the network during this process to avoid potential network conflicts.
4. Install and set up the server on an Integrated xSeries Server that is the same as the one at the remote site. Any differences in the Integrated xSeries Server hardware configuration will require modifications at the remote site and can cause problems.

   For example, using different PCI slots for the network adapters will trigger the Plug & Play mechanism when you start the server first on the remote machine. Also, someone must configure the new LAN adapters at the remote site because you have no remote control without a working network connection.
5. Configure all the components as if you were at the remote site (including TCP/IP addresses and so on).
6. Save the configuration information to a save file (use the OS/400 `SAVCFG` command).
7. Save the server storage spaces to save files (use the OS/400 `SAVOBJ` command).
8. Save the user storage spaces to save files (use the OS/400 `SAV` command).
9. Using FTP, send the save files to the remote system (see 15.3.4, “Using FTP” on page 375).
10. Restore the user storage spaces (use the OS/400 `RST` command).
11. Restore the network server description (use the OS/400 `RSTCFG` command), and change the resource name, if necessary.
12. Restore the line descriptions (use the OS/400 `RSTCFG` command).
13. Create the Integrated xSeries Server TCP/IP interfaces. It is possible to save and restore the TCP/IP interfaces, but it is usually as easy to re-create them on the new system manually.
14. Restore the server storage spaces (use the OS/400 `RSTOBJ` command).
15. Vary on the server.

The process of saving and restoring the objects is described in detail in Chapter 7, “Backup and restore” on page 151.

15.3.3 Distributing storage space

You may operate in an environment where you need frequent updates of data held on the server. For example, you have a price list or customer file that is updated weekly. In this case, one option is to load the new data onto a storage space at the central site, send it to the remote iSeries server, unlink the old storage space from the Integrated xSeries Server, and link the new one in its place.

We suggest that you keep the following points in mind when you plan for this process:

- Do not use this process to send applications to the remote server. Applications usually make entries in the registry when you install them. If you link a storage space to a server, and the storage space has applications already installed on it, the applications do not have entries in the registry and will not work correctly. You need to install applications on the server on which they are used.
- Keep the storage spaces as small as possible. Large storage spaces can take a long time to transmit. The largest storage space you can create is 64 GB. This may take several hours to transmit from one iSeries server to another over a local LAN and a lot longer over a remote connection.

An example of this process is shown in Figure 200.

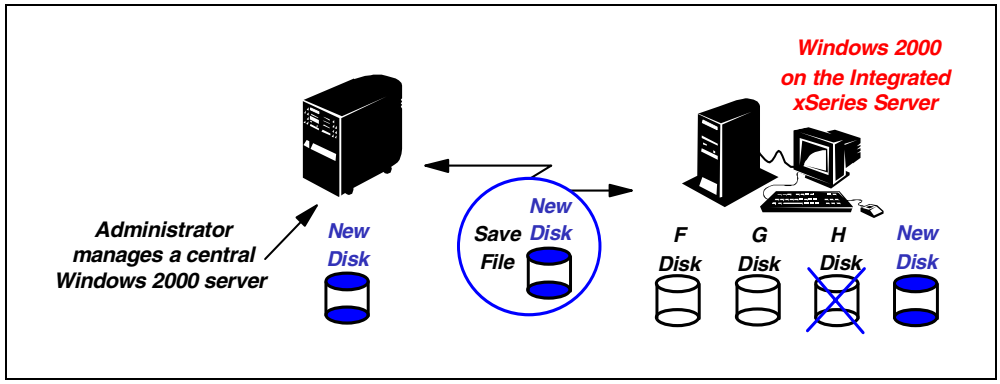

Figure 200. Sending a new storage space to a remote location

We suggest that you follow these steps to distribute a storage space:

1. When you first create the server at the remote site, create a user storage space with a standard name (for example, PRICE). This storage space will contain only the data that you want updated (in this case, the price list).
2. On your central system, create another user storage space that contains the updated data. Make sure the directory structure on the central drive is identical to the structure on the remote drive. Use a name for the storage space that distinguishes it from the one you are replacing, for example, PRICE001. You can call the subsequent one PRICE002 and so on.
3. Save this user storage space to a save file on the central iSeries server. Type the following command:

   ```
   SAV DEV('/qsys.lib/ntbackup.lib/userstg.file')
     OBJ(('/qfpnwsstg/price001') DTACPR(*YES)
   ```

   Press Enter.
4. Use FTP to send the save file (see the following section for details). You can send the same save file to many different iSeries servers if your organization requires this. For example, you may have 20 sales offices and they all need the same price list.

5. Restore the user storage space on the remote system. Type the following command:

   ```
   RST DEV('/qsys.lib/ntbackup.lib/userstg.file')
     OBJ(('/qfpnwsstg/price001')
   ```

   Press Enter. The user storage space is now ready to be linked to the server.

6. To unlink the old user storage space and link the new one, you need to vary off the server.

7. When the server is varied off, use the Work with Network Server Storage (WRKNWSSTG) display to remove the link to the old storage space and link to the new one. Keep the drive number the same to ensure that users know where to find the data. Shares made to the old drive are not retained for the new drive. Therefore, you have to re-share the drive when the server is restarted.

8. Vary on the server again, and verify whether the new data is accessible.

Delete the old storage space when you are sure you do not need it. You can keep it on the iSeries server indefinitely, or you can remove it to avoid wasting disk space.

15.3.4 Using FTP

If you are not familiar with using FTP on an iSeries server, you can follow these steps:

1. Type `FTP`
2. Enter the IP address or the name of the system to which you want to send the save file.
3. Enter a user profile that is valid on the remote system, and then enter its password.
4. Type `NAMEFMT 1`

   This allows you to enter the file names using the integrated file system format. If you are routing the file through a system that does not support NAMEFMT 1, you can use the `CD /` command instead.

5. Type `BIN`

   This sends binary data.

6. Type the following command:

   ```
   PUT /QSYS.LIB/library.lib/savefile.file /QSYS.LIB/library.lib/savefile.file
   ```

   Press Enter.

   The first set of parameters are the source library and save file name (on the central system). The second set of parameters include the destination library and save file (on the remote system). As with all save files, the save file must exist on the destination system before you run this command.

7. Repeat this command for each save file you created. If you want to make the transfer easier, you can put all your save files into one library on the source iSeries server. Then, save that library into a save file, and send only the one save file. Of course, you will need to restore the library at the other end before you start to restore the objects.

8. When you are finished, press F3 to exit FTP.

15.4 Tivoli IT Director

Tivoli IT Director is a systems management product that is designed to help you monitor, control, and manage systems. This list shows the major functions of IT Director:

- **Proactively manages your business system**

  You face a myriad of challenges when managing your business-critical technology. For example, you must monitor the operations of your IT assets, keep business-critical resources available, and meet service agreements. You can use the IT Director alert function to warn you when one server's system drive is running full.

- **Asset and capacity management**

  You can obtain comprehensive information about a variety of hardware and software installed on the systems and export this information to a database. You an also monitor system resources (CPU utilization and disk space) to assist with capacity management. Tivoli IT Director even offers a complete inventory list of your installed hardware.

- **Problem detection and notification**

  You can use the alert support of Tivoli IT Director to notify you of impending problems, actual hardware failures, and so on. You can customize the product to automate some of the responses of these conditions.

- **Help Desk support**

  Tivoli IT Director provides tools to help you support your users. The most critical of these is Remote Control. Tivoli IT Director provides Remote Control for most operating systems, including Windows 3.x, Windows 95, 98, NT, and 2000.

- **Routine maintenance**

  Tivoli IT Director can automate many of the routine tasks that you perform on the system (for example, system backups, file updates, and system reboots).

- **Software distribution**

  Tivoli IT Director gives you the ability to automate the distribution of software packages (for example, Windows NT Service Packs). You customize the installation package one time, and IT Director installs this package without any user interaction on your distributed systems. This connection will work on LAN support even when the workstation is down.

Tivoli IT Director functions and scenarios are greatly discussed in these other IBM Redbooks:

- *Integration Examples for Tivoli IT Director: A First Look*, SG24-5207
- *Managing Applications with Tivoli IT Director*, SG24-5282
- *Tivoli IT Director Automation*, SG24-5295
- *Software Distribution with Tivoli IT Director*, SG24-5493

Chapter 16. PC server migration and consolidation

There are several advantages in migrating PC servers to an Integrated xSeries Server on the iSeries. This chapter covers some of the items that you need to consider when migrating PC servers and the benefits that you could achieve.

16.1 Migrating from a PC-based server to an Integrated xSeries Server

The Windows 2000 server on the Integrated xSeries Server provides the ability to run the Windows 2000 server on a PC-based server. The Integrated xSeries Server for iSeries gives you the advantage of space saving by having a smaller hardware footprint and less hardware to manage. It also gives you greater accessibility, data protection, and easier administration. An Integrated xSeries Server can support any existing Windows applications, provided that they don't depend on any hardware devices that cannot be directly attached to the Integrated xSeries Server. Therefore, you can migrate any existing PC-based server to the Integrated xSeries Server running on the iSeries server.

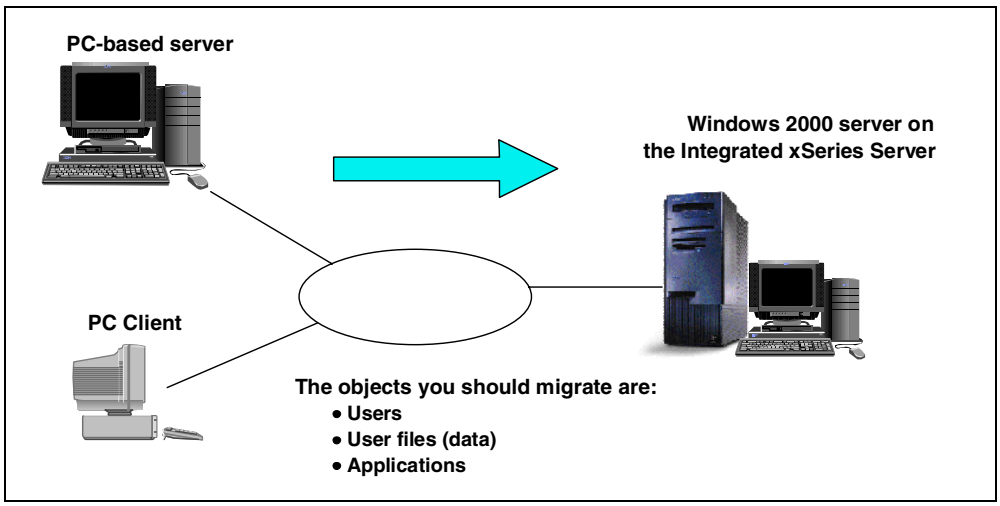

Figure 201. Migrating from a PC-based server to an Integrated xSeries Server

16.1.1 User enrollment planning

When you run the Windows 2000 server on an Integrated xSeries Server, you can enroll existing OS/400 users and groups on the Windows 2000 server. This enables you to administer one group of users, instead of users on both the Windows 2000 and iSeries servers. This synchronization provides great advantages to the users and administrators. When you migrate a PC server, consider how your user profiles will be affected. Refer to Chapter 19, "Windows NT to Windows 2000 server migration" on page 435, for more information.

16.1.2 Data migration planning

Data migration between the PC-based server and the Windows 2000 server on the Integrated xSeries Server requires a compatible tape device, if you going to use the backup and restore approach. However, the easiest way is to use the network. You can copy from an external PC-based server to a Windows 2000

server on the iSeries, or use backup tools that will allow you to save data to network drives.

For a more detailed information, refer to Chapter 19, “Windows NT to Windows 2000 server migration” on page 435.

16.1.3 Application migration planning

Migrating an application can prove to be very difficult, because most applications update the registry during installation.

We recommend that you re-install the applications on the Integrated xSeries Server. To install applications on the Windows 2000 server running on the Integrated xSeries Server, you can use the iSeries resources such as CD-ROM and tape drives.

16.1.4 Migration differences

Although running the Windows 2000 server on an Integrated xSeries Server is much like running Windows 2000 from a PC, there are a few differences, for example:

- **Diskette drive**: The most obvious difference between the Integrated xSeries Server and the PC-based server is the absence of a diskette drive. This means that you cannot use a startup diskette or an emergency repair diskette.
- **Installation**: Installing the Windows 2000 server on an Integrated xSeries Server is different from your typical PC server installation. First, you have to install the integration software on the iSeries server. Then, you have to install the Windows 2000 server on the Integrated xSeries Server using the Install Windows Server (INSWNTSVR) command.
- **Administration**: You can perform a lot of your user administration from the iSeries such as creating Windows 2000 servers users.
- **Disk storage**: The iSeries server manages storage differently than a PC does. You do not need to worry about partitioning a high-growth database, defragmenting disks, or striping on your Integrated xSeries Server.

16.1.5 Benefits

There are a number of benefits of running a Windows 2000 server on the iSeries:

- **Hardware reliability**: The Windows 2000 server on the Integrated xSeries Server has the advantage of sharing available iSeries devices that generally are more reliable when compared with PC-based devices.
- **Hardware availability**: iSeries storage space is shared with the Windows 2000 server by means of the network storage space, which can be protected by using disk functions, such as mirroring and RAID-5. The process that controls such functions is provided by the OS/400 itself. Because of this, the Windows 2000 server and the Integrated xSeries Server are not aware that these functions are being used.
- **Software availability**: Corruption of critical information has always been one of the many challenges of Windows server administrators. Depending on the amount of corruption, this can result in the re-installation of the Windows 2000 server. With the improvement in storage space backups such as file-level

backup, you can totally avoid such situations. Refer to Chapter 7, “Backup and restore” on page 151, for more information.

- **Advantages of OS/400 Integration for Windows Server**: One of the major advantages is the ability for Integration Services to provide management of the Windows 2000 server. You can either sign on locally or remotely to the iSeries on which the Integrated Netfinity is installed and manage it.

  The management conduit for these services is an internal LAN between the iSeries and the Integrated xSeries Server. The internal LAN provides high reliability and high levels of security against external network disruptions and tapping.

  The functions that are handled by Integration Services include starting up, shutting down, and displaying status of the server and its properties. These functions can be done using Operations Navigator.

  If the Integrated xSeries Server hardware fails, replacing the failing item would simply mean replacing a card. If a spare Integrated xSeries Server is available on the same iSeries, you could switch over to the spare Integrated xSeries Server and have your application up and running in a matter of minutes.

  Through the internal connection, the TCP/IP protocol can also be used for client/server applications including ODBC.

- **Hot-spare concept**: The Windows 2000 server running on the Integrated xSeries Server uses an OS/400 object called a *network server description*, where the physical resource name of the Integrated xSeries Server helps to identify the hardware that the description represents. The network server storage spaces are linked to the network server description. If an Integrated xSeries Server goes down because of a hardware problem, you can minimize downtime by simply changing the Resource name parameter of the network server description to another Integrated xSeries Server adapter that is unused and then varying it on.

In summary, the benefits of migrating from a PC-based server to an Integrated xSeries Server are:

- Availability of iSeries resources
- Reliability of iSeries hardware
- Availability of the software
- Ease of management
- Advantages of iSeries integration
- Hot-spare concept

16.2 PC server consolidation

Depending on the iSeries model, you can have multiple Integrated xSeries Servers configured on one iSeries server. Multiple servers can run in a single iSeries server similar to a rack of PC servers. Even if you had only a single Integrated xSeries Server, you can still gain significant advantages by integrating the rest of the Windows 2000 server domain onto the iSeries server.

To find out more about the actual hardware and software of the Integrated xSeries Server cards, refer to Chapter 10, “Integrated xSeries Server hardware and software” on page 255.

16.2.1 Benefits of PC server consolidation

One of the obvious benefits with server consolidation is that you have a smaller overall footprint. The PC-based servers that are available today are usually built in a tower style that generally takes up quite a lot of space. When you consolidate your servers, you save space. With OS/400 Integration for Windows Server, you basically have a smaller hardware footprint, with fewer pieces of hardware to manage as compared to a separate PC server.

With the Windows 2000 server integrated in the iSeries server, you have better access to the iSeries disk storage, which is generally more reliable than a PC hard disk. The storage architecture of the iSeries that spreads storage across multiple disk storage arms helps to improve disk storage access performance. It also gives you faster iSeries tape drives to back up your Windows 2000 server since now you can share the tape resources of the iSeries server. You can have better data protection if you use mirroring or RAID on the iSeries server in which Windows 2000 server takes advantage of to protect the data.

With Client Access/400, you can gain access to DB2 UDB for AS/400 data through an enhanced Open Database Connectivity (ODBC) driver. This driver enables server-to-server applications between the Windows 2000 server and a second tier in a three-tier client/server application.

When you consolidate your servers, you benefit from better administration and maintenance capabilities. You can manage multiple applications and services in a single server and, at the same time, lower the cost of network administration. You also benefit from easier administration of user parameters, such as the password parameter, for the iSeries. You can create users and groups and enroll them from an OS/400 and Windows 2000 server environment. For OS/400 Version 4 Release 5 (V4R5) and later releases, you can save the data from your Windows 2000 server on the same media as your other OS/400 data and restore individual files and objects.

OS/400 Integration for Windows Server gives you the ability to run multiple Windows 2000 servers simultaneously on multiple Integrated xSeries Servers. As many as 16 Windows 2000 servers can be managed in a single iSeries server.

Remote management and problem analysis is an added ability. You can sign on to the iSeries from a remote location and shutdown or restart your Windows 2000 servers. You can also perform remote analysis of a Windows 2000 server error because you can mirror Windows 2000 server Event Log information to the iSeries.

To ensure that your production in not impacted as a result of a hardware failure, you can have an additional Integrated xSeries Server installed for backup purposes. In the event of such a failure, you simply change the resource name in the network server description to use the available hardware. Not only do you benefit from additional hardware backup for your production application, the iSeries hardware also provides disk protection, such as mirroring or RAID-5, for your data.

An integrated Windows 2000 server communicates with the iSeries server by using an internal LAN. This connection is virtual because it uses the system bus for communication instead of external network adapters. This way, data sent over this LAN is secured.

With server consolidation, you can reduce maintenance costs. The iSeries warranty covers the Integrated xSeries Server without any additional charge.

When you consolidate all of your mission-critical applications on the iSeries server, you can actually do more than cut costs. You can create a total business solution. Essential cost savings can be identified as administrative savings, space savings, performance, disk storage savings, and power.

For more information on server consolidation, refer to *AS/400 Consolidation/Strategies*, SG24-5186.

For more information regarding server consolidation, refer to the Web site at:
`http://www.as400.ibm.com/scon`

16.3 Logical Partitioning (LPAR)

Since the last study of IDC in 1998 regarding server consolidation, many companies have since consolidated their servers to cut costs and gain a competitive advantage. With the announcement of Logical Partitioning (LPAR) in OS/400 V4R4 and later releases, customers have been able to carry out physical system consolidation, while keeping each environment logically separate from others. A large number of companies have since merged their existing iSeries servers into one physical iSeries server to reduce overall running costs and improve management.

LPAR functions give you the ability to divide a single iSeries server into multiple logical systems, depending of the hardware resource that is available. A Logically Partitioned iSeries server has a primary partition and one or more secondary partitions. Each logical partition is assigned a different system name and may be set to run its own OS/400 version, system values, and national language. The secondary partitions run relatively independently, but are controlled from the primary partition for procedures, such as disk IOP relocation.

All V4R4 and later release iSeries servers have a primary partition with all resources allocated to it. Creating and managing resources is done from the primary partition itself. Logical partitions provide the ability to shift resources, although certain rules apply. The movement of processors, memory, and interactive performance between partitions can only be achieved with an IPL to the affected partitions.

The primary partition supports these characteristics:

- Requires a minimum of OS/400 Version 4 Release 4 (V4R4).
- Requires a minimum one processor and 256 MB of memory.
- The primary partition owns and manages all the resources in the system.
- An IPL or outage in the primary partition affects all secondary partitions.
- Certain resources, such as processor, memory, and interactive performance, require an IPL in the affected partitions before the changes take place.
- Dynamic allocation of I/O processor-based resources are to CD-ROM, tape drives, communications lines, and workstation controllers.

The secondary partitions have these characteristics:

- Partitions are created and managed from the primary partition.
- To create a secondary partition, a minimum of one processor and 64 MB of memory are required.
- Additional resources, such as load source disk, alternate IPL device, and workstation controller for a console, are required.
- Runs a separately loaded OS/400 version, and the minimum OS/400 version required is Version 4 Release 4.
- Have their own unique system name and system attributes, such as time zone and language.

Disk drives cannot be shared between partitions, and devices attached to IOPs cannot be subdivided between partitions. For example, if you have a magnetic storage controller with two tape drives attached it, each tape drive cannot be allocated to different partitions.

Managing partitions is done from Dedicated Service Tools (DST) and System Service Tools (SST). Allocation of physical resources is done at the input/output processor (IOP) level from DST or SST. Sharing certain devices, such as the CD-ROM, in the base system is not possible. This is because it is attached to the multi-function IOP (MFIOP). The MFIOP also has other items, such as the load source device or boot disk, which cannot be moved. We recommend that you attach at least one more CD-ROM to an IOP that can be dynamically moved from one partition to another or allocate a CD-ROM for each partition. Depending on the model of your tape drive and IOP, this IOP card may also be used to control the attachment of tape drives to the partition.

Note

To manage resources between partitions, you must have knowledge about how to use Dedicated Service Tools (DST) and System Service Tools (STRSST). Integrated xSeries Servers can be divided across various locations on a bus. Take care to ensure that you have enough I/O capacity available on your system to meet your requirements.

For more information on LPAR, refer to *Slicing the AS/400 with Logical Partitioning: A How to Guide,* SG24-5439.

16.4 Clustering

iSeries servers have a long history of designing key functions into the hardware and software that really add to the reliability of the system. Knowledge of these major functions account for single-system availability from a system management point of view.

Cluster technology has been implemented on the iSeries server to provide the availability that is required for planned and unplanned outages. This highly reliable design has been long used for unplanned outages by OS/400 customers worldwide. Today, clusters are implemented to reduce down time due to planned

and unplanned outages and especially for site disasters. The OS/400 cluster solution is a cooperative effort of multiple applications.

In a world moving rapidly toward e-commerce, the pressure has never been greater to have a server that is available 24 hours a day, 365 days a year. In such an organization, focus must also be placed on scheduled down times because they must be minimized. It is estimated that even with good planning, over 80% of all down time will still be scheduled for procedures, such as system backups, IPLs, and software installation.

As more and more servers are consolidated into a single OS/400, it becomes more important to protect against outages, whether they are planned or unplanned. With new functions that are available in Version 4 Release 5 and the use of a high availability tool, it may be possible to improve the availability of your Integrated xSeries Server environment through the use of clustering.

Because this is a new environment, we do not propose that this is the only way of implementing clustering with Integrated xSeries Servers. However, you can use this as a starting point to improve your systems' availability.

16.4.1 Clustering a Windows 2000 server on Integrated xSeries Servers

Clustering is basically linking independent systems together to perform a common tasks, such as servicing clients, with a common set of applications. In a continuous availability environment, two or more OS/400s that are joined together form a cluster. They are physically connected via a LAN or high-speed OptiConnect bus or over telephone lines for systems at different locations. Setups like this enable the system to use a failover that is not possible with a single stand-alone system.

To implement a cluster on OS/400, you need a secondary iSeries server that is replicating activity on the primary iSeries server. The configuration of the secondary unit must allow the business to continue to function following the outage. For an Integrated xSeries Server, this means that you have an Integrated xSeries Server in the secondary machine with the same network cards. The CPU and memory configuration can vary, but the card must be capable of running the software.

To improve the environmental redundancy of the Windows 2000 server, an Integrated xSeries Server is necessary to restructure the environment from the standard Windows 2000 server environment. In an effort to improve visibility, it is necessary to split data stored into dynamic data and static data. *Dynamic data* changes regularly, such as users home directories, templates, and mail files. *Static data* does not change often like application programs.

This distinction is required for the following reasons:

- Windows 2000 server integration implements disk storage as storage spaces that have limited visibility from OS/400.
- Storage spaces cannot be duplicated while they are attached to an active server.

To overcome these issues, NetServer can be used to store the dynamic data, which can be tracked by OS/400 and the high availability tools. This allows you to replicate file by file, where required, while taking advantage of the high speed of

Windows 2000 file serving to provide application files. Essentially the structure would appear as shown in Figure 202.

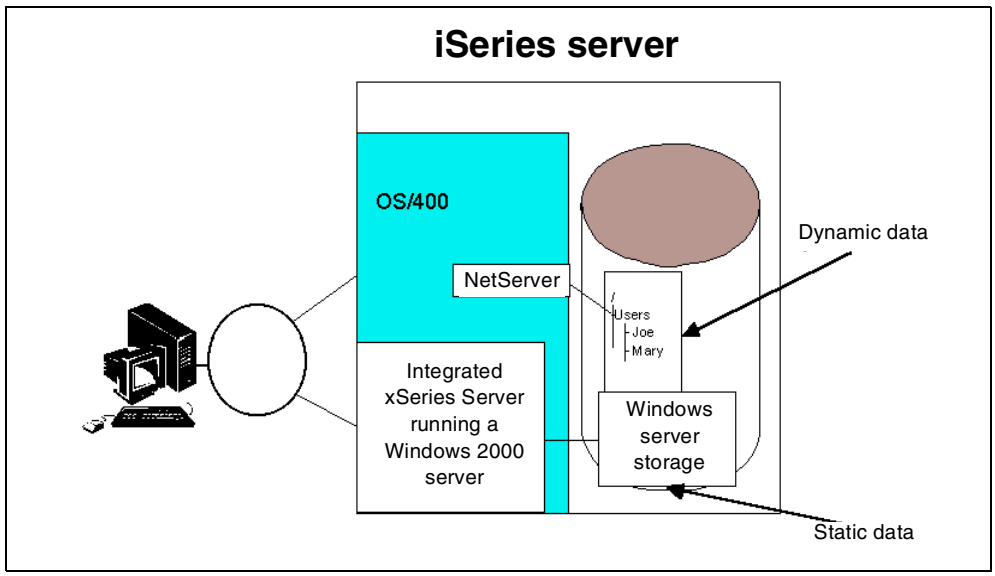

Figure 202. Structure of user data stored to permit clustering to be implemented

To make this structure effective, both the Windows 2000 server storage and NetServer files must be replicated. However, the frequency of replication must be significantly higher for the NetServer files because these files are changing more frequently.

The structure of the recover domain would appear as shown in Figure 203.

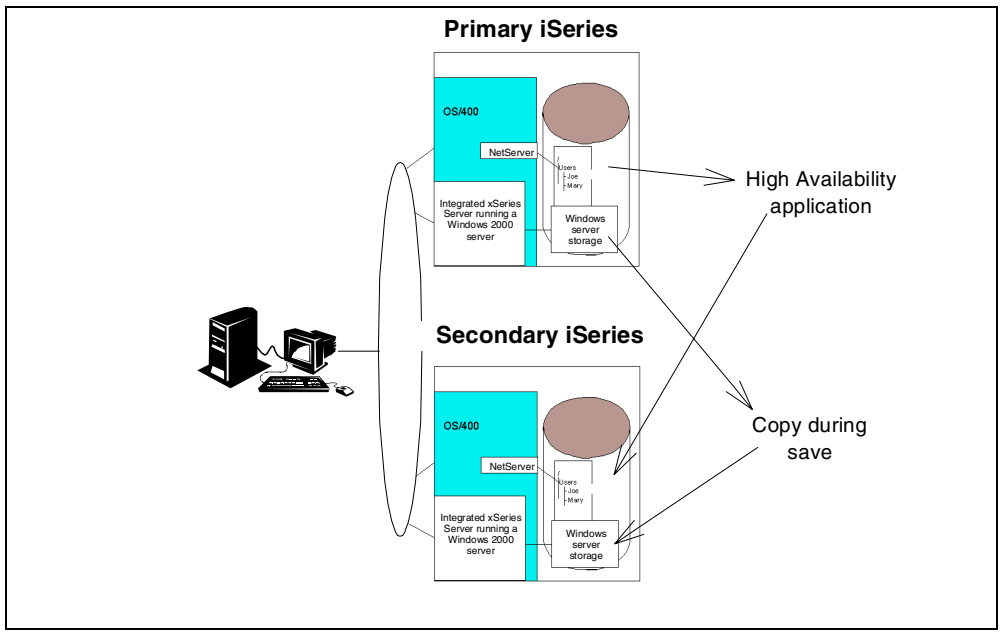

Figure 203. Structure of a cluster group with Integrated xSeries Servers

When the primary OS/400 server goes offline, the client should detect that the server has failed. However, no changes should need to be made to the client.

After the secondary iSeries comes online, a reboot of the client should reconnect the client back to the server.

This type of structure may be implemented as part of a wider recovery strategy on the iSeries server where user profiles, database files, and program objects are also replicated to support the line of business application. When including Integrated xSeries Servers running Windows 2000, consider these points:

- The network server description on the secondary OS/400 that was copied from the primary OS/400 *cannot* be active while the primary is active. However other servers, such as test servers, can be implemented on the secondary iSeries server.
- The storage spaces used by the Windows 2000 server on the primary iSeries should be duplicated as frequently as possible, for example, copied from primary to secondary during the daily save. Notice that the Windows 2000 server must be varied off to carry out the copy. Refer to Chapter 7, “Backup and restore” on page 151, for details on how to copy the storage spaces.
- The high availability application should be configured to duplicate objects saved in NetServer as soon as possible after the file is saved by the PC. In most environments, the delay is probably in seconds to minutes. Use care because some PC applications hold locks on files while they are active. This may stop the high availability application from replicating the data.
- During the cutover from the primary to the secondary partition, an IP takeover must occur on both the iSeries and the Integrated xSeries Servers. This involves starting an additional IP interface on the OS/400 and starting the network server descriptions.
- NetServer on the secondary system must have the same attributes as the primary system does during the cutover. This is achieved by using commands and API calls to shut down NetServer, change its attributes, and restart it.
- The storage spaces for the Windows 2000 server are only as current as the last time they were backed up (ideally this should be approximately every 24 hours). Therefore, there may be some discrepancies, including user profiles and passwords. Some minor administration tasks may be required following startup. If significant work was carried out inside these storage spaces since they were last copied, this additional work is not carried forward.
- This environment does not work with Windows 2000 Server Terminal Server Edition. Refer to the Web site `http:// www.as400.ibm.com/netserver` for more information on this topic.
- At the time of the cutover, it is likely that some Windows 2000 server user profiles may have an incorrect password because it may have changed since the last time the storage space was transferred.
- If the cutover is scheduled, the storage spaces should be transferred to the secondary node prior to the primary node in the cluster group being shutdown.

Clustering started with the iSeries servers at V4R4, and it has certainly evolved with the newer release. As consolidation of iSeries and PC servers becomes more common, its importance will continue to grow. With the improved management available with a consolidated server, it should also be easier to implement than for distributed servers.

Chapter 17. Printing in a network environment

This chapter explains how you can set up printers in a network environment. It concentrates on providing guidance for setting up those connections that enable OS/400 users to print on Windows printers and vice versa.

Printing in a network is very complex. The objective of this chapter is to give you an understanding of the terminology and setup options that are available in a network environment. In addition, it provides a structured guide that will enable you to set up your printers with the help of other reference material.

17.1 Introduction

Figure 204 shows the different ways in which printers can be connected in a network containing OS/400 Version 4 Release 5 systems, Windows NT and 2000 servers, and Windows 95, 98, NT and 2000 workstations.

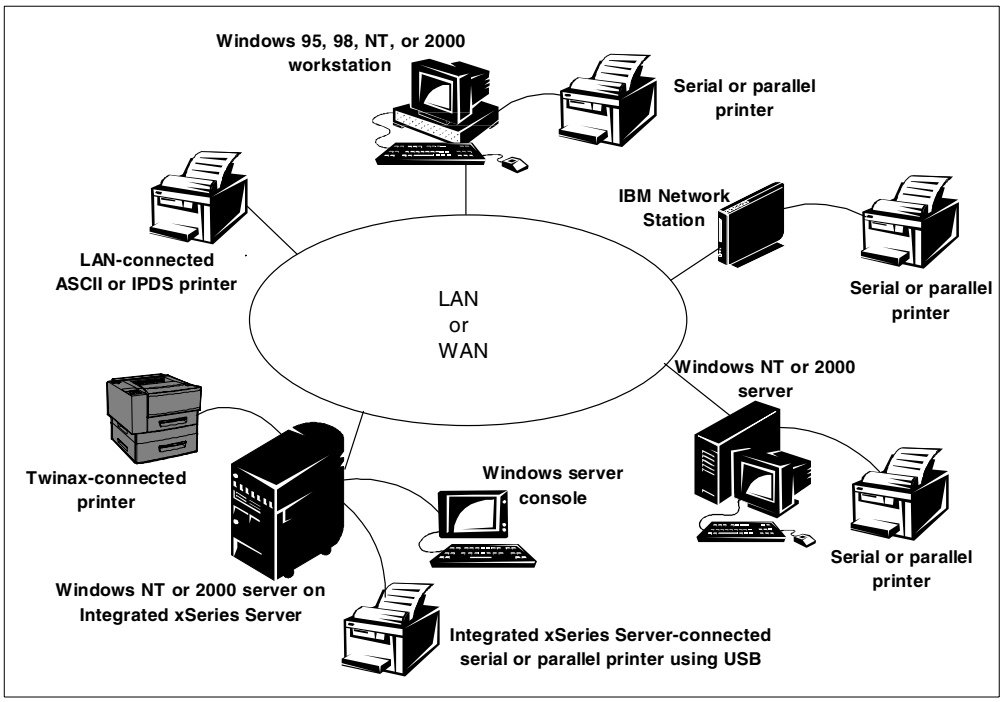

Figure 204. Printer connection possibilities in a network environment

Note

There is no difference in the way you set up a printer connected to an Integrated xSeries Server running Windows NT or 2000 compared with a PC-based Windows server except, perhaps, for the way that you connect the printer. The 700 MHz Integrated xSeries Server has two USB ports for the connection of external devices such as printers.

Because of space and time constraints, only iSeries and Windows servers are discussed in this chapter. *Windows* refers to Windows NT and 2000 servers, and Windows 95, 98, NT, and 2000 workstations. We only discuss how to print from

Windows applications. Printing from DOS applications running under Windows is not considered.

Before we describe how to set up printers in this environment, we need to define the types of users and printers that are present in this scenario.

17.1.1 User categories

In this chapter, we refer to *OS/400 users* and *Windows users*, the two different categories of users. Each type of user is explained here:

- **OS/400 users**: OS/400 users are those people who are using an application that is physically running on the iSeries server and want to print an OS/400 spooled file generated by this application.

  Someone who is using an OS/400 application through a 5250 emulator (such as the one that comes with OS/400 Client Access), running under Windows on a PC, is classified as an OS/400 user because it is the OS/400 application that is generating their spooled files, not a Windows application. This is an important distinction.

- **Windows users**: Windows users are those people who are using an application that is physically running on a Windows 95, 98, NT, or 2000 PC and want to print a Windows spooled file generated by this application.

  More specifically, a Windows user is someone who is using a *native* Windows application, such as Lotus 1-2-3 or Microsoft Word, and wants to print their spread sheet or document.

17.1.2 Printer categories

Before you set up your printer, you need to determine to which category of printer it belongs. Read through this section, determine the category into which your printer belongs, and write it down (for example, ASCII printer - LAN interface - external LAN adapter running the LPD function). Notice that your printer may appear to belong to more than one category.

Note: It is important to read this section carefully to determine to which category your printer really belongs, because this determines how you configure the printer and its level of function.

The network shown in Figure 204 on page 387 identifies three major categories of printers:

- **ASCII printers**: ASCII printers are common in the PC world and are named because they accept an ASCII data stream, as opposed to an EBCDIC data stream.

  ASCII printers can be further subdivided according to how they attach:

  - ***Serial or parallel attached***: These printers are grouped together because they behave almost identically.

    ASCII printers can attach directly to a workstation through a serial or parallel interface. The workstation (PC or IBM Network Station) to which the printer is connected may also be running the line printer daemon (LPD) function. In this case, the PC or Network Station can be thought of as acting as an external network adapter for the printer.

You need to draw a distinction between an ASCII printer connected to a PC that is running the LPD function and one that is not. In most cases, the PC is *not* running the LPD function.

Serial or parallel connected ASCII printers can attach directly to PCs and Network Station using the following methods:

- *Windows PC*: Serial or parallel printers connected to a Windows PC can be driven *natively* by Windows using a printer driver that customizes the output from an application so that it can be printed on a particular printer attached locally to the PC. This is by far the most common method of configuring a serial or parallel printer in Windows and is mainly used to print from a Windows application to a locally attached printer.

  Windows printer configurations contain a description of a physical printer, for example, an IBM 4039. The configuration is based on a printer driver that is supplied directly by the printer manufacturer or is included with Windows. The printer driver not only customizes the spooled output for a particular make and model of printer, but it also enables you to control the way the printer behaves. For example, you can specify the size of paper the printer uses, the printing resolution, the page orientation, and other characteristics.

  When you use the printer emulation function provided by a product, such as OS/400 Client Access, an ASCII serial or parallel printer can emulate an SCS twinaxial (*native* OS/400) printer. The emulator handles the data stream translation from SCS (EBCDIC) to ASCII.

- *A Windows PC or IBM Network Station running the line printer daemon (LPD) function*: A serial or parallel printer attached to a LAN-connected Windows PC or IBM Network Station running the TCP/IP LPD function, appears to the network as if it is directly connected to the LAN. The LPD function accepts spooled files from line printer requester (LPR) functions running on other computers on the network. Notice you need to configure one or more LPRs to use an LPD.

  There are software packages available for Windows that provide the LPD function and other powerful capabilities such as print stream rendering, forms design, and print stream redirection. Some examples of these software packages are provided in 17.2.2.1, “Configuring LPD on a Windows PC” on page 395.

  The LPD function is a standard component of the software that runs on the IBM Network Station. Network Station running the LPD function behaves in a similar way to a Windows PC running the LPD function.

  The iSeries at V3R1 and later releases supports LPR and LPD by means of a remote output queue. The iSeries’s LPR function can send spooled output to an ASCII printer connected to a LAN-attached PC or IBM Network Station running the LPD function.

- *Twinax workstation*: Many twinaxial *green-screen* workstations (also called *non-programmable terminals (NPTs)*) provide a connection for an ASCII serial or parallel printer and an in-built printer emulator, so the ASCII printer can emulate a twinaxial SCS printer.

- ***LAN attached***: ASCII printers can attach to a LAN directly using an internal network adapter, an external network adapter, or even a PC running the LPD function.

We classified an ASCII printer attached to a LAN-connected PC or Network Station running the LPD function as a serial or parallel attached printer, although it could equally be classified as a LAN-attached printer. We covered this category of printer under the *serial or parallel attached* point at the beginning of this list.

ASCII printers can connect to the LAN using these methods:

- *Internal or external LAN adapter running the LPD function*: An internal or external intelligent LAN adapter running the LPD function can be used to connect an ASCII printer to the LAN. The LPD function accepts spooled files from LPR functions running on other computers on the network. Again, you need to configure one or more LPRs to use an LPD.

  The iSeries at Version 3 Release 1 and later releases supports LPR and LPD by means of a remote output queue. The OS/400 LPR function can send spooled output to an ASCII printer attached in this way.

  Examples of intelligent LAN adapters that are capable of running the LPD function are the Marknet XLE from Lexmark and the HP JetDirect.

- *Internal or external intelligent LAN adapter using Printer Job Language (PJL)*: PJL is supported on some ASCII printers (IBM, Lexmark, and Hewlett Packard) connected to the LAN using an internal or external intelligent LAN adapter. PJL provides a higher level of function than LPR and LPD. It is supported on the iSeries at Version 3 Release 7 and later releases by means of a printer device description. Examples of printers that support PJL are the IBM Network Printer (NP) range of LAN connected printers.

- *Internal/external Lexmark intelligent LAN adapter using the Lexlink protocol*: An internal or external Lexmark intelligent LAN adapter using the Lexlink protocol can provide a LAN connection for an ASCII printer. Lexlink is a proprietary protocol that provides a higher level of function than LPR or LPD. It is supported on the iSeries at Version 3 Release 1 and later releases by means of a printer device description. The Marknet XLE supports Lexlink.

  Notice that the Lexlink protocol cannot be transmitted across a router.

- **SNA Character String (SCS) printers**: SCS printers attach to an iSeries through a twinaxial workstation controller, or to a remote control unit, such as a 5394 or 5494. This is the traditional type of OS/400 printer, and SCS printers are only capable of printing text.

  This class of printer can be emulated on a PC that is running DOS, Windows, or OS/2 by using a product, such as OS/400 Client Access.

- **Intelligent Printer Data Stream (IPDS) printers**: IPDS printers have all-points-addressable (APA) capability. They can attach to the iSeries using twinax, or they can connect through a LAN.

  IPDS printers can be configured on the iSeries with AFP set to *YES or *NO as follows:

  - AFP set to *NO

    Only IPDS printers connected through twinax can use this setting, and only SCS and IPDS data streams are supported.

- AFP set to *YES

  SCS, IPDS, and AFPDS data streams are supported. Notice that PSF/400 is required.

  IPDS printers configured with AFP set to *YES can be connected to the iSeries using the following methods:

  - Twinax connection
  - LAN connection through an internal LAN adapter
  - LAN connection through an Advanced Function Common Control Unit (AFCCU)
  - LAN connection through an I-Data 7913 LAN attachment

  An IPDS printer connected via a LAN using TCP/IP requires AFP and, therefore, PSF/400.

17.1.3 Setting up your printer

Follow these three steps to complete the setup of your printer and make it available for others on the network to use:

1. Configure the printer on a computer.

   You must first configure your printer on a computer before you can use it.

   We do not attempt to explain how to configure each category of printers described in 17.1.2, “Printer categories” on page 388, because this would fill several publications. However, we describe in detail how to configure LPR and LPD on Windows 95, 98, NT, and 2000, because it is becoming a common requirement, and the procedure is not well documented elsewhere. For other configurations, we direct you to an appropriate reference.

   Note

   Even if your printer configuration is not documented here, you should still continue with the sections on *sharing* the printer and *connecting* to the printer after you have configured it. Section 17.3, “Sharing your printer to the network” on page 402, and 17.4, “Connecting to a printer across the network” on page 404, apply to *all* printers, whether their configuration is described in this chapter.

   Refer to 17.2, “Configuring your printer on a computer” on page 392, for an explanation of how to configure a printer.

2. Share the printer to the network.

   If you want to make the printer you configured available to other users on the network, you need to *share* it. Refer to 17.3, “Sharing your printer to the network” on page 402, for an explanation of how to share a printer.

3. Connect to the printer across the network.

   Before users on the network can use your shared printer, they need to *connect* to it. Refer to 17.4, “Connecting to a printer across the network” on page 404, for an explanation of how to connect to a printer.

17.2 Configuring your printer on a computer

The first step in setting up your printer is to configure it on a computer. This configuration contains a definition of the printer, its characteristics, and properties. This configuration determines how the printed output looks. Implicit in the creation of a printer configuration is the co-creation of a printer queue. It is the queue where the spooled file is held (queued) for printing.

In the network environment shown in Figure 204 on page 387, you must configure your printer either on an iSeries server or a Windows PC using one of the following methods:

- **Windows-configured printers**: Windows printer configurations are represented by an icon that appears in the Start->Settings->Printers window on the Windows system on which they are configured.

  A Windows-configured printer can be used by:

  – A Windows user on the PC on which it is configured.

  – If the printer is shared, other Windows users in the network can also access the printer.

- **OS/400-configured printers**: OS/400 printer configurations (except LPR/LPD) are usually represented by a device description and an output queue on the iSeries on which they are configured. Notice that an LPR/LPD printer is only represented by an output queue.

  An OS/400-configured printer can be used by OS/400 users who have authority to it and share it across the network.

In this section, we do not explain how to configure all of the different categories of printers. We only look, in detail, at the most common techniques that you can use to configure Windows printers for use by OS/400 users and vice versa. For other printer configurations, we refer you to the appropriate documentation when configuring these printers.

In 17.1.2, “Printer categories” on page 388, you should have been able to identify your printer as belonging to one of the following categories:

- **ASCII printer - serial or parallel interface - Windows PC**: This configuration is not covered in detail in this section, because it is the most common way to define a Windows printer, and Windows provides a wizard for this purpose. To configure this category of printer, select **Start->Settings-> Printers**. Then double-click the **Add Printer** icon. The wizard guides you through the printer configuration process. You need to specify a printer driver for your printer. You can select a suitable driver from the list of drivers provided on the Windows installation media or provide your own driver.

  ASCII printers in this category are often set up to emulate an OS/400 SCS twinaxial printer using Client Access printer emulation capability. After you have configured the printer under Windows, refer to 17.2.1, “Configuring an emulated printer” on page 394, to find out how to it set up as an emulated printer.

- **ASCII printer - serial or parallel interface - Windows PC or IBM Network Station running the LPD function**: The LPD (receiving) function is always associated with one or more LPR (sending) functions. Section 17.2.2,

"Configuring your LPR/LPD printer" on page 394, explains how to set up LPR and LPD on Windows PCs.

LPR can also be set up on the iSeries server to print to an LPD running on a PC. Configuration of LPR on the iSeries is not covered here because there are other excellent resources to help you. Refer to the following publications:

- *IBM AS/400 Printing V*, SG24-2160
- *TCP/IP Configuration and Reference*, SC41-5420

- **ASCII printer - serial or parallel interface - twinax workstation**: This configuration is not covered in detail in this section. Twinax workstations to which you can attach an ASCII printer include the 3197, 3477, 3486, 3487, 3488, and 3489. For information about configuring ASCII printers connected to these workstations, refer to their respective manuals.

- **ASCII printer - LAN interface - internal or external LAN adapter running the Line Printer Daemon (LPD) function**: Configuration of the LPD function on an internal or external LAN adapter is not necessary. However, you may need to specify an IP address, subnet mask, and gateway address for the adapter. The LPD (receiving) function is always associated with one or more LPR (sending) functions.

  Section 17.2.2, "Configuring your LPR/LPD printer" on page 394, covers how to set up LPR on a Windows PC to send spooled output to an LPD running on an internal or external LAN adapter.

  LPR can also be set up on the iSeries server to print to an LPD running on an adapter. Configuration of LPR on the iSeries is not covered here because there are other excellent publications to help you, including:

  - *IBM AS/400 Printing V*, SG24-2160
  - *TCP/IP Configuration and Reference*, SC41-5420

- **ASCII printer - LAN interface - internal or external intelligent LAN adapter using Printer Job Language (PJL)**: Configuration of the PJL function on an internal or external LAN adapter is not necessary. However, you may need to specify an IP address, subnet mask, and gateway address for the adapter.

  In a similar way to LPR/LPD, PJL running on an internal or external LAN adapter requires PJL to be configured on the iSeries (it is not supported by Windows). This is accomplished by creating a printer device description. This is described in *OS/400 Printer Device Programming V4R3,* SC41-5713.

- **ASCII printer - LAN interface - internal or external Lexmark intelligent LAN adapter using the Lexlink protocol**: In a similar way to LPR/LPD, Lexlink running on an internal or external LAN adapter requires Lexlink to be configured on the iSeries (it is not supported by Windows). This is accomplished by creating a printer device description. This is described in Chapter 3 in *CL Reference*, SC41-5722.

- **SNA character string (SCS) printers**: This configuration is not covered in detail in this section. For information about configuring SCS printers, refer to *OS/400 Printer Device Programming,* SC41-5713.

  Notice that, once configured, a Windows user can connect to and use an SCS printer as an OS/400 network printer in a similar way to how the user would connect to a Windows network printer. You can connect to the printer using either the Client Access for Windows 95 and NT or AS/400 NetServer network print serving capability. Client Access for Windows 95 and NT also provides a

range of printer drivers for SCS and IPDS printers. You need the appropriate printer driver for your SCS printer when you come to install the printer in Windows after you connect to it across the network.

- **Intelligent Printer Data Stream (IPDS) printers**: This configuration is not covered in detail in this section. For information about configuring IPDS printers, refer to *OS/400 Printer Device Programming,* SC41-5713.

  Notice that, once configured, a Windows user can connect to and use an IPDS printer as an OS/400 network printer in a similar way to how the user would connect a Windows network printer. You can connect to the printer using either the Client Access for Windows 95 and NT or AS/400 NetServer network print serving capability. Client Access for Windows 95 and NT also provides a range of printer drivers for SCS and IPDS printers. You need the appropriate printer driver for your IPDS printer when you come to install the printer in Windows after you have connected to it across the network.

17.2.1 Configuring an emulated printer

An emulated printer is a serial or parallel printer that is physically connected to, or configured on, a Windows PC but appears to the iSeries as a twinaxial SCS printer. For example, using the OS/400 Client Access printer emulation function, you can configure an IBM 4039 laser printer connected to a PC through a parallel interface as emulating an IBM 3812 model 1 twinaxial connected laser printer. In this case, the iSeries sees the 4039 as a 3812 model 1 printer and generates a 3812-1 compatible spooled file for it. Then, the 3812-1 data stream is translated to an IBM 4039 compatible data stream either on the iSeries (if you specified Host Print Transform) or by the OS/400 Client Access printer emulator on the PC.

Until Version 4 Release 2, you could only configure an emulated printer on a Windows PC connected to an iSeries using the SNA or Anynet (SNA over TCP/IP) protocols. Version 4 Release 2 provides you with the ability to configure an emulated printer using the TCP/IP protocol natively.

For a description of how to configure an emulated printer using TCP/IP, refer to *IBM AS/400 Printing V*, SC24-2160.

Notice that, instead of setting up a serial or parallel printer that is physically connected to the Windows PC as your emulated printer, you can redirect the printer data stream from the iSeries to a printer that was configured and shared on another Windows PC and installed on the PC where you set up the emulation session.

17.2.2 Configuring your LPR/LPD printer

LAN-connected printers are becoming increasingly popular because they are flexible in the ways in which they can be used. A single LAN-connected printer can be configured on multiple computers (which equals multiple queues) because it is not physically connected to any one particular computer. It is connected to a shared medium (the LAN). Therefore, a LAN connected printer can simultaneously accept print files from the iSeries and other operating systems, such as Windows 2000 and Novell NetWare. All computers on which a LAN connected printer is configured think that they have exclusive control of the printer. The printer, itself, handles the queueing and buffering of spooled files that are sent to it from the different queues.

A common method used to set up a printer on a LAN is LPR and LPD. The LPR function is a service running on a TCP/IP host that sends spooled files to an LPD function running on a LAN printer or another TCP/IP host, such as an iSeries. LPR on the source system sends spooled files to the LPD function on the target system using TCP/IP. Because LPR and LPD work together, we show you how to configure both on Windows PCs. The iSeries also supports both the LPR and LPD functions.

LAN connected printers may support printing functions other than LPR and LPD, such as using PJL drivers. However, in this section, we limit ourselves to a discussion of LPR and LPD because this is a common method of configuring a LAN-connected printer in an environment comprised of iSeries servers and Windows PCs.

Refer to *IBM AS/400 Printing V*, SG24-2160, which details how to configure an iSeries to use LPR/LPD and PJL.

The following sections describe how to configure LPR and LPD on Windows PCs.

17.2.2.1 Configuring LPD on a Windows PC

As previously described, one way to connect a serial or parallel printer to the LAN is through a PC running an LPD utility.

Depending on whether your printer is attached to a Windows 95 or 98 workstation or a Windows NT or 2000 workstation, you can configure LPD in the following ways:

- **Configuring LPD on Windows 95 or 98**: Microsoft does not supply an LPD function with Windows 95 or 98; you must acquire an LPD from another vendor. Once you set up LPD on your Windows 95 or 98 PC, the PC can accept spooled files sent from an LPR running on a TCP/IP host somewhere else on the network and print them on the directly attached printer.

  Examples of three products that supply an LPD function for Windows 95 or 98 workstations are:

  – NIPrint from Network Instruments:
  `http://www.netinst.com/html/niprint.html`

  – Remote Print Manager (RPM) from Brooks Internet Software:
  `http://www.brooksnet.com/rpm.html`

  – Werx4Printers from Spinifex Computing Pty Ltd:
  `http://www.spinifex.com.au`

- **Configuring LPD on Windows NT**: Microsoft supplies an LPD function with Windows NT. Once you set up LPD on your Windows NT PC, the PC can accept spooled files sent from an LPR running on a TCP/IP host somewhere else on the network and print them on the directly attached printer.

  To set up the LPD function on Windows NT, follow these steps:

  a. Click **Start->Settings->Control Panel->Network**.

  b. Click the **Services** tab and click **Add** to add the Microsoft TCP/IP Printing service, if it is not already listed under Network Services.

  c. Point to the Windows NT installation media so that the support files can be copied. The Microsoft TCP/IP Printing service is added to the list of installed Network Services as shown in Figure 205 on page 396.

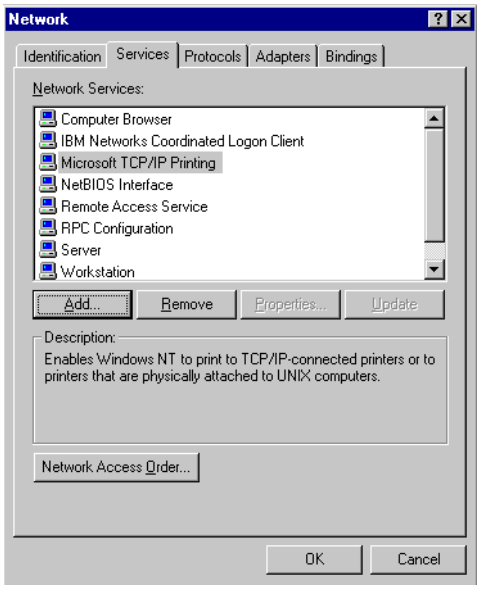

Figure 205. Adding Microsoft TCP/IP Printing to the list of services

d. After the copy is completed, click **Close**, and restart your computer.

e. After your computer is restarted, click **Start->Settings->Control Panel->Services**.

f. Highlight the **TCP/IP Print Server** service, and click **Start** to start it, as shown in Figure 206.

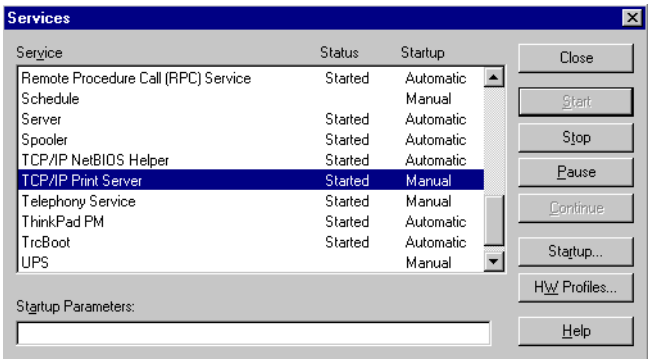

Figure 206. Starting the Microsoft TCP/IP Print Server

g. To automatically start the TCP/IP Print Server at PC startup, click **Startup** in the Services panel, and select **Automatic** for Startup type.

h. Click **OK** and then **Close** to save your changes.

You can now continue to configure a printer on this Windows NT workstation (for example, a parallel printer connected to LPT1:) to print files received from LPRs on the network. When you share this printer, you need to record the share name because it is needed to identify the LPD when you configure the LPR on an iSeries or Windows workstation. For example, you would enter the printer share name in the Remote printer queue parameter in the OS/400 Create Output Queue (CRTOUTQ) command.

- **Configuring LPD on Windows 2000**: Microsoft supplies an LPD function with Windows 2000. Once you set up LPD on your Windows 2000 PC, it can accept spooled files sent from an LPR running on a TCP/IP host somewhere else on the network and print them on the directly attached printer.

  To set up the LPD function on Windows 2000, follow these steps:

  a. Click **Start->Settings->Control Panel->Administrative Tools->Computer Management->Services and Applications->Services**. Scroll down until you see the TCP/IP Print Server service as shown in Figure 207.

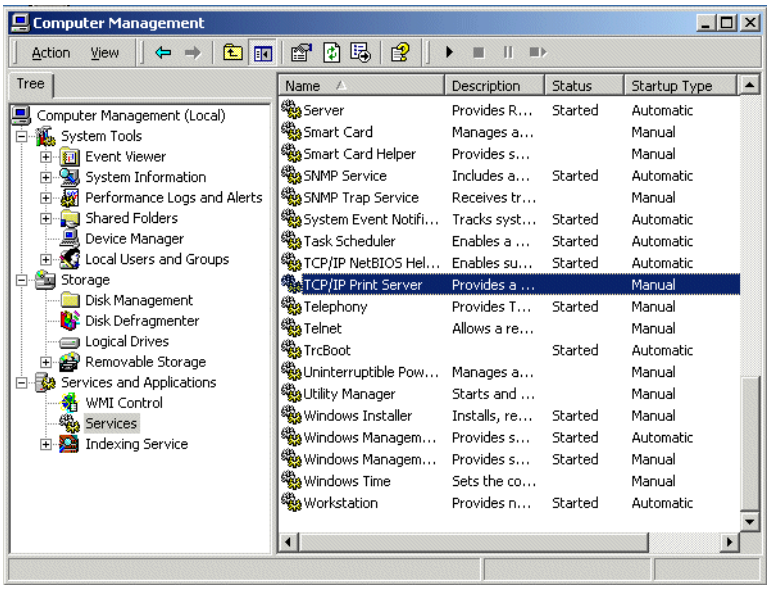

Figure 207. Windows 2000 TCP/IP Print Server service

  b. Highlight the **TCP/IP Print Server** service and right-click. Select **Automatic** for Startup type, and click the **Start** button as shown in Figure 208. After the service starts, click **OK**.

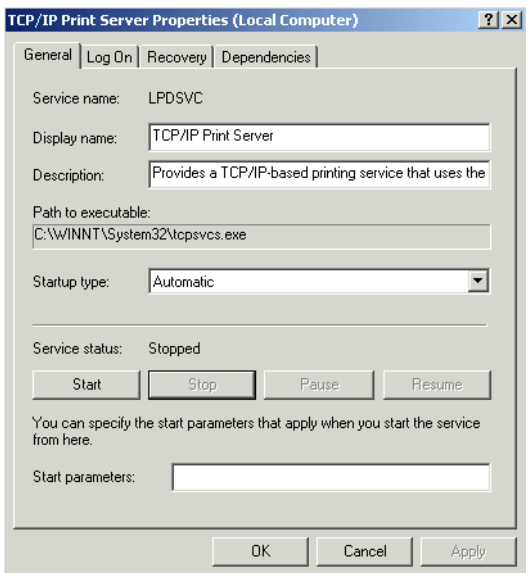

Figure 208. Starting the Windows 2000 TCP/IP Print Server service

You can now proceed to configure a printer on this Windows 2000 workstation (for example, a parallel printer connected to LPT1:) to print files received from LPRs on the network. When you share this printer, you need to record the share name because it is needed to identify the LPD when you configure the LPR on an iSeries or Windows workstation. For example, you would enter the printer share name in the Remote printer queue parameter in the OS/400 Create Output Queue (CRTOUTQ) command.

17.2.2.2 Configuring LPR on a Windows PC

Setting up LPR on Windows 95 and 98 is different than Windows NT and 2000. See the following sections.

Configuring LPR on Windows 95 or 98

Microsoft does not supply an LPR function for Windows 95 or 98. You must acquire an LPR from another vendor. An example of a product that supplies an LPR function for Windows 95 and 98 workstations is NIPrint from Network Instruments. Their Web site at `http://www.netinst.com/html/niprint.html` has more details.

Configuring LPR on Windows NT

Microsoft supplies an LPR function with Windows NT.

To set up the LPR function on Windows NT, you first need to set up the Microsoft TCP/IP Printing service as follows:

1. Click **Start->Settings->Control Panel->Network**.
2. Click the **Services** tab and **Add** to add the Microsoft TCP/IP Printing service, if it is not already listed under Network Services.
3. Point to the Windows NT installation media so that the support files can be copied. The Microsoft TCP/IP Printing service is added to the list of installed Network Services, as shown in Figure 209.

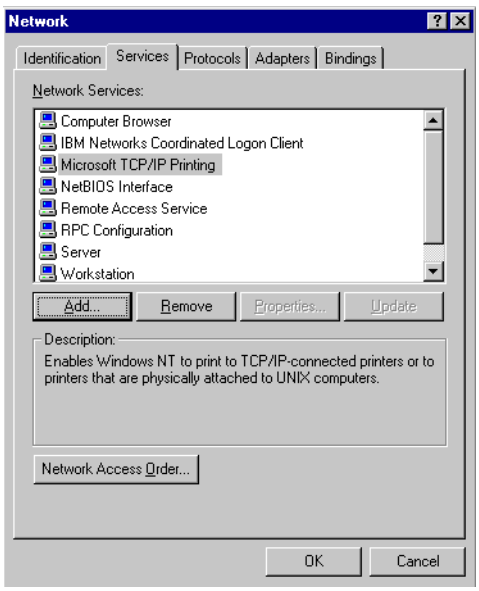

Figure 209. Adding Microsoft TCP/IP Printing to the list of services

4. After the copy is completed, click **Close**, and restart your computer.

5. After your computer is restarted, click **Start->Settings->Control Panel ->Services**.
6. Highlight the **TCP/IP Print Server** service, and click **Start** to start it as shown in Figure 210.

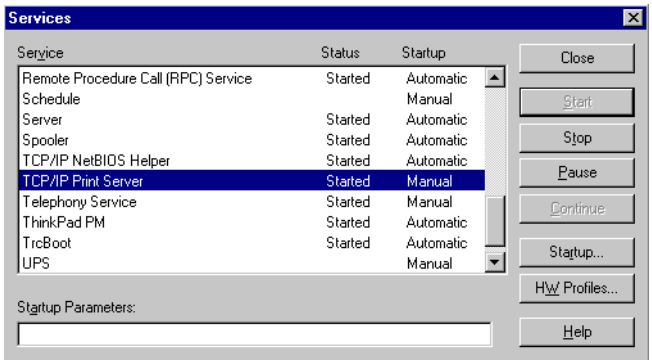

Figure 210. Starting the Microsoft TCP/IP Print Server

7. To automatically start the TCP/IP Print Server at PC startup, click **Startup** in the Services panel, and select **Automatic** for Startup Type.
8. Click **OK** and then **Close** to save your changes.

You can now proceed to configure the LPR function:

1. Click **Start->Settings->Printers->Add Printer** to start the Add Printer wizard.
2. Click **My Computer->Add port**.
3. On the Printer Ports panel, highlight **LPR Port**. Then, click **New Port** .
4. On the Add LPR compatible printer panel, shown in Figure 211, type the TCP/IP host name or address of the LPD to which you are sending spooled files. Also type the name of the printer or print queue on the LPD that you are using. This name must correspond to a share name (if you are printing to a Windows LPD printer) or a queue name (if you are printing to an iSeries or a LAN adapter or PC acting as an LPD).

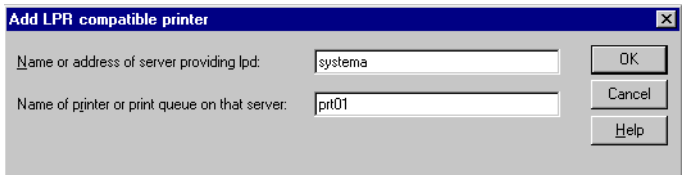

Figure 211. Entering LPD information

5. Click **OK** to return to the Printer Ports panel.
6. Close the Printer Ports panel.

   Notice the LPD is added as a new port, as shown in Figure 212 on page 400.

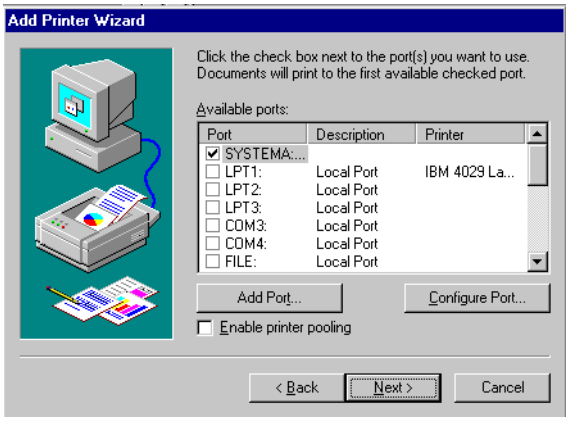

Figure 212. LPD added as a new port

7. Select the printer's manufacturer and model (click **Have Disk** to point to a printer driver if your printer is not listed).
8. Select a name for the printer, and specify whether it is your default printer.
9. Click **Not shared**.

   We describe the printer sharing option later in this chapter.
10. Print a test page, and click **Finish**.
11. You may need to supply the location of the Windows NT installation files so that the printer driver can be installed.
12. After the driver is installed, an icon for the printer you configured is added to the Printers panel.

The printer is now available for a Windows application running on your PC to use.

Configuring LPR on Windows 2000

Microsoft supplies an LPR function with Windows 2000.

To set up the LPR function on Windows 2000, you first need to set up the TCP/IP Print Server service as follows:

1. Click **Start->Settings->Control Panel->Administrative Tools->Computer Management->Services and Applications->Services**. Scroll down until you see the TCP/IP Print Server service as shown in Figure 213.

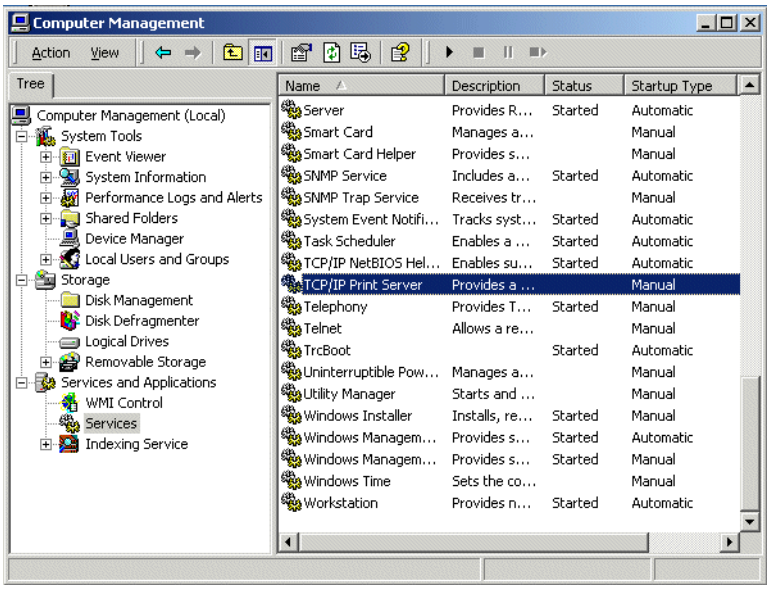

Figure 213. Windows 2000 TCP/IP Print Server service

2. Highlight the **TCP/IP Print Server** service and right-click. Select **Automatic** for Startup type, and click the **Start** button as shown in Figure 214. After the service starts, click **OK**.

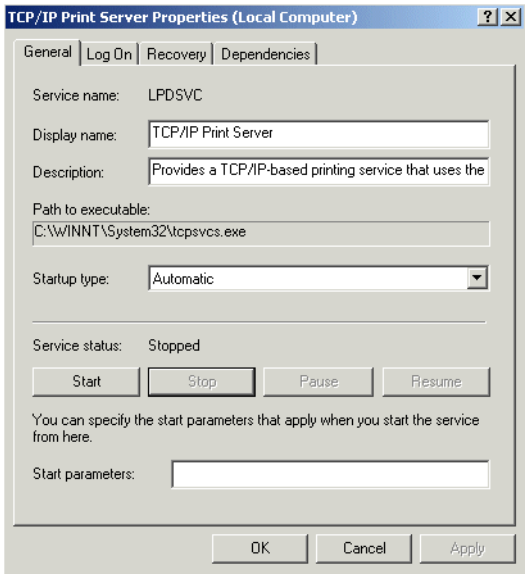

Figure 214. Starting the Windows 2000 TCP/IP Print Server service

You can now configure the LPR function:

1. Click **Start->Settings->Printers->Add Printer** to start the Add printer wizard. Click **Next** on the Welcome panel.
2. Make sure that the **Local printer** radio button is selected. Deselect the **Automatically detect and install.....** checkbox. Click **Next**.
3. On the Select the Printer Port panel, click the **Create a new port** radio button, and click the down arrow. Click **LPR Port**, and then click **Next**.

4. On the Add LPR compatible printer panel, shown in Figure 215, type the TCP/IP host name or address of the LPD to which you are sending spooled files. Also type the name of the printer or print queue on the LPD that you are using. This name must correspond to a share name (if you are printing to a Windows LPD printer) or a queue name (if you are printing to an iSeries, or a LAN adapter or PC acting as an LPD).

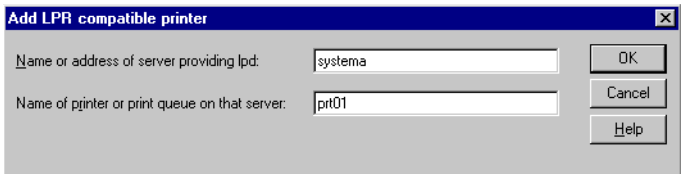

Figure 215. Entering LPD information

5. Click **OK** to return to the Add Printer Wizard.
6. Select the printer's manufacturer and model (click **Have Disk** to point to a printer driver if your printer is not listed).
7. Select a name for the printer and specify whether it is your default printer. Click **Next**.
8. Click **Do not share this printer**. Click **Next**.

   We describe the printer sharing option later in this chapter.
9. Print a test page, and click **Next**.
10. Click **Finish**.
11. You may need to supply the location of the Windows 2000 installation files so that the printer driver can be installed.

After the driver is installed, an icon for the printer you configured is added to the Printers panel. The printer is then available for a Windows application running on your PC to use.

17.3 Sharing your printer to the network

The second step in setting up your printer is to share it. You only need to share your printer if you want to make it available for others on the network to use. If not, you have already completed the setup for your printer and do not need to proceed further.

Sharing a printer has a different meaning to different people depending on whether you come from an OS/400 background or a Windows background. For our purposes, we define sharing in the following ways:

- **Sharing a printer in Windows terminology**: The Windows *share* operation allows a printer defined on either a Windows 95, 98, NT, or 2000 PC to be available for other Windows 95, 98, NT, or 2000 PCs to connect to and use.

  Once a printer has been shared, it can either be seen in the Windows Network Neighborhood or located on the network by Windows workstations selecting Start->Find->Computer.

  OS/400 Support for Windows Network Neighborhood, also known as AS/400 NetServer, uses this same sharing concept to make available OS/400 file and

print resources to Windows clients on the network. Before an OS/400 print resource can be used by Windows client PCs on the network, it must be shared by the AS/400 NetServer administrator in a similar way to a Windows print resource.

- **Sharing a printer in OS/400 terminology**: OS/400 print resources can be made available to Windows PCs on the network using AS/400 NetServer or the OS/400 Client Access for Windows 95/NT network print server function.

  The main difference between the way that OS/400 Client Access makes print resources available, and sharing in the Windows sense, is that OS/400 Client Access network print resources are immediately available for Windows PCs to use. No sharing operation is required as with Windows and AS/400 NetServer.

- **Sharing a LAN connected printer**: Sharing a LAN connected-printer can have a different meaning altogether. LAN printers are inherently shared because they are physically connected to a shared medium (the LAN). Therefore, any computer on which a LAN printer is configured shares the printer implicitly with other computers on which the printer is also configured.

Note: Once a LAN printer has been configured on a Windows PC or iSeries, you can use the Windows or AS/400 NetServer share operation respectively to make the printer available to other Windows workstations on the network.

Note

From now on, when we refer to *sharing*, we mean sharing a printer in Windows terminology.

Depending on whether your printer is configured on an iSeries or Windows PC, proceed as follows:

- To share a printer configured on an iSeries, refer to the following section.
- To share a printer configured on Windows, refer to 17.3.2, “Sharing a printer configured on Windows” on page 404.

17.3.1 Sharing a printer configured on the iSeries server

Before Windows users can connect to an OS/400 network resource, such as a printer, they need to locate the resource through either the Windows Network Neighborhood or by selecting Start->Find->Computer. There are two ways in which OS/400 print resources can be made available to Windows computers on the network:

- **AS/400 NetServer network print server:** Only IFS directories and printer output queues that have been shared by the AS/400 NetServer administrator appear in the Network Neighborhood or when you click Start->Find->Computer.

  Using the AS/400 NetServer network print server, both printer devices *and* remote output queues configured on the iSeries appear in the Network Neighborhood or when you select Start->Find->Computer.

  Refer to Chapter 14, “AS/400 NetServer” on page 345, for a description of how to share OS/400 resources using AS/400 NetServer.

- **OS/400 Client Access for Windows 95/NT network print server**: By default, all IFS root-level directories and printer devices appear under OS/400 Client

Access network in the Network Neighborhood window. Using the OS/400 Client Access network server, all printer devices configured on the iSeries are automatically shared to all OS/400 Client Access network clients. This means that there is no actual sharing operation (in Windows terminology) required to make these resources available to Windows computers on the network.

Notice that LAN connected ASCII printers configured on an iSeries as remote output queues using LPR do *not* appear under OS/400 Client Access network in the Network Neighborhood window. However, you can still connect to them using their Universal Naming Convention (UNC) names.

17.3.2 Sharing a printer configured on Windows

Although you can share a Windows printer when you configure it, we documented the sharing operation here to maintain a logical structure to the chapter. Depending on whether the printer you want to share has been configured on a Windows 95, 98, NT, or 2000 workstation, be aware of the following points:

- **Windows 95 or 98**: Make sure that file and printer sharing for the Microsoft Networks service is configured be selecting Control Panel->Network. This service is not installed by default.
  - You cannot share a printer that you configured to print to *file*.
  - You cannot re-share a network printer to which you are already connected.
  - When sharing a printer configured on a Windows 95 or 98 workstation, there is a limit of 10 users who can connect to and use the printer. You can circumvent this limitation by connecting to this Windows 95 or 98 printer share from a Windows NT or 2000 server and then re-sharing the printer to the network.
- **Windows NT or 2000**: You can share a printer that has been configured on any port including serial, parallel, file, and LPR.

  When sharing a printer configured on a Windows NT or 2000 workstation, there is a limit of 10 users who can connect to and use the printer. You can circumvent this limitation by connecting to this Windows NT or 2000 printer share from a Windows NT or 2000 server and then re-sharing the printer to the network.

Refer to the Microsoft documentation if you need more assistance.

17.4 Connecting to a printer across the network

The third and final step in setting up your printer is to connect users to it across the network. Once you connect users to a printer, they can print files to it from their Windows applications.

Printers are defined to the network by their Universal Naming Convention (UNC) names. To connect directly to a network file or print resource using its UNC name, click **Start->Run**, and type the UNC name. Alternatively, to view a list of available resources on a particular system, type the system name only. The UNC name of a print resource is in the following format:

```
\\system-name\printer-name
```

system-name is the name of the computer on which the printer is shared. *printer-name* is the name of the printer share to which you want to connect.

In terms of connecting to a printer across the network, you need to choose one of the following four possibilities:

- **Windows user connecting to a Windows-configured network printer**: If you can see a network printer through the Network Neighborhood or by selecting Start-> Find->Computer, you can connect to it and use it as long as you have authority. Even if you cannot see the printer, you may still be able to connect to it using its Universal Naming Convention (UNC) name by selecting Start->Run.

  To actually connect to a network printer, you need to install it using the Add Printer wizard which you can access by selecting Control Panel->Printers. Once you install the network printer, it appears in the list of printers that appears when you click Control Panel->Printers and is available for your applications to use. Notice that you can use the Add Printer wizard to configure a printer and to *connect to* (install) a network print resource. Because this is a fairly straightforward operation, we do not discuss it further.

- **Windows user connecting to an OS/400-configured network printer**: In this case, we also use the Windows Add Printer wizard to connect to an OS/400 print resource on the network.

  The only difference between a Windows user connecting to an OS/400 configured network printer versus a Windows-configured network printer is that a different network server is making the print resource available. In the case of an OS/400 configured network printer, a Windows user can access the OS/400 print resource using one of the following methods:

  - AS/400 NetServer network print server
  - OS/400 Client Access for Windows 95/NT network print server
  - Windows LPR printing to an OS/400 LPD

  These alternatives are described in more detail in 17.4.1, “Windows user connecting to an OS/400 network printer” on page 406.

- **OS/400 user connecting to a Windows-configured network printer**: You can use the TCP/IP LPR support on the iSeries to send spooled files direct to a Windows workstation acting as an LPD on the network. Otherwise, an OS/400 user cannot directly connect to and use a Windows-configured network printer without using Client Access. In this case, an indirect connection can be established as follows:

  a. Use Client Access to set up an emulated twinax SCS printer on a Windows workstation on the network.

  b. On the same Windows workstation, connect to a network printer share somewhere on the network using Windows networking.

  c. Specify the shared network printer that you connected to in the previous step as the target printer in the emulator settings.

  This scenario is described in more detail in 17.4.2, “iSeries user connecting to a Windows network printer” on page 410.

- **OS/400 user connecting to an OS/400-configured network printer**: In this case, we are really talking about connecting to a printer defined on another iSeries in the network. The easiest way to do this is to use the OS/400 LPR

capability. Configure your printer on the target iSeries, and then configure the LPR function on the source iSeries to point to the output queue you created on the target iSeries.

To configure LPR and LPD on the iSeries, refer to *IBM AS/400 Printing V*, SG24-2160.

17.4.1 Windows user connecting to an OS/400 network printer

For a Windows user to connect to an OS/400-configured network printer, there are three possibilities:

- AS/400 NetServer network print server

  Refer to 17.4.1.1, “AS/400 NetServer network print server”.

- OS/400 Client Access for Windows 95/NT network server

  Refer to 17.4.1.2, “OS/400 Client Access for Windows 95/NT network server” on page 409.

- Windows LPR printing to an OS/400 LPD

  Refer to 17.4.1.3, “Windows NT and 2000 LPR printing to an OS/400 LPD” on page 409.

17.4.1.1 AS/400 NetServer network print server

The Windows user can only see and connect to those IFS directories and printers that have been shared by the AS/400 NetServer administrator.

Note: All printers configured as either a remote output queue or a device on the iSeries (and have also been shared) appear in the AS/400 NetServer network server display.

For a Windows user to connect to an AS/400 NetServer shared print resource, there are two possibilities:

- **Windows 95 user**: Follow these steps:

  a. Click **Start->Settings->Printers**.

  b. Double-click **Add Printer**.

  c. Click the **Network printer** radio button.

  d. Click **Browse** to browse the Network Neighborhood.

     Locate the AS/400 NetServer network server on which the print resource you want to connect to is located. You need to look in the domain that is listed in the AS/400 NetServer properties under OS/400 Client Access Operations Navigator. Refer to 14.8, “Setup and administration using Operations Navigator” on page 360, to determine the domain and server names for your AS/400 NetServer server. If the AS/400 NetServer server does not appear in the Network Neighborhood window, you need to enter the UNC name for the printer. To determine the UNC name, follow these steps:

     i. Click **Start->Find->Computer**, and search on the name of your AS/400 NetServer server as shown in Figure 216.

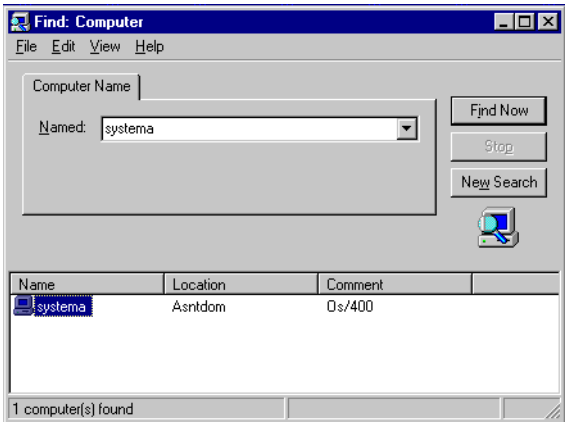

Figure 216. Searching for the AS/400 NetServer server

ii. Double-click the AS/400 NetServer server icon. The available shares are listed, as shown in Figure 217. Notice the name of the printer to which you want to connect.

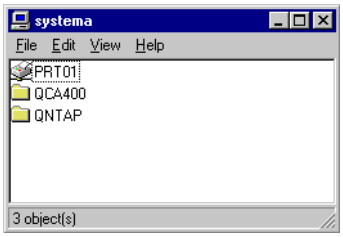

Figure 217. Available AS/400 NetServer shares

iii. Return to the Add Printer wizard panel.

e. Type the UNC name of the AS/400 NetServer printer you want to connect to as shown in Figure 218.

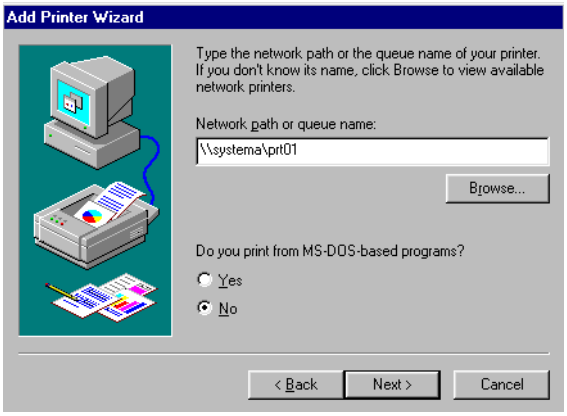

Figure 218. Identifying an AS/400 NetServer printer by its UNC name

f. You may see a message indicating that the printer is offline. You can ignore this message.

g. Complete the configuration the same as you would for a Windows network printer.

Refer to the Microsoft documentation if you need more assistance.

- **Windows NT or 2000 user**: Follow these steps:

  a. Click **Start->Settings->Printers**.

  b. Double-click **Add Printer**.

  c. Click **Network printer server**.

  d. Browse the Microsoft Windows Network.

     Locate the AS/400 NetServer network server on which the print resource you want to connect to is located. You need to look in the domain that is listed in the AS/400 NetServer properties under OS/400 Client Access Operations Navigator. Refer to 14.8, “Setup and administration using Operations Navigator” on page 360, to determine the domain and server names for your AS/400 NetServer server. If the AS/400 NetServer server does not appear in the Network Neighborhood window, you need to enter the UNC name for the printer. To determine the UNC name, proceed as follows:

     i. Click **Start->Find->Computer**, and search on the name of your AS/400 NetServer server, as shown in Figure 219.

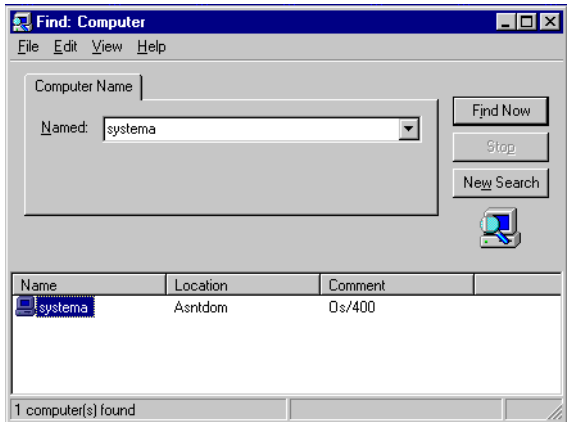

Figure 219. Searching for the AS/400 NetServer server

     ii. Double-click the **AS/400 NetServer** server icon, and the available shares are listed, as shown in Figure 220. Notice the name of the printer to which you want to connect.

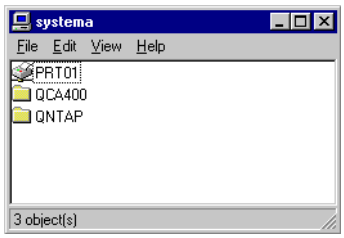

Figure 220. Available AS/400 NetServer shares

     iii. Return to the Connect to Printer panel.

  e. Type the UNC name for the AS/400 NetServer printer to which you want to connect, as shown in Figure 221.

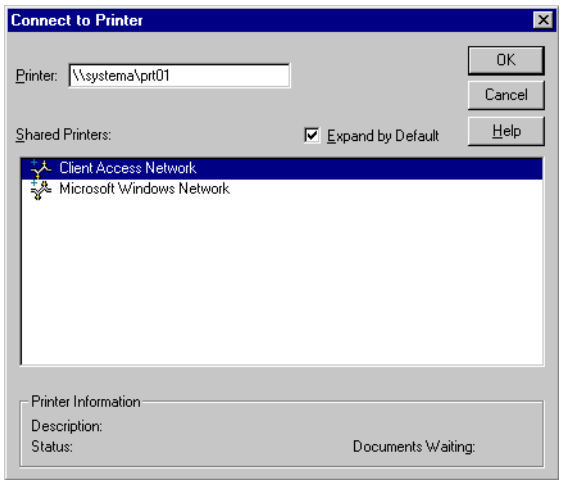

Figure 221. Identifying an AS/400 NetServer printer by its UNC name

f. You may see a message indicating that the printer is offline. You can ignore this message.

g. Complete the configuration the same as you would for a Windows network printer.

Refer to the Microsoft documentation if you need more assistance.

17.4.1.2 OS/400 Client Access for Windows 95/NT network server

Using the Client Access network server, a Windows user sees all IFS root-level files, directories, and printers, but can only connect to and use those resources to which the user has authority.

Notes

- Printers configured as remote output queues on the iSeries do not have an associated device description and do not appear in the OS/400 Client Access network server display. However, the user can still connect to such a resource using its UNC name.
- OS/400 Client Access provides a number of AFP and SCS Windows printer drivers that you can use to connect to IPDS and SCS printers configured on the iSeries.

For a Windows user to connect to an OS/400 Client Access shared print resource, refer to Chapter 14, Sections 14.2 and 14.3, of *Inside AS/400 Client Access for Windows 95/NT Version 3 Release 1 Modification 2*, SG24-4748.

17.4.1.3 Windows NT and 2000 LPR printing to an OS/400 LPD

Because LPR/LPD is a generic printing application, Windows LPR users can print files on OS/400 LPD printers, provided that they have a suitable Windows printer driver for the OS/400 printer.

A Windows user can print to an OS/400 printer acting as an LPD using a Windows LPR function. After the LPR printer is configured, it can be shared to the network to which other Windows users can connect.

Note: OS/400 Client Access provides a number of AFP and SCS Windows printer drivers that you can use to connect to OS/400 IPDS and SCS network printers.

To set this up, refer to 17.2.2.2, “Configuring LPR on a Windows PC” on page 398.

17.4.2 iSeries user connecting to a Windows network printer

For an OS/400 user to connect to a Windows-configured network printer, there are two possibilities, which are explained in the following sections.

17.4.2.1 Using LPR on the iSeries

To set this up, follow these steps:

1. Configure LPD on the Windows PC to which the printer you want to use is connected. Refer to 17.2.2.1, “Configuring LPD on a Windows PC” on page 395, for a description of how to do this.

   Write down the Windows queue name. You need this value when you set up LPR on the iSeries.

2. Set up the LPR function on the iSeries by configuring a remote output queue as described in *IBM AS/400 Printing V*, SG24-2160.

Now you can send OS/400 spooled files to the printer that is connected to the Windows PC running LPD.

17.4.2.2 Using a redirected emulated printer

To set this up, follow these steps:

1. On a Windows PC in the network, use the Add Printer wizard to configure a Windows network printer so that you can print to it from the PC. This is the printer that you want to ultimately print to from the iSeries.
2. On the same PC that you set up the Windows network printer on in step 1, use the Client Access printer emulation function to set up an emulated printer, as shown in the following steps:

   a. Start the PC5250 session configurator.

   b. Enter a workstation ID.

   c. On the Configure PC5250 panel, click the **Printer** radio button and then the **Setup** button. Select the option to **Transform print data to ASCII on OS/400**, as shown in Figure 222.

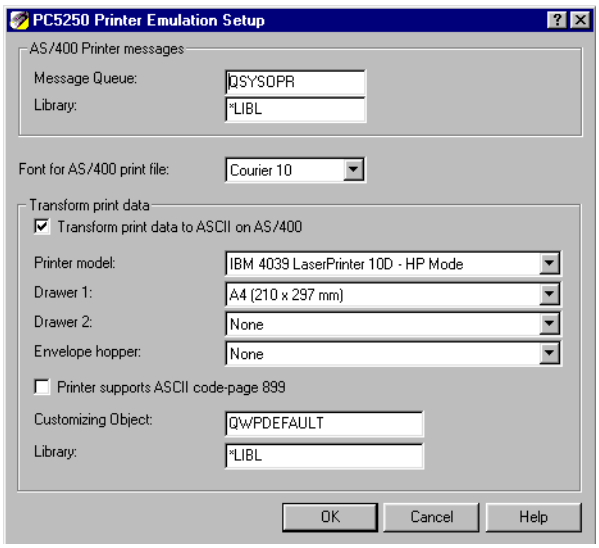

Figure 222. Configuring an emulated printer

d. Click the drop-down list on the Printer model box, and select the appropriate printer type to be compatible with the network printer to which you are printing.

e. Select the default paper size for each drawer.

   Click **OK**, and then click **OK** again.

f. In the printer emulation session window, click **File->Printer Setup...**.

g. Select the network printer that you set up in step 1.

h. In the printer emulation session window, select **File->Save as**, and follow the steps to save the printer session definition and create an icon.

   Notice that the session needs to be active before you can use it to relay spooled files from the iSeries to the network printer. You may want to add the session icon to the Startup group.

3. Close down the printer emulation session on the PC.
4. Go to an OS/400 session and vary off the printer device.
5. Change the OS/400 printer device description parameter Online at IPL to `*YES` if required.
6. Vary on the printer device.
7. Start the printer emulation session on the PC.
8. Test the setup by sending an OS/400 spooled file to the output queue of the emulated printer.

Now you can send OS/400 spooled files to the output queue of the emulated printer and have them print out on the Windows network printer.

Chapter 18. DBCS considerations

Implementing the double-byte character set (DBCS) version of Windows 2000 on the Integrated xSeries Server is similar to having Windows NT DBCS on the Integrated xSeries Server. The functions supplied with the OS/400 Integration for Windows Server are the installation command and the support for user enrollment, error messages, service pack application and some device drivers.

Figure 223 shows the DBCS data flow between the iSeries and Windows server.

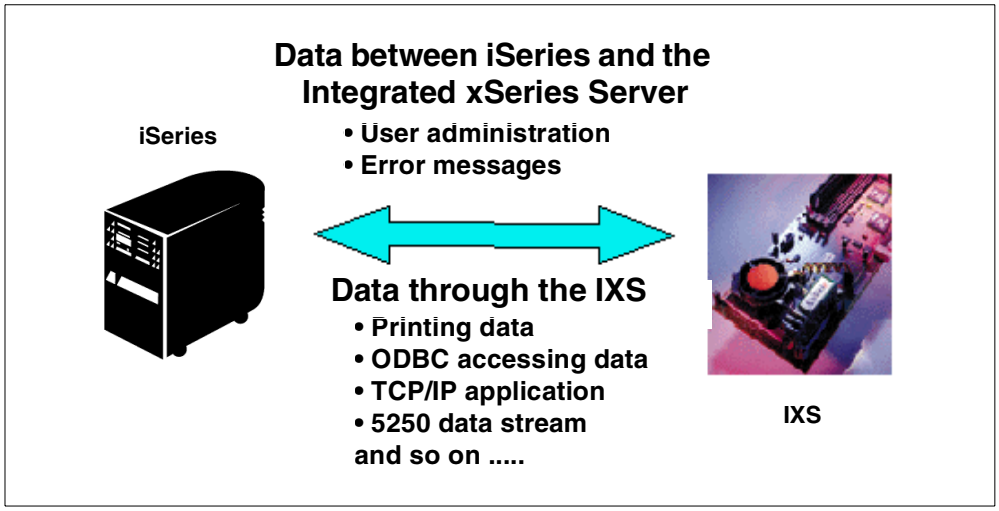

Figure 223. DBCS data flow

In the following sections, we describe some of the DBCS issues associated with the OS/400 Integration for Windows Server code. Related functions, such as ODBC, TCP/IP, and 5250 emulation, are also discussed. We use terms such as *CCSID* (especially a *job CCSID*), *Unicode*, and *Code Page*, which are important for correct data translation. We describe CCSIDs and other related items in 18.4, “DBCS language support” on page 423.

18.1 System requirements

A double-byte character set (DBCS) version of the Windows 2000 server uses more memory and requires more hard disk space compared to a single-byte character set (SBCS) version, due to the way DBCS characters are converted and displayed.

Windows 2000 system requirements can be obtained from the respective Microsoft Web site. For example, the English version of the Windows 2000 server Web site is located at:

`http://www.microsoft.com/windows2000/guide/server/overview/default.asp`

From the Web site, you can obtain system requirements such as the following example. You can use the following list as a base and increase the requirements for DBCS.

- Minimum supported memory is 128 MB, but the recommended memory is 256 MB.
- 2.0 GB of hard disk with a minimum of 1.0 GB free space.

You can obtain information regarding system requirements for other DBCS versions of the Windows server from these Web sites:

- **Japanese version**:
  `http://www.microsoft.com/japan/windows2000/guide/server/sysreq/default.asp`
- **Korean version:**
  `http://www.microsoft.com/korea/windows2000/guide/server/sysreq/default.asp`
- **Chinese version:**
  `http://www.microsoft.com/china/windows2000/guide/datasheet/server.htm`

Note

As a general rule, the Asian-language version requires more system resource than the English-language version. The amount of memory in the preceding list is the *minimum* requirement for running a Windows 2000 server. You may need more memory and disk for a production system.

18.2 Software requirements

Make sure you have the correct primary and secondary language versions for your OS/400 Integration for Windows Server license program.

With DBCS, there are few changes to the OS/400 Integration for Windows Server code. Only a few of the integration functions need character conversion such as installation, user enrollment, and error messages. However, other functions are not DBCS sensitive.

In the following sections, we describe these functions from a DBCS point of view.

18.2.1 Installation

OS/400 Integration for Windows 2000 Server (5769-WSV option 2) feature is an optional part of OS/400 Integration for Windows Server (5769-WSV option *BASE). Confirm that both these options and their language modules are installed. When you install the DBCS version of the Windows 2000 server on the Integrated xSeries Server, confirm that the language version parameter of the INSWNTSVR command is specified correctly as shown in Figure 224.

```
                    Install Windows Server (INSWNTSVR)

Type choices, press Enter.

Full Name  . . . . . .

Organization . . . . . .

Language version . . . . . .   *PRIMARY      *PRIMARY, 2911, 2922, 2923...
Synchronize date and time  . . .   *YES         *YES, *NO
Windows license key  . . . . . .

License mode:
  License type . . . . . .   *PERSEAT      *PERSEAT, *PERSERVER
  Client licenses  . . . . . .   *NONE        5-9999, *NONE
  Desktop licenses . . . . . .   *NONE        5-9999, *NONE
Restricted device resources  . .   *NONE        Name, *NONE, *ALL...
              + for more values
Text 'description' . . . . . .   *BLANK

                                                                      Bottom
```

Figure 224. INSWNTSVR command display

If you install Windows 2000 on an iSeries that has no language support for this version of Windows 2000, messages related to functions, such as user enrollment, are not displayed as you expect.

The Language version parameter is the only place in the INSWNTSVR command where you can specify the language environment. You can confirm other fields, such as Code page, in the network server description using the Display Network Server Description (DSPNWSD) command after the installation is completed. However, these values are not used by the Windows 2000 server on the Integrated xSeries Server.

According to the value entered in the Language version parameter of the INSWNTSVR command, associated MRI resources are copied to the server storage space.

It is possible for the iSeries to determine the language version of the Windows 2000 server that is installed from CD-ROM. Therefore, be careful when multiple language versions of the Windows 2000 server are installed because you cannot change the language in the network server description, and the INSWNTSVR command never checks the contents of the CD-ROM.

Table 28 shows the supported Language version (LNGVER) languages of the INSWNTSVR command.

Table 28. OS/400 language versions

Language version	National language
*PRIMARY	Uses the language version of the primary language that is installed on the iSeries
2911	Slovenian
2922	Portuguese
2923	Dutch

Language version	National language
2924	English upper/lowercase
2925	Finnish
2926	Danish
2928	French
2929	German
2931	Spanish
2932	Italian
2933	Norwegian
2937	Swedish
2938	English uppercase DBCS
2939	German MNCS
2940	French MNCS
2942	Italian MNCS
2950	English uppercase
2962	Japanese DBCS
2963	Dutch MNCS
2966	Belgian French
2975	Czech
2976	Hungarian
2978	Polish
2980	Portuguese
2981	Canadian French MNCS
2984	English upper/lowercase DBCS
2986	Korean DBCS
2987	Chinese, Traditional
2989	Chinese, Simplified
2994	Slovakian
2996	Polish MNCS

18.2.2 User enrollment

OS/400 Integration for Windows Server provides a user enrollment function that propagates OS/400 user profiles to the Windows 2000 server environment.

When you enroll a user profile from the iSeries to a Windows 2000 server, the user profile name, user password, and text description are propagated. The user profile and password cannot be DBCS. However, the text description can contain DBCS data. On the Windows 2000 server side, they are entered in the

Username, Password, Confirm Password, and Description fields of the User Account. At the same time, the characters that are entered in the Username and Password fields are converted to lowercase, whether you input the data in uppercase or lowercase. All the data is converted from OS/400 EBCDIC to Windows 2000 Unicode because data within Windows 2000 must be Unicode.

User enrollment is initiated by a system job, the job (name after the network server description) can be seen in the Work with Active Jobs (WRKACTJOB) displayed under the QSYSWRK subsystem. For example, in Figure 225, you can see a job named TESTDBCS under subsystem QSYSWRK. This job is submitted as a batch job with the name of the network server description, and its CCSID is associated with the QSYS user profile by the vary on process.

```
                              WORK WITH ACTIVE JOBS
                                                                  17/04/00
 CPU %:    1.6     ELAPSED TIME:   00:19:10     ACTIVE JOBS:   113

TYPE OPTIONS, PRESS ENTER.
  2=CHANGE   3=HOLD   4=END   5=WORK WITH   6=RELEASE   7=DISPLAY MESSAGE
  8=WORK WITH SPOOLED FILES   13=DISCONNECT ...

OPT  SUBSYSTEM/JOB  USER        TYPE  CPU %  FUNCTION        STATUS
       QTWSG12031   QTMTWSG     BCH      .0                  SELW
       QTWSG12093   QTMTWSG     BCH      .0                  TIMW
       QVNAVARY     QSYS        BCH      .0  PGM-QVNAVARY    EVTW
       QZHQSRVD     QUSER       BCH      .0                  SELW
       QZRCSRVSD    QUSER       BCH      .0                  SELW
       QZSCSRVSD    QUSER       BCH      .0                  SELW
       QZSOSGND     QUSER       BCH      .0                  SELW
       QZSOSMAPD    QUSER       BCH      .0                  SELW
       TESTDBCS     QSYS        BCH      .0  PGM-QVNAAMON    SELW
                                                                MORE...
```

Figure 225. WRKACTJOB display

Figure 226 on page 418 shows how EBCDIC to Unicode conversion takes place using OS/400 Integration for Windows Server code.

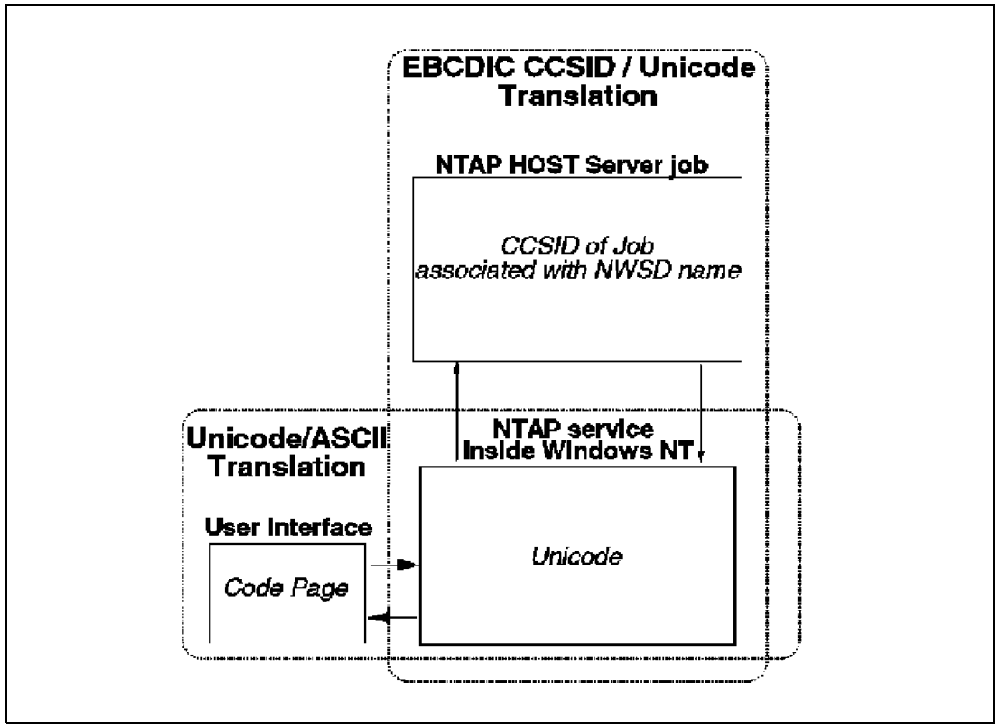

Figure 226. EBCDIC to Unicode conversion mechanism

Here is an example of using values that will give you *expected* results with user enrollment. In this example, we installed the Windows 2000 server in the following environment:

- Language version of the OS/400 is 2938 (ENGLISH UPPERCASE DBCS).
- Language version specified in the INSWNTSVR command is *PRIMARY (2938).
- Windows 2000 server language version is Japanese.
- System value of QCCSID is 5035.
- System value of QCHRID is CS 1172 / CP 1072.
- System value of QCNTRYID is JP.

Using Operations Navigator, we added user profiles to the iSeries as shown in Figure 227.

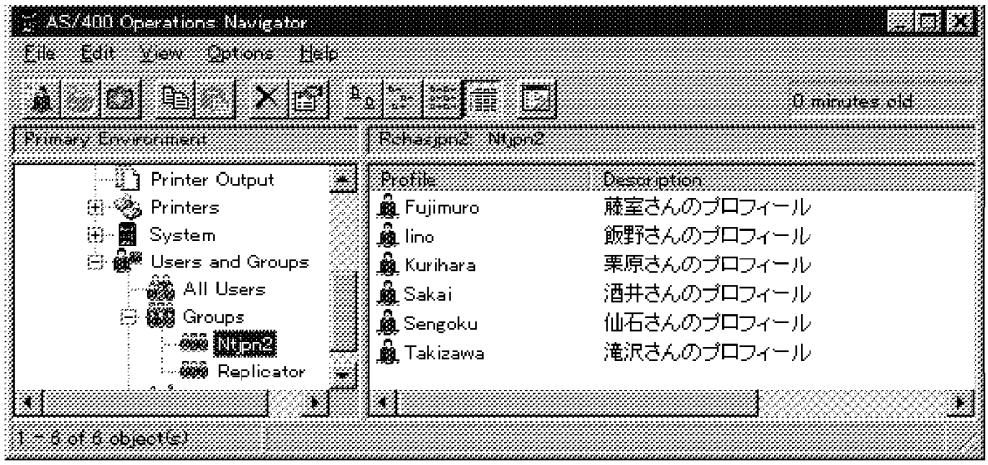

Figure 227. Creating a user profile on an iSeries using Operations Navigator

The User Manager for Domains panel on the Windows 2000 server displays the propagated users as shown in Figure 228.

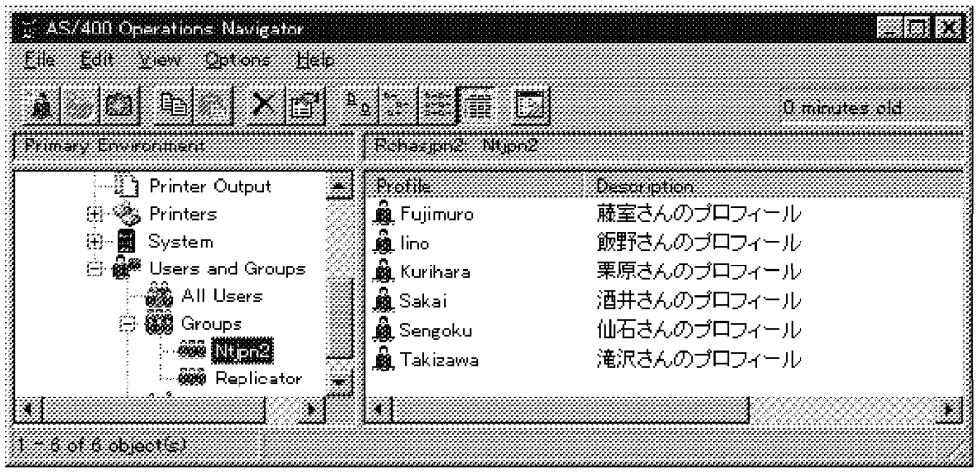

Figure 228. User profile enrollment on the Windows 2000 server

The job attributes of the enrollment job are shown in Figure 229 on page 420.

```
                    Display Job Definition Attributes
                                                                  System:
JOB:   TESTDBCS       USER:   QSYS          NUMBER:   001692

PRINT KEY FORMAT  . . . . . . . . . . . . . . . . . :   *PRTHDR
SORT SEQUENCE . . . . . . . . . . . . . . . . . . . :   *HEX
  LIBRARY . . . . . . . . . . . . . . . . . . . . . :
LANGUAGE IDENTIFIER . . . . . . . . . . . . . . . . :   ENP
COUNTRY IDENTIFIER  . . . . . . . . . . . . . . . . :   JP
CODED CHARACTER SET IDENTIFIER  . . . . . . . . . . :   5035
DEFAULT CODED CHARACTER SET IDENTIFIER  . . . . . . :   5035
JOB MESSAGE QUEUE MAXIMUM SIZE  . . . . . . . . . . :   16
JOB MESSAGE QUEUE FULL ACTION . . . . . . . . . . . :   *NOWRAP
ALLOW MULTIPLE THREADS  . . . . . . . . . . . . . . :   *NO




                                                                  BOTTOM
PRESS ENTER TO CONTINUE.
```

Figure 229. Job attributes: A good example

Here is a an example of conflicting values that will give you *unexpected* results with user enrollment.

Next we changed the following system values:

- System value QCCSID to `65535`.
- System value QCHRID to `CS 697 / CP 37`.
- System value QCNTRYID to `US`.

The result of the change caused the User Manager for Domains panel to show incorrect text descriptions as shown in Figure 230.

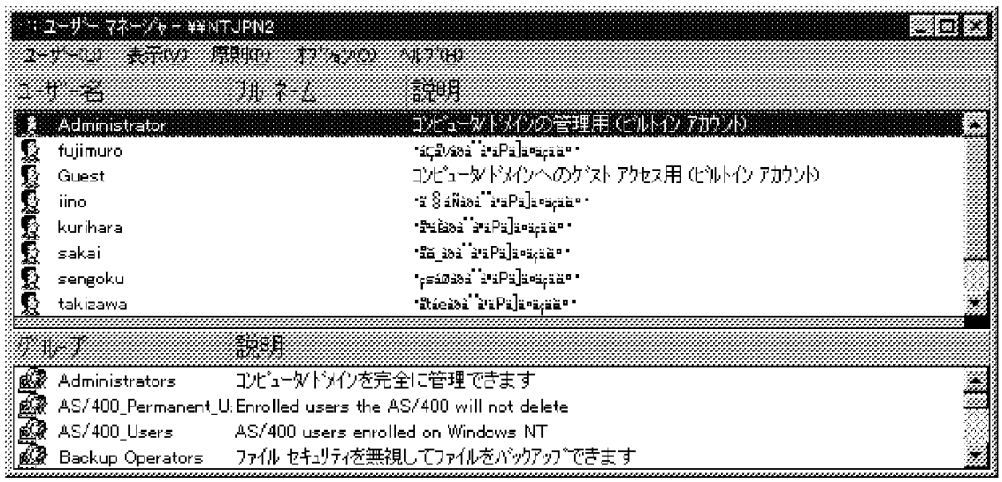

Figure 230. User profile enrollment on the Windows 2000 server

The job attributes of the enrollment job are shown in Figure 231.

```
                    Display Job Definition Attributes

JOB:   TESTDBCS       USER:   QSYS          NUMBER:   001756

PRINT KEY FORMAT  . . . . . . . . . . . . . . . . . :   *PRTHDR
SORT SEQUENCE . . . . . . . . . . . . . . . . . . . :   *HEX
  LIBRARY . . . . . . . . . . . . . . . . . . . . . :
LANGUAGE IDENTIFIER . . . . . . . . . . . . . . . . :   ENU
COUNTRY IDENTIFIER  . . . . . . . . . . . . . . . . :   US
CODED CHARACTER SET IDENTIFIER  . . . . . . . . . . :   65535
DEFAULT CODED CHARACTER SET IDENTIFIER  . . . . . . :   37
JOB MESSAGE QUEUE MAXIMUM SIZE  . . . . . . . . . . :   16
JOB MESSAGE QUEUE FULL ACTION . . . . . . . . . . . :   *NOWRAP
ALLOW MULTIPLE THREADS  . . . . . . . . . . . . . . :   *NO




                                                                          BOTTOM
PRESS ENTER TO CONTINUE.
```

Figure 231. Job attributes: Bad example

The TESTDBCS job is responsible for language conversion. The iSeries stores its information in EBCDIC format where the Windows 2000 server uses Unicode. This conversion is all processed on the OS/400 side by one job for each network server. The iSeries does not know the language that is used on the Windows 2000 server because the job uses the attributes of the QSYS user profile, not the network server description. The QSYS user profile itself has the value of *SYSVAL for its language fields, such as LNGID, CNTRYID, and CCSID. This forces you to make the language version of the Windows 2000 server and the system values of the iSeries correspond to each other.

Note

Multiple Windows 2000 servers using different DBCS languages do not work on one iSeries server, unless you manually change the job attributes to suit the Windows 2000 language.

18.2.3 Error messages

Error messages and status codes generated by the OS/400 Integration for Windows Server code running on the Windows 2000 server are sent to the OS/400 side by a Windows 2000 service. This data is converted from Windows 2000 Unicode to OS/400 EBCDIC by the job, which takes its name from the network server description. On the OS/400 side, the messages are sent to the message queue specified in the network server description.

18.3 Considerations for related applications

This section discusses DBCS enablement and networking products.

18.3.1 ODBC

The OS/400 Client Access ODBC driver for a Windows NT service is similar for the Windows 2000 server. You can gain an understanding of the code conversion mechanism by reading the Client Access/400 for Windows 95/NT documentation *OS/400 Client Access for Windows 95/NT API and Technical Reference*, SC41-3513, and *National Language Support*, SC41-5101. This section provides a brief overview.

Client Access is a client/server application that uses the code translation functions of both PC modules and OS/400 modules. This is different from the OS/400 Integration for Windows Server code. On the OS/400 side, host server jobs work to service Client Access requests. On the PC, Client Access functions, such as File Transfer, Operations Navigator, and ODBC, work to service user interface or host requests. On both sides, code translation between EBCDIC and ASCII or different CCSIDs can be done. Figure 232 shows how the conversion is done on both sides.

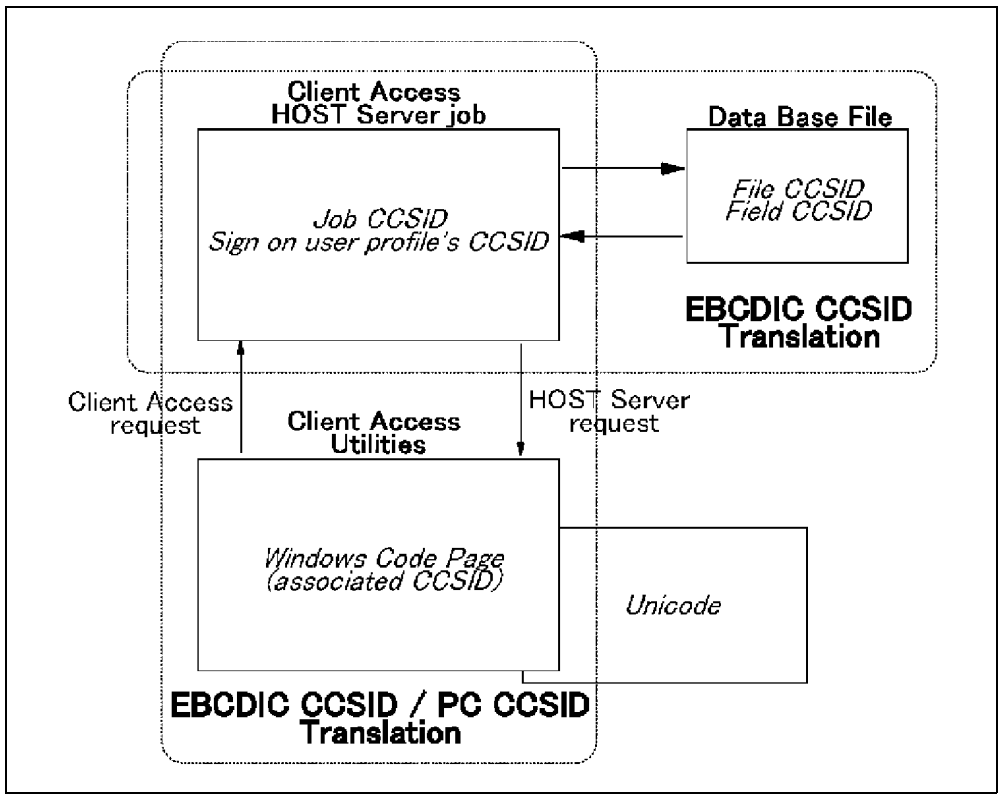

Figure 232. Client Access code translation

Host server jobs are pre-started on the OS/400 side. The user profile used by default is QUSER. When a request is received from a client, QUSER is replaced by the user profile that issued the request.

18.3.2 TCP/IP

The iSeries can communicate with the Windows 2000 server by using the TCP/IP application through the internal LAN.

They are many points to consider when using DBCS languages in this environment since neither the iSeries nor Windows 2000 server can determine the CCSID or code page of the other.

18.3.3 5250 emulation

You can use an emulator, such as Personal Communication, to enable a 5250 session. In Personal Communications, the Host Code Page can be specified (this is the same as the CCSID). Usually the default value is set to an appropriate value for each country. This value is not set automatically by any host server function. The value for this field must be consistent with the job's CCSID that is set by the user profile, JOBD, or the QCCSID system value.

18.4 DBCS language support

In the following sections, we provide a short description of the DBCS support for both the Windows 2000 and iSeries platforms.

In some Asian countries, several thousand ideographic characters are used. They are Chinese in origin and called “Hanzi” in Chinese, “Kanji” in Japanese, and “Hanji” in Korean. In addition to these ideographic characters, Roman alphabetic characters, Arabic numbers, Chinese numbers, special symbols, and language unique phonetics (such as “bo-po-mo-fo” in Chinese, “Hiragana/Katakana” in Japanese, and “Hangle” in Korean) are used. One byte can represent only 256 characters. Therefore, the double-byte character set (DBCS) is defined for these Asian languages.

The OS/400 language environment uses a Coded Character Set Identifier (CCSID), which basically supports the conversion of characters between multiple languages. CCSIDs are not only used by the DBCS environment, but they are also used in the Single-Byte Character Set (SBCS) environment, where the concept is the same. Mixed CCSIDs is the only feature that distinguishes the DBCS environment from the SBCS environment. More information on mixed CCSIDs is provided in 18.4.2, “OS/400 language support” on page 426.

The Windows 2000 server also supports multiple languages. In the Windows 2000 server environment, CCSIDs are not used. Code pages are used instead to support a standardized method of conversion between multiple languages. However, the Windows 2000 server uses Unicode internally. More information on Unicode is provided in 18.4.2, “OS/400 language support” on page 426.

18.4.1 Windows 2000 language support

Because the Windows 2000 server on the Integrated xSeries Server is marketed worldwide, all OS/400 Integration for Windows Server displayable text is enabled for translation into many languages. However, the National Language Support (NLS) provided for the Windows 2000 server is limited to the support that is provided by Microsoft.

Languages supported by the Windows 2000 server are shown in the Table 29.

Table 29. Windows 2000 language versions

Language	Language
English	French
German	Italian
Spanish	Dutch
Swedish	Norwegian
Finnish	Danish
Brazilian Portuguese	Portuguese
Polish	Hungarian
Russian	Korean
Traditional Chinese	Simplified Chinese
Japanese	Thai
Hebrew	Arabic

The following DBCS languages are discussed in this section:

- Japanese
- Korean
- Simplified Chinese
- Traditional Chinese

The Windows 2000 server is supplied with NLS that contains translation tables such as ASCII-Unicode-EBCDIC and EBCDIC-Unicode-ASCII for all of the popular host code pages. Table 30 shows Windows 2000 code pages and the corresponding translation tables.

Table 30. Sample Windows 2000 code pages and corresponding translation tables

Code page	Windows NT translation table
932 Japanese	c_932.nls
949 Korean	c_949.nls
936 Simplified Chinese	c_936.nls
950 Traditional Chinese	c_950.nls

The registry key in My Computer, `"\HKEY_LOCAL_MACHINE\System\CurrentControlSet\control\NLS\CodePage"` lists all of the code pages that are installed or that can be installed on your system. In this registry key, the Name entry specifies the code page, and the Data entry specifies the corresponding file that contains the code page information. For example, in Figure 233, "`c_932.nls`" is the file for code page 932. ACP is the default ANSI code page, OEMCP is the default OEM code page, and MACCP is the default Macintosh code page.

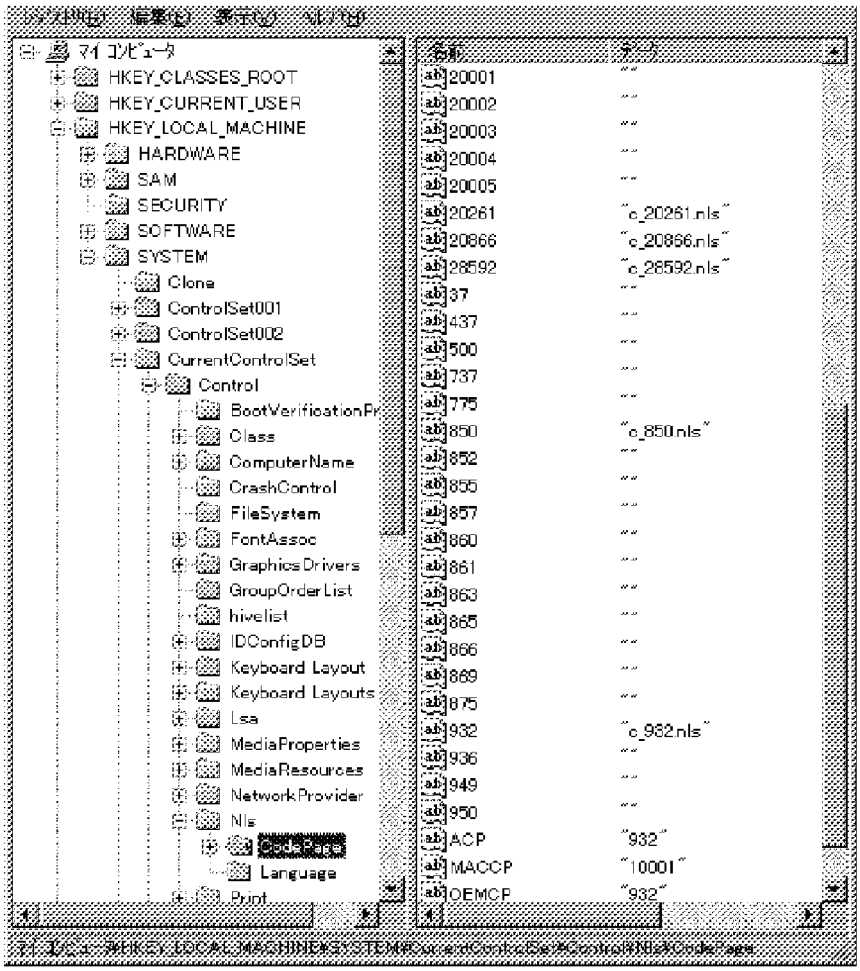

Figure 233. Windows 2000 server REGEDIT window

The most common character set in use by computers today is ASCII. The ASCII format has proved adequate for Western languages. However, as computers have become more popular in European and Asian countries, the limitations of ASCII have become clear. One way to solve this problem is by using a coding system called Unicode.

Unicode is the native code set for Windows 2000. The Win32 NLS API that resides on the Windows 2000 server provides both Unicode-to-ASCII and ASCII-to-Unicode conversion services.

Unicode employs a 16-bit coding scheme that allows for 65,536 distinct characters (more than enough to include all languages in use today). In addition, it supports several archaic or arcane languages, such as Sanskrit and Egyptian hieroglyphics. Unicode includes representations for punctuation marks, mathematical symbols and dingbats, with room left for future expansion. Because it establishes a unique code for each character in each language, Windows NT can ensure that the character translation from one language to another is accurate.

Windows 2000 uses Unicode internally. Unicode is translated to ASCII for communication with Windows 2000 users and translated to EBCIDIC for

communication with the iSeries. Figure 234 shows the relationship between Unicode, ASCII, and EBCIDIC.

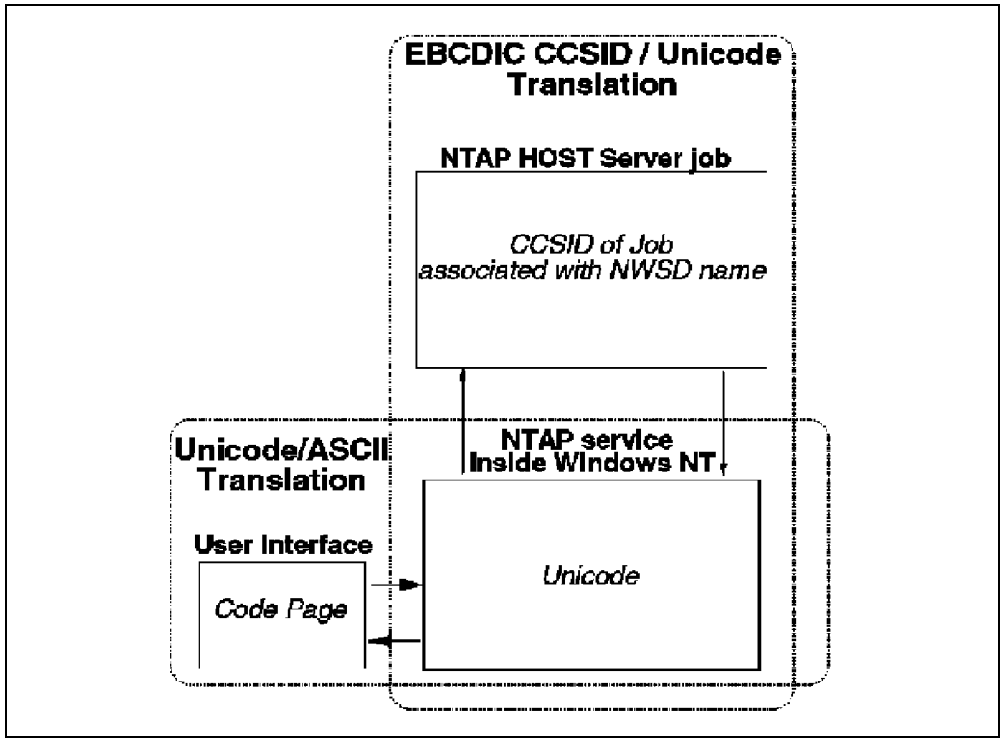

Figure 234. Windows 2000 character code translation

Therefore, the OS/400 Integration for Windows Server code is enabled for translation to Unicode. This conversion is done by code residing on the OS/400 side, which provides EBCDIC-to-Unicode and Unicode-to-EBCDIC code page conversion services.

18.4.2 OS/400 language support

The OS/400 Integration for Windows Server code is packaged as an additional code to the OS/400. You can install one language as the primary language and another language as the secondary language. When you execute the INSTWNTSRV command, you can specify the language you want for the Windows 2000 server. You can install a different language version of the Windows 2000 server for each Integrated xSeries Server. For example, if NTTEST1 is English, NTTEST2 can be Japanese, provided that DBCS enabled English and Japanese are set up as primary and secondary languages on the iSeries and you loaded the appropriate version of the Windows 2000 server.

At this point, you need to understand how the language you specify works on the iSeries. We describe the main points of the architecture here.

As previously explained, the iSeries uses CCSIDs to convert between character sets. These CCSIDs provide rules for handling characters on the iSeries server. Table 31 shows the DBCS language version, corresponding feature code, and CCSID.

Table 31. OS/400 DBCS Language Version

Language	Feature codes (primary/secondary)	CCSID
Japanese	2962/5962	5026 5035
Korean	2986/5986	933
S-Chinese	2989/5989	935
T-Chinese	2987/5987	937

There are three components to a CCSID:

- **CS (Character Set)**: A defined set of characters that does not have an exact code point for each character. It is no more than a set of characters. The code point is provided by the CP. In other words, a CS is a collection of characters that has no name.
- **CP (Code Page)**: A collection of characters in a character set.
- **ES (Encode Scheme)**: A rule for encoding and decoding characters. This value determines how the converted data is displayed.

Some typical encoding schemes are shown in Table 32.

Table 32. Typical encoding schemes

ES ID	Description
1100	EBCDIC, single-byte, no code extension is allowed.
1200	EBCDIC, double-byte, no code extension is allowed.
1300	EBCDIC, mixed byte, no code extension is allowed.
1301	EBCDIC, mixed byte, using shift-in (SI) and shift-out (SO) code extension method.
2100	IBM-PC data, single-byte, no code extension is allowed.
2200	IBM-PC data, double-byte, no code extension is allowed.
2300	IBM-PC data, mixed byte with implicit code extension.

The following sets of tables describe the CCSIDs used in Asian countries.

Table 33 through Table 38 show CCSIDs for the Japanese language.

Table 33. Japanese OS/400 mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
05026	00290 00300	01172 00370	1301	Japan Katakana (extended range) 1880 UDC
05035	01027 00300	01172 00370	1301	Japan English (extended range) 1880 UDC
00930	00290 00300	01172 01001	1301	Japan Katakana (extended range) 4370 UDC
00939	01027 00300	01172 01001	1301	Japan English (extended range) 4370 UDC

Table 34. Japanese OS/400 SBCS

CCSID	CP	CS	ES	Description
00290	00290	01172	1100	Japan Katakana (extended range)
01027	01027	01172	1100	Japan English (extended range)

Table 35. Japanese OS/400 DBCS

CCSID	CP	CS	ES	Description
00300	00300	01001	1200	Japan English
04396	00300	00370	1200	Japan Host DB including 1880 UDC

Table 36. Japanese PC Mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
00932	00897 00301	01172 00370	2300	Japan PC Data Mixed Old Shift-JIS
00942	01041 00301	01172 00370	2300	Japan PC Data Mixed Old Shift-JIS
00943	01041 00941	01172 00370	2300	Japan PC Data Mixed New Shift-JIS

Table 37. Japanese PC SBCS

CCSID	CP	CS	ES	Description
00897	00897	01172	2100	Japan PC Data (non-extended)
01041	01041	01172	2100	Japan PC Data (extended)

Table 38. Japanese PC DBCS

CCSID	CP	CS	ES	Description
00301	00301	00370	2200	Japan PC Data Old Shift-JIS
00941	00941	00370	2200	Japan PC Data New Shift-JIS

Table 39 through Table 44 on page 430 show CCSIDs for the Korean language.

Table 39. Korean OS/400 Mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
00933	00833 00834	01173 00934	1301	Korean (extended range) 1880 UDC

Table 40. Korean OS/400 SBCS

CCSID	CP	CS	ES	Description
00833	00833	01173	1100	Korean (extended range)

Table 41. Korean OS/400 DBCS

CCSID	CP	CS	ES	Description
00834	00834	00934	1200	Korean Host double-byte, 1880 UDC

Table 42. Korean PC Mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
00949	01088 00951	01278 01050	2300	KS PC Data, 1800 UDC
00934	00891 00926	01224 00934	2300	Korean PC Data
00944	01041 00926	01173 00934	2300	Korean PC Data Mixed

Table 43. Korean PC SBCS

CCSID	CP	CS	ES	Description
01088	01088	01278	2100	KS PC data single-byte
00891	00891	01224	2100	Korean PC data (non-extended)
01041	01041	01173	2100	Korean Latin PC data (extended)

Table 44. Korean PC DBCS

CCSID	CP	CS	ES	Description
00926	00926	00934	2200	Korean PC data DBCS, 1880 UDC
00951	00951	01050	2200	KS PC data DBCS, 1800 UDC

Table 45 through Table 50 show CCSIDs for the Simplified Chinese language.

Table 45. S-Chinese OS/400 Mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
00935	00836 00837	01174 00937	1301	Simplified Chinese extended range
01388	00836 00837	65535 65535	1301	GBK support

Table 46. S-Chinese OS/400 SBCS

CCSID	CP	CS	ES	Description
00836	00836	01174	1100	Simplified Chinese extended range

Table 47. S-Chinese OS/400 DBCS

CCSID	CP	CS	ES	Description
00837	00837	00937	1200	Simplified Chinese
04933	00837	65535	1200	GBK support

Table 48. S-Chinese PC Mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
00936	00903 00928	01185 00937	2300	Simplified Chinese PC non-extended
00946	01042 00928	01239 00937	2300	Simplified Chinese PC data mixed
01381	01115 01380	00103 00937	2300	Simplified Chinese, GB PC mixed
01383	00367 01382	00103 01081	2300	Simplified Chinese
01386	01114 01385	65535 65535	2300	GBK support

Table 49. S-Chinese PC SBCS

CCSID	CP	CS	ES	Description
00903	00903	01185	2100	Simplified Chinese PC data non-extended
01042	01042	01239	2100	Simplified Chinese PC data extended
01115	01115	00103	2100	Simplified Chinese, GB PC SBCS

Table 50. S-Chinese PC DBCS

CCSID	CP	CS	ES	Description
00928	00928	00937	2200	Simplified Chinese PC data DBCS, 1880 UDC
01380	01380	00937	2200	Simplified Chinese, GB PC data DBCS

Table 51 through Table 56 on page 432 show CCSIDs for the Traditional Chinese language.

Table 51. T-Chinese OS/400 Mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
00937	00037 00835	01175 00935	1301	Traditional Chinese extended range

Table 52. T-Chinese OS/400 SBCS

CCSID	CP	CS	ES	Description
28709	00037	01175	1100	Traditional Chinese extended range
00037	00037	00697	1100	U.S., Canada, Netherlands, Portugal, Brazil, New Zealand, Australia

Table 53. T-Chinese OS/400 DBCS

CCSID	CP	CS	ES	Description
00835	00835	00935	1200	Traditional Chinese host double-byte, 6204 UDC

Table 54. T-Chinese PC Mixed (DBCS + SBCS)

CCSID	CP	CS	ES	Description
00950	01114 00947	00103 00935	2300	Traditional Chinese PC data mixed for Big 5
00938	00904 00927	00103 00935	2300	Traditional Chinese PC data non-extended

00948	01043 00927	01175 00935	2300	Traditional Chinese PC data mixed, 6204 UDC

Table 55. T-Chinese PC SBCS

CCSID	CP	CS	ES	Description
00904	00904	00103	2100	Traditional Chinese PC data
01043	01042	01175	2100	Traditional Chinese PC data extended
01114	01114	00103	2100	Traditional Chinese, Taiwan Industry Graphic Character Set (BIG-5)

Table 56. T-Chinese OS/400 PC DBCS

CCSID	CP	CS	ES	Description
00927	00927	00935	2200	Traditional Chinese PC data DBCS, 6204 UDC
00947	00947	00935	2200	ASCII double-byte
01114	01114	00103	2100	Traditional Chinese, Taiwan Industry Graphic Character Set (BIG-5)

For example, in the case of the Japanese language (primary OS/400 language feature 2962, secondary language feature 5962), we specify 5035 in the system value QCCSID, which means the system setting is:

- **For SBCS**:
  - CS is 1172
  - CP is 1027

  This is CCSID 01027.
- **For DBCS**:
  - CS is 370
  - CP is 300

  This is CCSID 04396. ES is 1301.

This means that CCSID 01027 and CCSID 04396 are included in CCSID 05035. More importantly, the job CCSID performs the major role in communications between the iSeries and Windows 2000. If you use the QUSER user profile to start a job, and QUSER has *SYSVAL as its CCSID parameter, then the job that is started has 5035 as its CCSID.

On the other hand, Windows 2000 uses a code page to describe the character set. Table 57 summarizes the code pages supported on Windows 2000. It also includes IBM PC code pages that are equivalent to Windows 2000. Both Windows 2000 and IBM follow the default industry standard for code pages. However, notice that even when a code page has been changed on Windows 2000, Microsoft has not assigned a new code page number. Another important point is that the Windows 2000 code page does not necessarily correspond to the IBM code page, even though they both have the same number. Strictly speaking, code pages 932, 936, 949, and 950 described in the previous section are not the same

as CCSIDs 00932, 00936, 00949, and 00950, even though the numbers are the same. For example, Microsoft code page 936 is completely different from CCSID 00936.

Table 57. Windows 2000 code pages and corresponding IBM code pages

Language	Windows 2000	IBM PC equivalent to Windows NT code	IBM PC standard
Japanese	00932 New Shift-JIS	00943 New Shift-JIS	00932/00942 Old Shift-JIS
Korean	00949 KS Code	01363 (MS-00949)	00949 KS Code
S-Chinese	00936 GBK Code	01386 GBK Code	01381 GBK Code
T-Chinese	00950 BIG-5	00950 BIG-5	00950 BIG-5

Chapter 19. Windows NT to Windows 2000 server migration

Since many customers have already installed a Windows NT 4.0 server on the Integrated Netfinity Server, this chapter covers migration scenarios from Windows NT 4.0 to the Windows 2000 server. There are different ways you can perform an upgrade. The process also depends on the hardware you want to use, an older Integrated Netfinity Server or the new 700 MHz Integrated Netfinity Server.

19.1 General remarks

We tried to cover the most common upgrade scenarios in this chapter. However, when you perform an upgrade, your installed base stays the same. This existing installation might be a problem. We describe all migration scenarios with blank server installations, which means there are no printers or other additional hardware configured and no applications installed on these servers. Due to the fact that this will be different on your server, you may see additional pop-up windows or installation requests during your installation.

We also cover scenarios where only the hardware changes and the installed operating system, Windows NT 4.0 or Windows 2000, stays the same. It is often an advantage to transfer the existing installation to new hardware first, because then, the testing possibilities and needed installation time are less critical.

Although Microsoft encourages to perform an upgrade installation, you should be very careful with the installation mode. If one of your applications is not able to run on the Windows 2000 server, this might crash the entire server. We recommend that you use the upgrade method for installations using only file and print serving and domain controlling. It may be safer to do a new installation and migrate your data disks.

Before you perform an upgrade to Windows 2000, you have to plan your Windows 2000 domain structure and Active Directory structure to set up your server the correct way. It is also important that you have a full backup of your existing Windows NT server before you begin the upgrade, so you can recover your old installation in case anything fails.

Important

- Whenever possible, try to make a fresh installation of Windows 2000, instead of performing an upgrade. This will clean up your registry, and you can set up your applications sequentially to test them on the new Windows 2000 server.
- Plan your Active Directory topology before you upgrade to Windows 2000.
- Be sure to have a complete backup of your running server before you try any upgrade function.

19.2 High-level overview about upgrade scenarios

This section gives a general overview of the steps that are required to perform a migration in different environments. It is only a high-level overview; some of these scenarios are explained more in detail later in this chapter.

Table 58. Migration scenarios

Current installation	**To: V4R5 - Current Hardware - Windows NT 4.0**	**To: V4R5 - Current Hardware - Windows 2000**	**To: V4R5 - Model 820, 830, 840, 270 with 700 MHz - Windows NT 4.0**
From V4R4, V4R3, V4R2 Current Hardware (333 MHz, 200 MHz) Windows NT 4.0	1. Perform OS/400 release upgrade. 2. Perform OS/400 integration upgrade on server.*	1. Perform OS/400 release upgrade. 2. Upgrade to Windows 2000 using the *UPGRADE option of the INSWNTSVR command.	1. Perform OS/400 release upgrade. 2. Perform OS/400 integration upgrade on the server.* 3. Save server objects and disks. 4. Migrate to new Hardware. 5. Restore server objects and disks. 6. Delete external Host LAN configuration. 7. Install a video driver.

Current installation	**To: V4R5 - Model 820, 830, 840, 270 with 700 MHz - Windows 2000**	**To: V4R5 - Model 820, 830, 840, 270 with 333 MHz in Migration Tower - Windows NT 4.0**	**To: V4R5 - Model 820, 830, 840, 270 with333 MHz in Migration Tower - Windows 2000**
From V4R4, V4R3, V4R2 - Current Hardware (333 MHz, 200 MHz) - Windows NT 4.0	1. Perform OS/400 release upgrade. 2. Perform OS/400 integration upgrade on the server.* 3. Save server objects and disks. 4. Migrate to new hardware. 5. Restore server and objects. 6. Upgrade to Windows 2000 using the *UPGRADE option of the INSWNTSVR command. 7. Delete the external Host LAN configuration.	1. Perform OS/400 release upgrade. 2. Perform OS/400 integration upgrade on the server.* 3. Save server objects and disks. 4. Migrate to new hardware. 5. Restore server objects and disks. 6. Delete external Host LAN configuration.	1. Perform OS/400 release upgrade. 2. Perform OS/400 integration upgrade on the server.* 3. Save server objects and disks. 4. Migrate to new hardware. 5. Restore server objects and disks. 6. Upgrade to Windows 200 using the *UPGRADE option of the INSWNTSVR command. 7. Delete external Host LAN configuration.

* Refers to selecting the Install release from OS/400 option on the Level Check program on your Windows server. This step requires the latest Microsoft service pack on CD-ROM to install the standard Hardware Abstraction Layer (HAL).

19.3 General preparation to migrate

You must perform some steps before every possible migration scenario. These steps create the environment to enable you to perform a transfer of your existing

operating system to new hardware or to upgrade your operating system on the new 700 MHz Integrated xSeries Server or legacy.

19.3.1 OS/400 release change

To use the new license program 5769-WSV and convert the existing network storage spaces, you have to perform a release change on your legacy hardware to OS/400 V4R5 at first. Figure 235 shows the possible upgrade paths.

Note: As always when changing anything to the release level of OS/400, be sure to have a complete backup of your entire system!

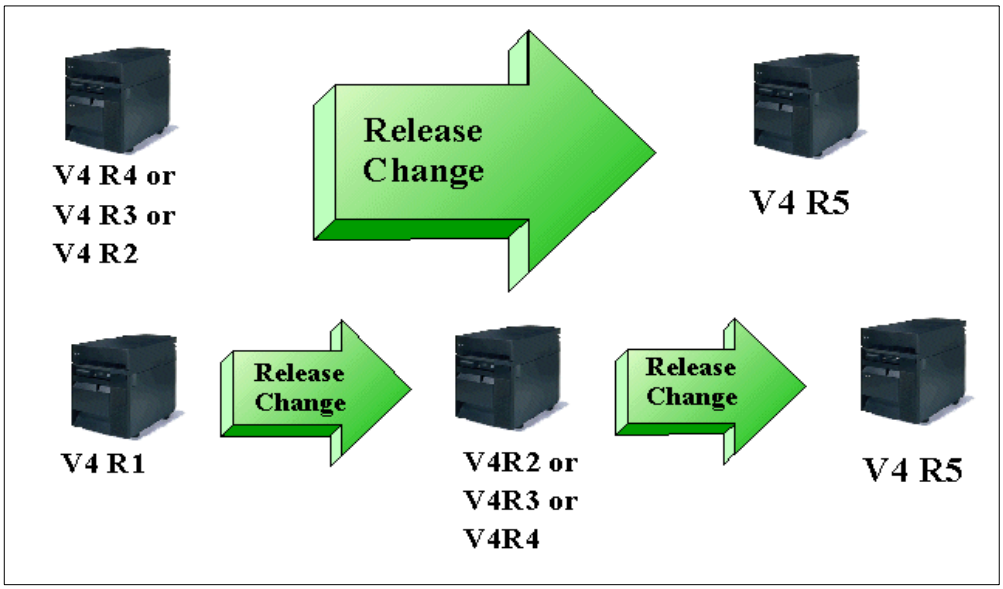

Figure 235. OS/400 upgrade paths to V4R5

19.3.2 Installing license program 5769-WSV

During the upgrade of OS/400 to version V4R5, the former SS1 option 29 is replaced by the new bonus licensed program 5769-WSV, which contains the new integration software for Windows NT 4.0 and Windows 2000. After upgrading, you will already see this program, but you have to install the two support options for Windows NT 4.0 and Windows 2000 manually. To do this, follow these steps:

1. Type `GO LICPGM` on your console screen.
2. Insert the OS/400 bonus pack CD-ROM into your CD-ROM drive.
3. Choose option `11` from the Work with Licensed Programs menu.
4. Page down the list of licensed programs until you see the description Integration for Windows Server. Complete the information on the screen as shown in Figure 236 on page 438. Then press Enter twice, and specify the name of your CD-ROM device. The installation starts when you press Enter the next time.

```
                          Install Licensed Programs
                                                              System:   AS27
Type options, press Enter.
  1=Install

       Licensed  Product
Option Program   Option   Description

       5769WP1    3       OfficeVision - Mail
       5769WP1    4       OfficeVision - Editor
       5769WSV    *BASE   Integration for Windows Server
  1    5769WSV    1       Integration for Windows NT 4.0
  1    5769WSV    2       Integration for Windows 2000
       5763XD1    *BASE   Client Access/400 Optimized for Windows
       5769XE1    *BASE   Client Access/400 Express for Windows
       1TMELCF    *BASE   Tivoli Management Agent
       5763XK1    *BASE   Client Access/400 for Windows 3.1
       5763XK1    1       CA/400 - Windows 3.1 SBCS
       5763XK1    2       CA/400 - Windows 3.1 DBCS
       5763XK1    3       CA/400 - Windows 3.1 PC5250 Korean
                                                                      More...
F3=Exit   F11=Display status/release   F12=Cancel   F19=Display trademarks
```

Figure 236. Installing integration software options

19.3.3 Applying latest PTFs to the Windows integration software

After you install the OS/400 Integration for Windows Server license program and upgrade your operating system, you have to install the latest cumulative program temporary fix (PTF) from IBM:

1. On the OS/400 command line, type `GO PTF` and press Enter.
2. To install the program temporary fix package, type `8` and press Enter.
3. In the device field, enter the name of your optical device.
4. Use the default `*YES` for Automatic IPL, unless your system uses logical partitions. Press Enter to install all PTFs. Unless you changed the value to *NO, your system automatically shuts down and restarts.

19.3.4 Upgrading your OS/400 integration software

To use the new integration software, you have to perform an upgrade of it using the OS/400 Windows Integration Level Check program. Refer to Chapter 8, “Updating the integration software” on page 219, to see how to upgrade the integration software. Be sure to have a CD available with the applied Microsoft service pack, because during the upgrade, the standard Microsoft HAL is copied to your installation. Beginning with the release of V4R5, an IBM customized HAL is no longer used to support the Integrated xSeries Server.

19.4 Moving the Windows NT 4.0 server to the new Integrated xSeries Server hardware

Although this is a redbook deals mainly with Windows 2000, we describe the process of transferring an existing Windows NT 4.0 server to a new Model 270 or 8xx machine, because in many cases, you first move the existing Windows NT server to the new hardware and perform the upgrade later when the system setup is finished. We recommend that you do this when you have new hardware,

because you will not lose your running Windows NT 4.0 server and you have enough time to test it on the new hardware.

Performing the simple change of INS hardware covering your Windows NT server is the simplest migration scenario. Here, you can really consider the advantage of the Windows integration concept in the iSeries.

It takes you only about 20 minutes to migrate to the new hardware (backup and recovery time not included). It is not possible to do this with any PC server. It is not possible. To migrate to the new hardware on the iSeries, complete the steps in the following section.

Note

Your new iSeries server should have a working network connection so that you can use Operations Navigator. Otherwise, you will not be able to perform one important migration step!

19.4.1 Saving and restoring your current installation

There are two possible ways to move your server to another system:

- Save all needed objects to a tape
- Save all needed objects to a save file and transfer it via FTP to the new system

This section only describes the first choice. To see how to perform the second way, see Chapter 15, “Managing Windows 2000 servers remotely” on page 369.

Follow these steps:

1. Save all your configuration objects:
   a. To save all your configuration objects, run the following command:

      ```
      SAVCFG DEV(TAP01)
      ```

   b. Save your Windows NT 4.0 system drives using the following command:

      ```
      SAV DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QFPNWSSTG/WINNT*')
      ```

      Replace *WINNT** in the object parameter by the mask applying to your server Windows NT installation and *TAP01* with the name of your tape device. Then, do the same for your user network storage spaces linked to your Windows NT server if they are not covered by the object mask.
2. Restore the saved objects to your new iSeries server. Follow these steps:
   a. Restore the related configuration objects by typing this command on an OS/400 command line:

      ```
      RSTCFG DEV(TAP01) OBJ(WINNT*)
      ```

      This restores the network server description and the configured communication lines and devices that belong to your Windows NT server installation.

Important

Use a maximum of five characters for the mask, plus an asterisk (*) to describe the objects you want to restore. Otherwise not all related communication objects will be restored.

b. Restore the Windows NT server system drives by using this command:

```
RST DEV('/QSYS.LIB/TAP01.DEVD') OBJ('/QFPNWSSTG/WINNT*')
```

c. Perform the same for your other network storage spaces linked to the transferred Windows NT server if they are covered by the object mask.

3. You have now moved all objects needed for your Windows NT server to the new machine. Using the WRKNWSSTG command, check the order of the assigned links (see Figure 237). The link numbers should match the number added to the network storage space. When these links are not in the correct order, your server cannot boot.

```
                  Work with Network Server Storage Spaces
                                                              System:   AS27
Type options, press Enter.
  1=Create   3=Copy   4=Delete   5=Display   6=Print   10=Add link
  11=Remove link

                 Percent
Opt  Name        Used     Size   Server      Drive  Format    Access      ASP

     EMEAW2K2      38     1000  EMEAW2K         4    *FAT      *UPDATE       1
     NTTEST1        0     2000  NTTEST          3    *NTFS     *UPDATE       1
     NTTEST2        0      450  NTTEST          4    *FAT      *UPDATE       1
     WINNTMIG1     72     2000  WINNTMIG        3    *NTFS     *UPDATE       1
     WINNTMIG2     38     1000  WINNTMIG        4    *FAT      *UPDATE       1

Check the numbers added to the names corresponding to the drive numbers.

Check whether the order of these drive numbers correspond to the order of the names.

                                                                        Bottom
Parameters or command
===>
F3=Exit   F4=Prompt   F5=Refresh   F6=Print list   F9=Retrieve
F11=Display text      F12=Cancel   F17=Position to
```

Figure 237. Check for correct order of drive numbers

4. Gather the internal LAN IP-address from your running system and create a new one on your new system that contains the same values for the IP address and line description. The used line description is the name of your server plus “00”. To create this interface, use the CFGTCP command and option 1. Figure 238 shows an example screen.

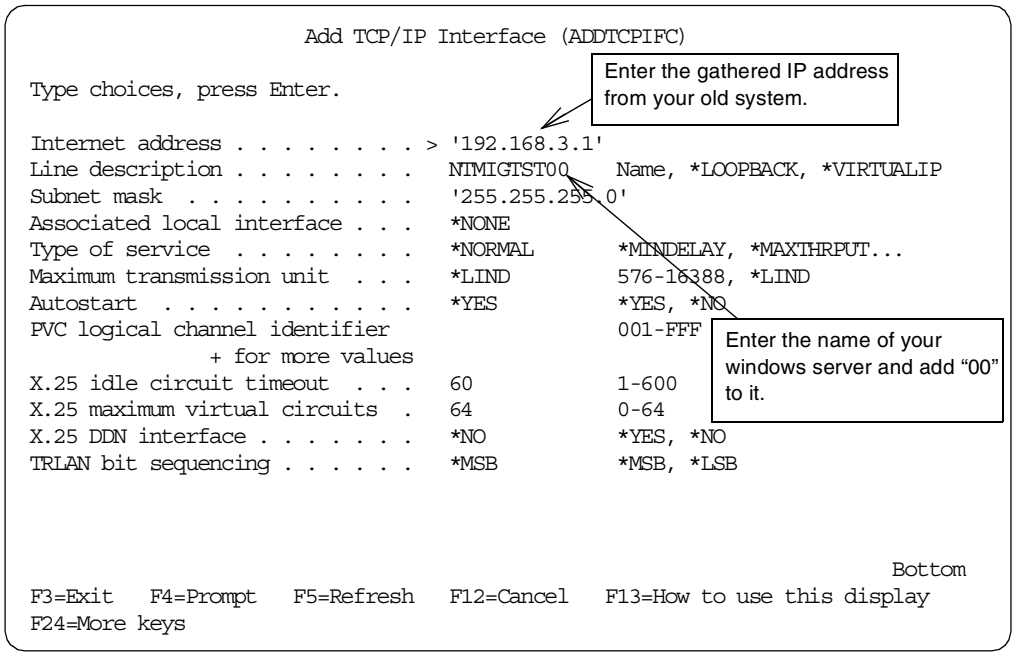

Figure 238. Configuration of Internal LAN IP address

5. Change the network server description to the new hardware resource. To find out which resource your new Integrated xSeries Server is using, enter the command:

   ```
   WRKHDWRSC *CMN
   ```

   Look for 2890 or 2790 hardware. Note the name of the resource such as 'LIN09', and use the following command on an OS/400 command line to change the network server description:

   ```
   CHGNWSD NWSD(winnt4) RSRCNAME(LINxx)
   ```

   Replace *winnt4* with the name of your network server description, and replace *LINxx* with the name of the resource you gathered before.

6. Create a guest user for AS/400 NetServer to allow the Level Check of the integration software. To do so, follow these steps:

   a. Create a user on your new OS/400 named "Guest" with any password (you can't leave it blank).

   b. Use the properties of Operations Navigator, and select **Networking-> Server-> TCP/IP-> NetServer** to tell NetServer to use the user.

   c. In the Properties window, select the **Advanced** tab, and click **Next Start** to enter the user name "Guest".

   d. Reset and restart AS/400 NetServer.

After you complete this step, everything is moved to your new system and ready configured to bring the server up.

19.4.2 Necessary changes on your Windows NT server

Now that all the tasks on the OS/400 side are completed, there are still some tasks to perform on the Windows NT installation to make your Windows NT 4.0 server run on the new hardware.

19.4.2.1 Installing the new graphics driver

Start your Windows NT 4.0 server on the new hardware using the vary on command or Operations Navigator. Because the new Integrated xSeries Server has a new graphics adapter, Windows NT will come up in VGA mode. You have to install the driver for the new graphics adapter manually now because Windows NT 4.0 does not support Plug & Play, and the necessary driver is not in the Microsoft driver library. Perform the steps as shown in Figure 239.

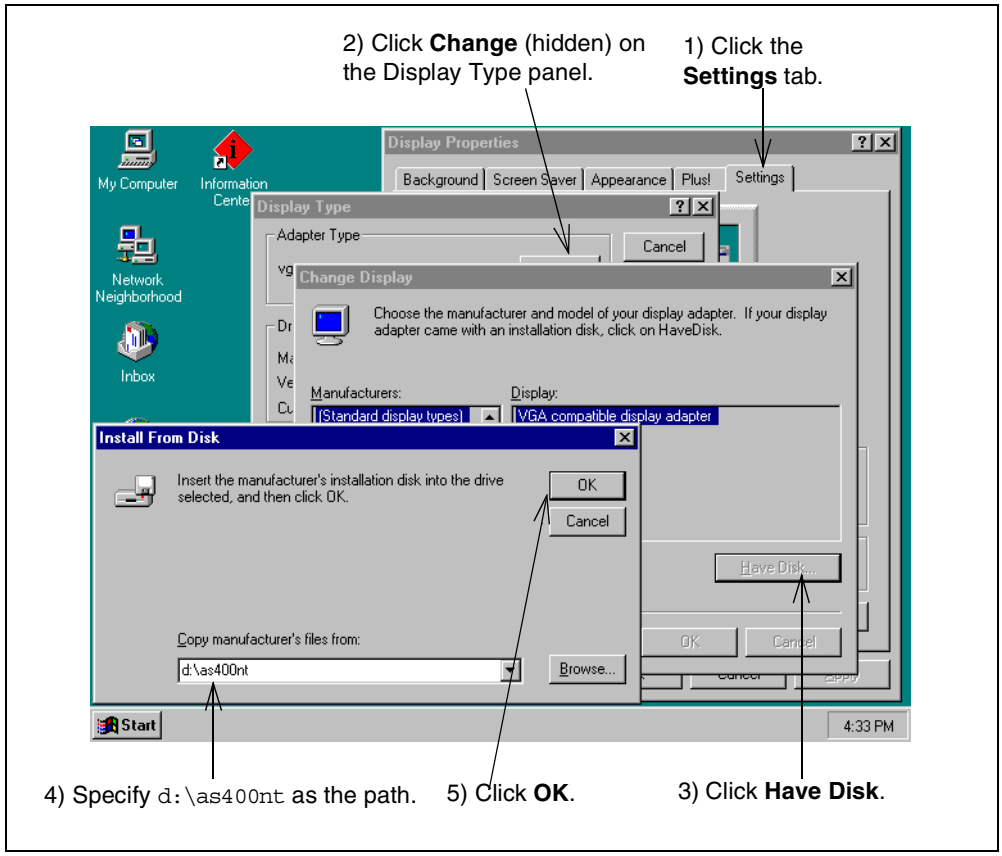

Figure 239. Installing a new graphics adapter driver for Windows NT 4.0

After you start the installation, Windows NT informs you of the installation of a driver for the Savage 4 video card. Click **OK**, and then click **Yes** to confirm the warning that you are installing a third-party driver.

Afterwards close all the open windows, and Windows NT will reboot. Then, log on. You can set the display settings to specify an appropriate resolution and number of colors.

19.4.2.2 Network configuration of Windows NT

Next, you have to reconfigure your network environment to use the new LAN adapters and perhaps not to use the external HostLan any longer. The external HostLan still works mostly on the new hardware, but it is not supported any longer, so you should not use it any more.

Follow these steps:

1. Right-click **Network Neighborhood**, and select **Properties**. If you used external HostLan before, select the **Protocols** tab, and delete all the protocols

named **OS/400 HostLan Bridge Driver**, as shown in Figure 240. Otherwise, continue with the steps that follow.

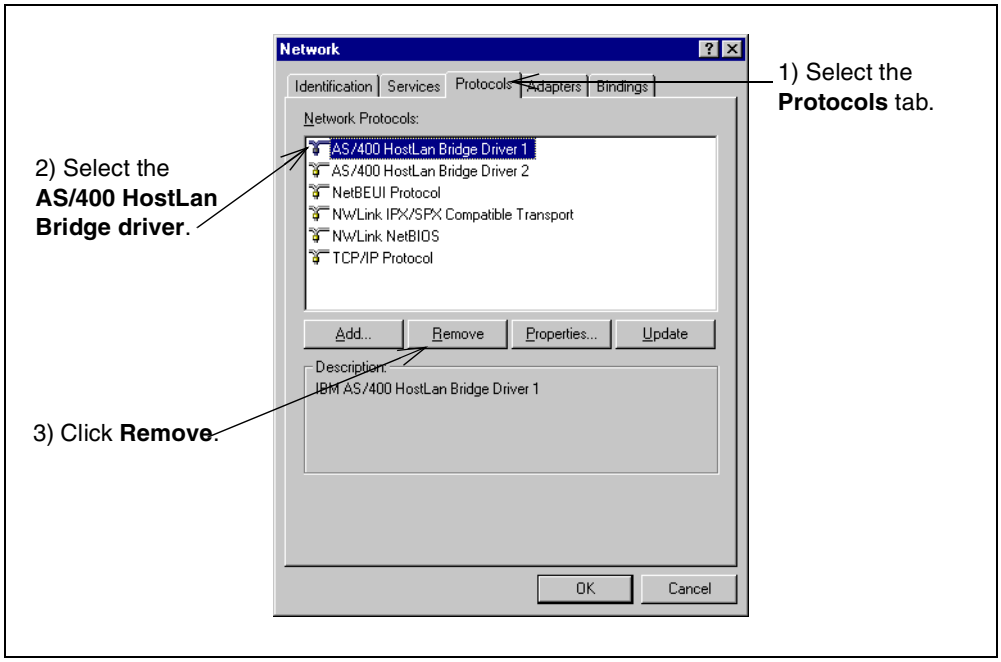

Figure 240. Removing OS/400 HostLan bridge driver

2. Remove the installed LAN adapters, and replace them with the new ones. To do so, change to the **Adapters** tab, and remove every adapter, except the AS/400 Virtual Token Ring Adapter as shown in Figure 241.

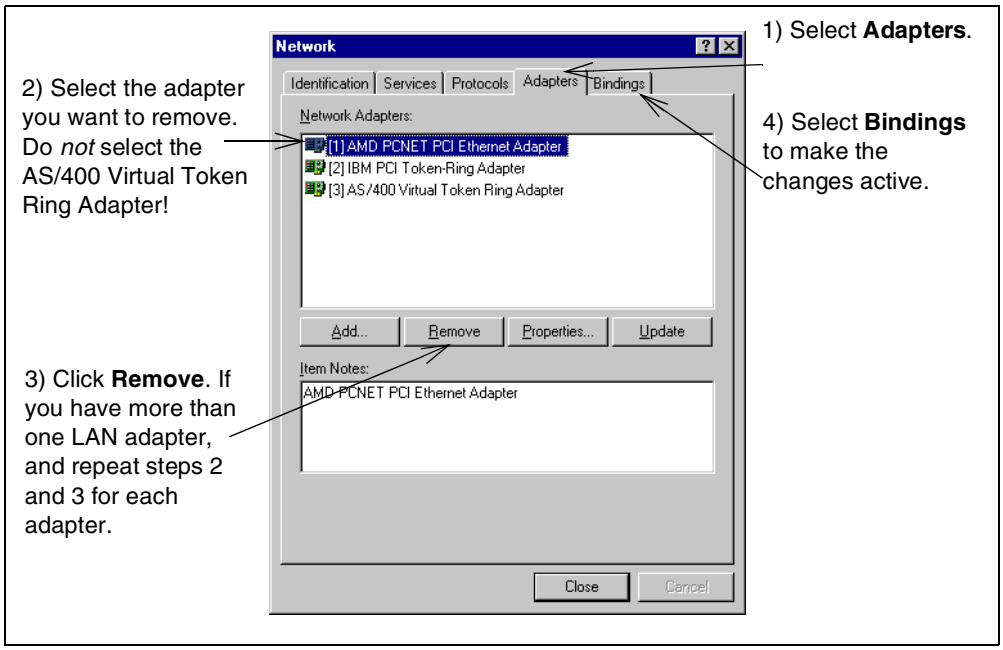

Figure 241. Removing Windows NT LAN adapters

3. To add the new LAN adapters, go back to the Adapters tab, and add them to your system. Because the necessary drivers are not included in Windows NT,

you must use the Have Disk option to install them. Figure 242 shows you how to do this.

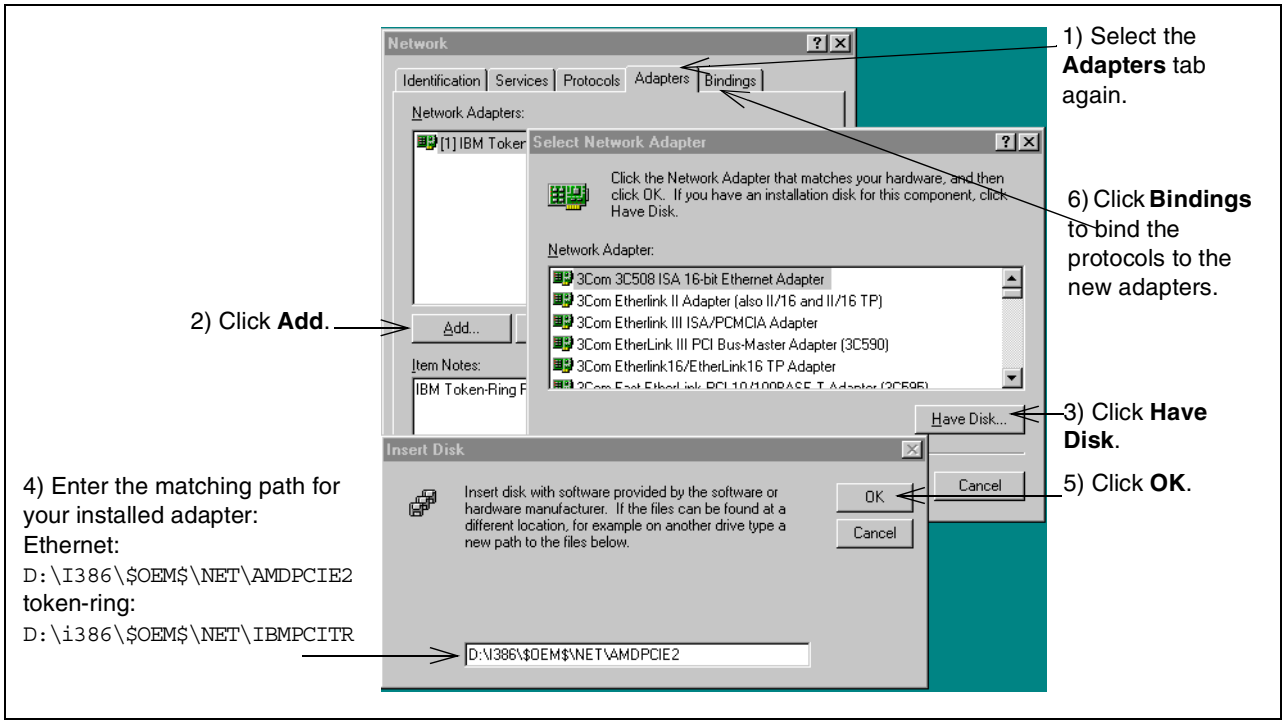

Figure 242. Adding the new LAN drivers

4. Configure the IP addresses of your new adapters.
   a. Change to the **Protocols** tab, and select **TCP/IP**.
   b. Click **Properties**, and enter the values in the appropriate fields for each LAN adapter that is installed.
   c. Complete the changes by closing the network properties. An application error will occur, but ignore it by clicking **OK**.
   d. Your changes will become active. Since you do not have the option to reboot the server, you must do this manually by selecting **Start-> Shut Down**.

After the server reboots, your Windows NT 4.0 server is completely migrated to the new hardware and can serve your users. The complete process without saving and moving the data takes about 20 minutes.

19.5 Upgrading from Windows NT 4.0 to Windows 2000 on legacy

This section covers the scenario that you want to upgrade your existing Windows NT server to a Windows 2000 server without any changes to the hardware you installed. You can run Windows 2000 on both of the older Integrated Netfinity Server (for example, 200 MHz and 333 MHz), but Windows 2000 is only supported on the 333 MHz model. We recommend that you *do not* install Windows 2000 on the 200 MHz Integrated Netfinity Server because this type of installation is not supported. If you were successful in installing it, Windows 2000 may not perform well.

Attention

Be sure to plan the new Windows 2000 Active Directory structure for your company before you migrate the Windows NT server. Necessary changes after installation could require a completely new installation!

19.5.1 Preparing for the Windows NT installation before the upgrade

Before you do anything on the upgrade procedure, make a disaster recovery backup of your existing server! This will allow you to reinstall it in case something goes wrong with the upgrade.

Important

Check the free disk space on the system drive of your installed Windows NT Server. You must have at least 1024 MB free space on the system drive to perform a successfull upgrade. If you do not have enough space, you have to perform a new installation!

If you checked the prerequisites and you can run an upgrade installation, remove the LAN adapter drivers from your existing Windows NT server. Refer to 19.4.2.2, “Network configuration of Windows NT” on page 442, to see how to remove the old LAN adapters. It is the same procedure in this case.

After you remove the LAN adapters, close the network properties and shut down your Windows NT server. If you installed an external HostLan, you have to answer a message that informs you that OS/400 will lose the network connection. Confirm this information, and the server will shut down.

19.5.2 Performing the upgrade to Windows 2000

To upgrade to Windows 2000, complete these steps:

1. Insert your Windows 2000 server CD into the iSeries CD-ROM drive.
2. Run the `INSWNTSVR` command.
3. Enter the name of the network server description that you want to upgrade. Press Enter.
4. Press F10 to see all parameters. Complete the parameters on the screen as shown in Figure 243 on page 446.

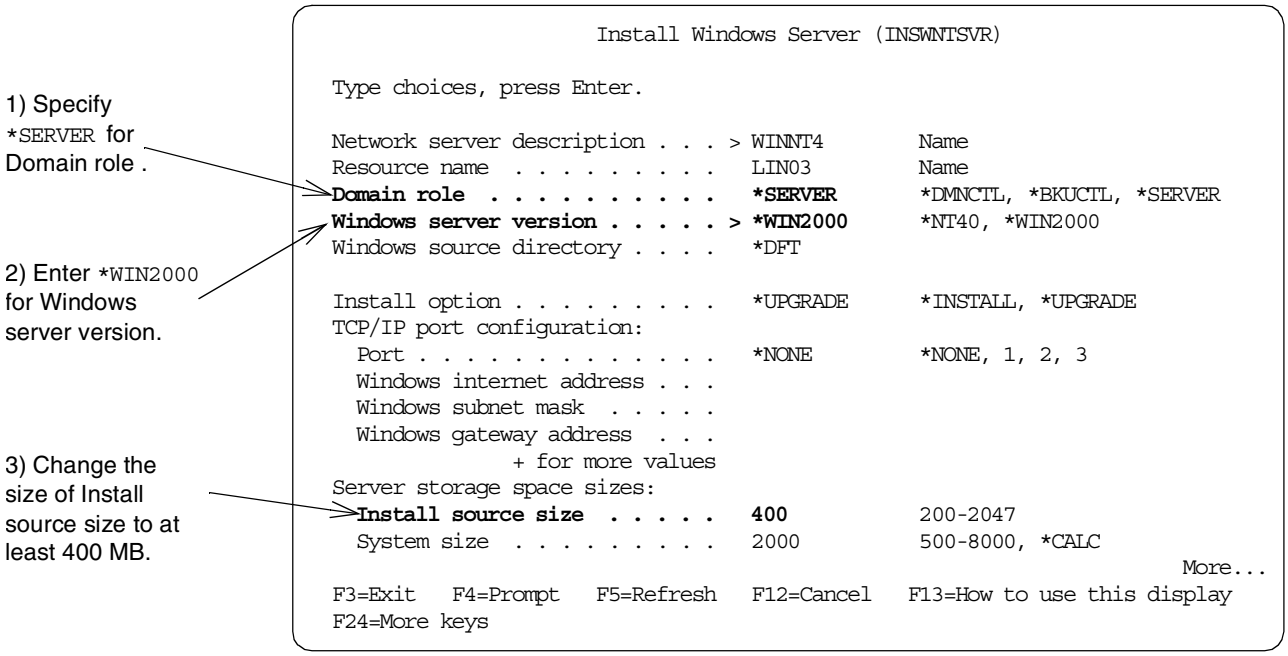

Figure 243. Install Windows Server display

5. Page down to the second screen, and change the ASP in which the drives are created. After you make all necessary changes, press Enter.
6. A message will be waiting for you in the QSYSOPR message queue. The message informs you that the installation source drive will be deleted. Normally you should not have stored any user data on the installation source drive so that you can ignore the warning.
7. Type `g` and press Enter to start the installation procedure.
8. OS/400 now creates the new installation storage space, and the I386 directory from your Windows 2000 CD is copied to the installation disk.
9. If the copying is finished, OS/400 will boot your existing Windows NT server.

   Note: This is not a typing mistake! Windows NT 4.0 is coming up.
10. Sign on to the Windows NT server as Administrator.
11. You have to start the update procedure now by calling a batch file from the OS/400 integration software as shown in Figure 244.

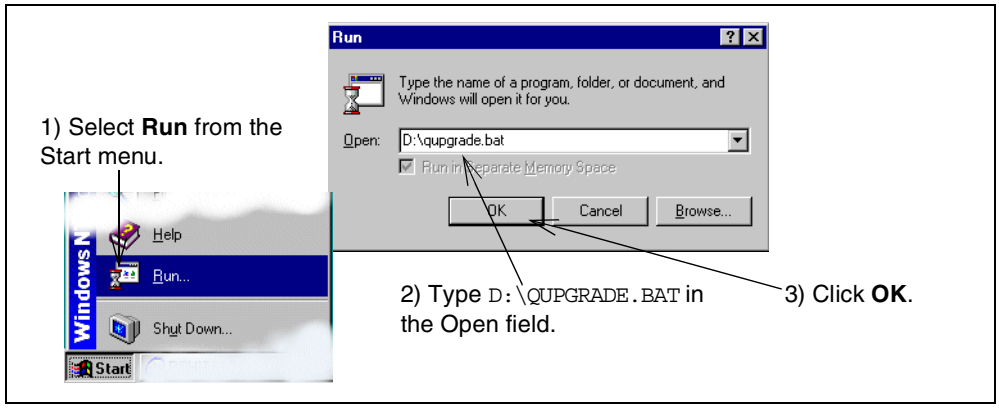

Figure 244. Running QUPGRADE.BAT to start the windows upgrade

12. The Microsoft Upgrade program will run now and copy all necessary files to your system drive.

13. After finishing the copy process, the server will reboot automatically and a new choice “Windows 2000 Setup” is added to the Windows NT Boot Manager, which starts directly.

14. The installation process continues in text mode and replaces your system files. After doing this, the server restarts again and the boot menu will only contain “Windows 2000”. The next time, the hardware detection runs, the start menu is created, and components are installed and registered. The entire process takes about 30 minutes and runs normally without any user interaction.

15. This step depends on whether your former server was a domain controller or a stand-alone server. If you did not have a domain controller installed, you can skip the next paragraph.

    If your installation was a former domain controller, Windows 2000 will bring up the Active Directory Installation wizard. This wizard starts without a need to sign on to the server. Although you can work on the server without running this wizard, you must proceed through this wizard to the end. Otherwise, you will not see a logon screen when you reboot the server. Refer to Chapter 3, “Installing the Windows 2000 server” on page 37, to see how Active Directory is installed. When you have finished the wizard, Windows 2000 must be rebooted. Confirm the request for reboot.

16. Windows 2000 starts now with the normal log on screen. Sign on as Administrator to perform the final configuration tasks. This is the configuration of the Network Adapters and Level Check to apply the new integration software.

    When you sign on the first time to the new server as Administrator, the OS/400 Windows Server Level Check program is automatically started and wants to install the updates for the integration software. Proceed through this program to obtain the newest version installed. After the installation, the server is rebooted.

17. On the AS400 Level Check display (Figure 245 on page 448), click **OK**.

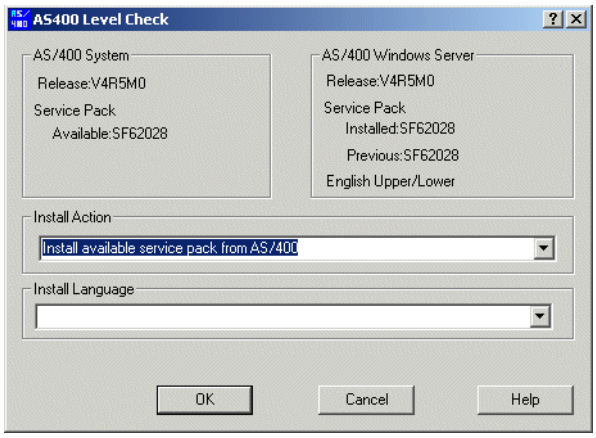

Figure 245. OS/400 Level Check program

18. After the reboot is finished, sign on again as Administrator.
19. You must configure now the network connections. See 3.5, “Completing the post-installation tasks” on page 48, to learn how to check and configure the network connections.

    External HostLan support is not migrated automatically to Windows 2000. If you need external HostLan support, you can configure it as described in 3.5, “Completing the post-installation tasks” on page 48.
20. Reboot your new Windows 2000 server again.

19.6 Upgrading from Windows NT 4.0 to Windows 2000 on new hardware

The process of upgrading Windows NT 4.0 to Windows 2000 is nearly the same as described in 19.5, “Upgrading from Windows NT 4.0 to Windows 2000 on legacy” on page 444. There are only two differences:

- On the new hardware, you should not configure the external HostLan. But, this does not affect the upgrade process, because the necessary drivers should have been removed during the movement from the old to the new hardware.
- On the new hardware, the upgrades takes significantly less time due to the faster CD-ROM drive and higher processor speed.

19.7 Upgrading Windows NT 4.0 TSE and Citrix MetaFrame

Due to the changes in the structure of Windows 2000 Server Terminal Services and Citrix MetaFrame for Windows 2000, we recommend that you perform a new installation in this scenario.

Note

You must have a version of Citrix MetaFrame for Windows 2000 to install it on a Windows 2000 server. The older version for Windows NT 4.0 TSE does not run under Windows 2000!

19.8 Tips and tricks

There are some ways you can perform the upgrade a little faster and easier. We recommend the following suggestions:

- Whenever possible, use save files and FTP for transfer to a new machine. This saves a great amount of time for backup and restore. If you are not familiar with using FTP, see 15.3.4, “Using FTP” on page 375, for guidance on how to do this.
- If you have a new machine and want to upgrade your existing Windows NT 4.0 server running on your old machine to Windows 2000 running on the new one, first move Windows NT 4.0 to your new hardware as explained in 19.4, “Moving the Windows NT 4.0 server to the new Integrated xSeries Server hardware” on page 438. Then, run the upgrade to Windows 2000. The advantages are that you keep your existing Windows NT 4.0 installation as the running server during the upgrade and test phase. Also, the upgrade runs faster by far on the new hardware.
- Whenever you change the operating system, delete the LAN adapters configured on your existing system before you do the upgrade. This avoids trouble with migrated drivers.

19.9 Common problems

There are a few problems that we determined while testing the migrations:

- If you perform an upgrade from Windows NT 4.0 to Windows 2000 on legacy hardware and you do not remove the old LAN drivers, the upgrade will be successful, and your network connections will work as they were configured on your existing server. The problem is that Windows 2000 uses the old Windows NT drivers to control the network adapters. This works fine until you want to use external HostLan because you will not have a possibility to change the adapter address. This is only possible with the new Windows 2000 drivers. If you see this problem, you can use the Update driver function in the network connections properties of Windows 2000. The new drivers are stored in subdirectories of C:\AS400NT.
- If your internal LAN connection does not work or you cannot start the Windows server on a new machine, all line descriptions and device objects for the internal LAN may not have been restored. Refer to the comments regarding saving and restoring a server installation in the beginning of this chapter.

Appendix A. Windows 2000 server supported language versions

This appendix contains a list of the Windows 2000 language versions that are supported on the language version (LNGVER) parameter of the INSWNTSVR command.

Table 59. Supported Windows 2000 language versions

LNGVER	National language
*PRIMARY	Uses the language version of the primary language that is installed on the iSeries
2911	Slovenian
2922	Portugese
2923	Dutch
2924	English upper/lowercase
2925	Finnish
2926	Danish
2928	French
2929	German
2931	Spanish
2932	Italian
2933	Norwegian
2937	Swedish
2938	English uppercase DBCS
2939	German MNCS
2940	French MNCS
2942	Italian MNCS
2950	English uppercase
2962	Japanese DBCS
2963	Dutch MNCS
2966	Belgian French
2975	Czech
2976	Hungarian
2978	Polish
2980	Portugese
2981	Canadian French MNCS
2984	English upper/lowercase DBCS
2986	Korean DBCS

LNGVER	National language
2987	Chinese, Traditional
2989	Chinese, Simplified
2994	Slovakian
2996	Polish MNCS

Appendix B. Universal Serial Bus (USB) devices

The new 700 MHz Integrated xSeries Server has two USB ports available. It should be possible to attach any USB device that supports the Windows 2000 server. Since USB is still new, you can expect more devices to become available for it.

Note

This section gives you an overview about the devices that we successfully connected to the USB ports of the Integrated xSeries Server. The devices may or may not work in your environment or configuration. We cannot guarantee that the devices mentioned here will work without a problem on your Integrated xSeries Server. Therefore, we are not providing detailed installation steps.

B.1 Serial and parallel ports

Limited testing was done on an Edgeport/21 from Inside Out Networks at: `http://www.ionetworks.com`

It features two serial ports and one parallel port.

Windows 2000 immediately detects the new hardware. However, you must give Windows 2000 the path of the driver software. You should obtain the latest version of the driver software from the Inside Out Networks' Web site and store it on one of your server drives. The device works properly without any reboot.

B.2 ZIP drive

We attached an IOMEGA ZIP250 USB (`http://www.iomega.com`) to an Integrated xSeries Server USB port. The ZIP drive offers you the ability to copy files to a ZIP disk, which can hold from 100 MB to 250 MB of data. It is also possible to format a ZIP disk with NTFS and enable compression. This allows you to store even more data on the ZIP disk.

You may want to use a ZIP drive for saving and restoring files to distribute data to a remote location or for Terminal Services users connected with a diskless client, such as an IBM Network Station, to take work home.

To install the ZIP drive, we followed these steps:

1. Install the drivers.
2. Vary off the Integrated xSeries Server.
3. Connect the ZIP drive.
4. Vary on the Integrated xSeries Server.

After booting up, the IomegaWare software shows a display like the example in Figure 246 on page 454.

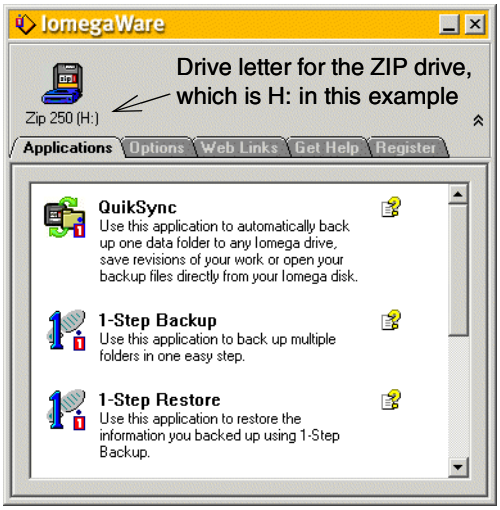

Figure 246. IomegaWare

Open **My Computer** to see all the available drives, including the ZIP drive as shown in Figure 247.

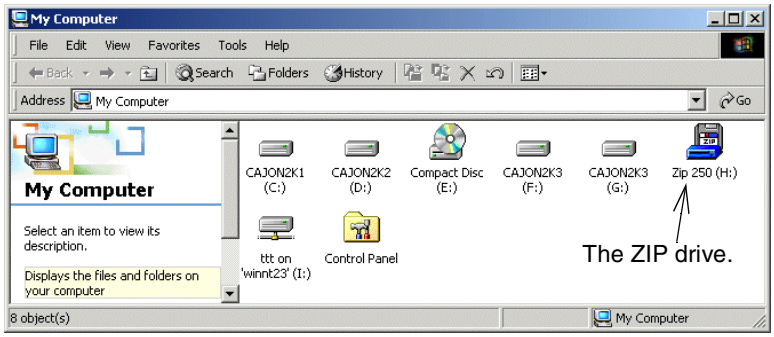

Figure 247. Installed ZIP drive

If you want to remove the ZIP drive, use the Unplug or Eject wizard. If a device that supports unplug or eject is installed, an icon appears in the taskbar. Figure 248 shows an example.

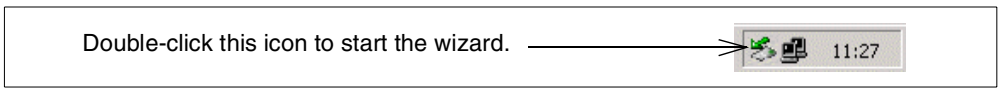

Figure 248. Unplug or Eject wizard

The Unplug and Eject wizard shows you the supported devices. You can now stop the ZIP drive and remove the cables to use the ZIP drive on another PC. See Figure 249 for an example.

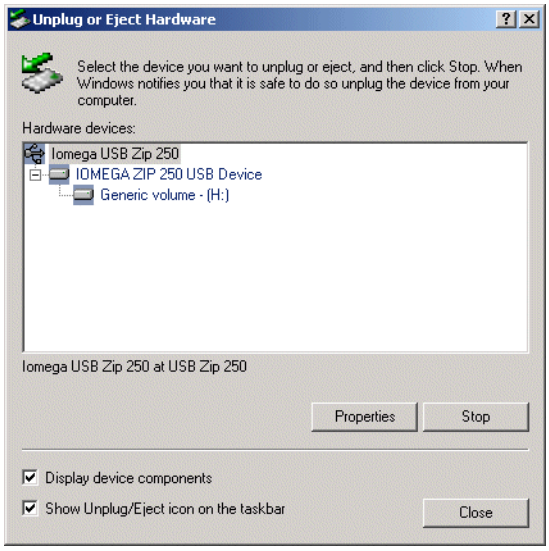

Figure 249. Unplug and Eject wizard stopping device

B.3 Digital camera

Throughout this redbook, we used a Kodak DC265 Digital Camera to take pictures of the images that appear on these pages. We then used Windows 2000 on the Integrated xSeries Server to move them onto our workstations.

Note

At the time this redbook was written, there was no official support from Kodak for this device to work with Windows 2000 and USB. Windows 2000 has built-in Twain drivers, that supported downloading the pictures from the digital camera using USB.

Figure 250 on page 456 shows you the selection panel, which allows you to select the pictures you want to download to Windows 2000 running on the Integrated xSeries Server.

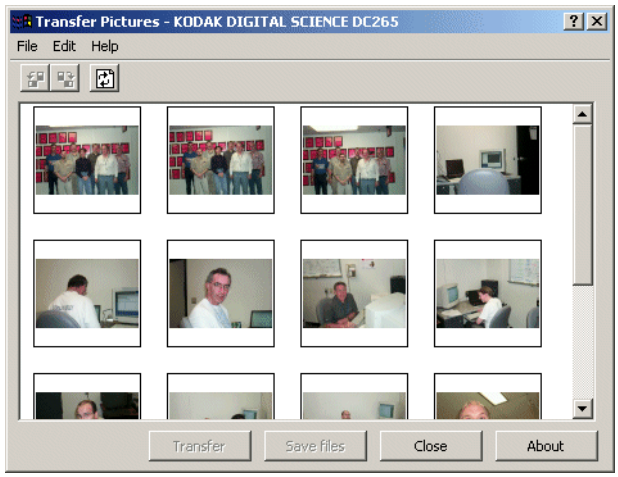

Figure 250. Digital camera USB

B.4 IBM PC camera

We used an IBM PC camera and Microsoft NetMeeting on the Integrated xSeries Server to run a meeting. An Administrator could help a user to solve a problem, by showing and explaining the tasks. We used an older model of the IBM PC camera, so the resolution is not perfect, but it was enough to achieve good results.

We installed the software, powered off the server, installed the hardware, and started the server. Then we configured Microsoft NetMeeting.

Our meeting administrator listens to the problem as shown in Figure 251.

Figure 251. IBM PC camera

Now the administrator explains how to solve the problem as shown in Figure 252.

Figure 252. IBM PC camera

We wanted to test an audio USB device, but were unable to for this test.

Appendix C. Installation files

The Install Windows Server (INSWNTSVR) command creates files on the C: and D: drives that are used for the unattended installation. We copied our versions of these files here for you to understand the installation a little better.

Note: Do *not* modify these files!

C.1 CONFIG.SYS

The following information is in the CONFIG.SYS file, which is located on the C: drive. It is very basic.

```
FILES 50
DOS=HIGH,UMB
DEVICE=C:\DOS\HIMEM.SYS
```

C.2 AUTOEXEC.BAT

The AUTOEXEC.BAT is located on the C: drive of the server and is used during the boot of the DOS boot image:

```
@ECHO OFF
PATH=C:\DOS;C:\;D:\I386
SMARTDRV /X


IF NOT EXIST D:\INSWNTSV.TAG GOTO END
ECHO  IBM AS/400 Integration for Windows Server (5769WSV)
DEL D:\INSWNTSV.TAG
D:
IF EXIST D:\AS400NT\AS400CPY.BAT CALL D:\AS400NT\AS400CPY.BAT -WIN2000
CD \I386
D:\I386\WINNT /B /T:C: /S:D:\I386 /U:D:\UNATTEND.TXT
:END
```

The statement in the fourth line checks for the existence of the INSWNTSV.TAG file on the D: drive. If the file exists, it is erased and an unattended installation of Windows NT server is started (lines 6 and 7).

If the INSWNTSV.TAG file does not exist, the system is not in an installation phase and DOS starts normally.

C.3 UNATTEND.TXT

The D: drive contains information for the unattended installation of the Windows 2000 server. We highlighted the parameters that correlate with the parameters that were entered in the INSWNTSVR command. Because we cannot show you valid IBM internal IP addresses, we overwrote them by using *x.xx.xx.xxx*.

```
; IBM AS/400 Integration for Windows Server
[Unattended]
;
UnattendMode = DefaultHide
OemPreinstall = Yes
FileSystem = ConvertNTFS
;
NtUpgrade = No
;
OverwriteOemFilesOnUpgrade = No
OemPnPDriversPath =
"\AS400NT;\AS400NT\INTLAN;\AS400NT\EXTLAN1;\AS400NT\AMDPCIET;\AS400NT\IBMPCITR"
```

```
DriverSigningPolicy = ignore
;

[GuiUnattended]
OemSkipWelcome = 1
OEMSkipRegional = 1
;
;
TimeZone = " "

[UserData]
;
FullName = "jane doe"
OrgName = "fictitious"
ComputerName = "AS4WIN2K"

[LicenseFilePrintData]
AutoMode = PERSEAT
;

;
[MassStorageDrivers]
"IBM AS/400 Virtual SCSI Disk Support" = "OEM"
"IBM AS/400 Virtual CDROM Support" = "OEM"
"IBM AS/400 Virtual Tape Support" = "OEM"
"IBM AS/400 Data Transport Support (2850)" = "OEM"

[OEMBootFiles]
TXTSETUP.OEM
QVNDVSDD.SYS
QVNDVSCD.SYS
QVNDVSTP.SYS
QVNDT400.SYS

[Identification]
;
JoinDomain = w2kdom

[Networking]
InstallDefaultComponents = Yes

[NetAdapters]
Adapter01 = params.Adapter01
Adapter02 = params.Adapter02
;
Adapter16 = params.Adapter16

[params.Adapter01]
InfID = "PCI\VEN_1014&DEV_003E"
PciBusNumber = 00
PciDeviceNumber = 13
PciFunctionNumber = 0


[params.Adapter02]
InfID = "PCI\VEN_1014&DEV_003E"
PciBusNumber = 00
PciDeviceNumber = 12
PciFunctionNumber = 0


;
[params.Adapter16]
ConnectionName = "Internal LAN"
InfID = "AS400_MP"

[NetClients]
MS_MSCLIENT = params.MS_MSCLIENT

[params.MS_MSCLIENT]

[NetProtocols]
MS_TCPIP = params.MS_TCPIP
;

[params.MS_TCPIP]
DHCP = No
UseDomainNameDevolution = No
```

```
EnableLMHosts = Yes
AdapterSections = params.MS_TCPIP.Adapter16
DNSSuffixSearchOrder = ITSOROCH.IBM.COM

[params.MS_TCPIP.Adapter01]
SpecificTo = Adapter01
NetBIOSOptions = 1
DHCP = No
;
;
;
DNSServerSearchOrder = x.x.xx.xx, x.x.xx.xx, x.x.xx.xx
DNSDomain = DOMAIN.COM

[params.MS_TCPIP.Adapter02]
SpecificTo = Adapter02
NetBIOSOptions = 1
DHCP = No
;
;
;
DNSServerSearchOrder = x.x.xx.xx, x.x.xx.xx, x.x.xx.xx
DNSDomain = DOMAIN.COM

;
[params.MS_TCPIP.Adapter16]
SpecificTo = Adapter16
NetBIOSOptions = 1
DHCP = No
IPAddress = 192.168.x.x
SubnetMask = 255.255.255.000

;
[NetServices]
MS_SERVER = params.MS_SERVER

[params.MS_SERVER]

[Components]
;
;

;
```

You can find a document with detailed information about all parameters on the Microsoft home page at: `http://www.microsoft.com/windows2000`

C.4 HOSTS file

Do not update the HOSTS file on the Windows 2000 server on an Integrated xSeries Server. This file is overwritten with information from the iSeries server each time the NWSD is varied on. Instead, update the desired information on the iSeries using the CFGTCP command, option 10.

C.5 BOOT.INI

The BOOT.INI file is located on the C: drive. It is generated during the Windows NT server installation and controls the Windows NT boot loader menu. There should be no reason to modify it.

```
[boot loader]
timeout=30
default=multi(0)disk(0)rdisk(0)partition(1)\WINNT
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Microsoft Windows 2000 Server"
/fastdetect
C:\="PC-DOS"
```

Appendix D. Release enhancements

This appendix highlights some of the major enhancements to the environment of running the Windows server on your iSeries server. The enhancements are separated by release and, to some degree, by name. In Version 4 Release 3, we installed Windows NT to the Integrated PC Server (IPCS), in Version 4 Release 4 we install Windows NT on the Integrated xSeries Server. OS/400 Version 4 Release 5 adds support for the Windows 2000 server.

D.1 Version 4 Release 3 enhancements

The following enhancements were made at Version 4 Release 3:

- Easier installation

  Added parameters on Install Windows NT Server (INSWNTSVR) command:

  – Windows NT Version (WNTVER)

  – Server storage space sizes (SVRSTGSIZE)

    Allows you to specify sizes for Install source drive size and System drive size. This support was sent by PTF back to Version 4 Release 2 with PTF SF51636 and to Version 4 Release 3 with PTF SF52201.

  – Restricted Device resources (RSTDDEVRSC)

  – OS/400 internet address

- Submit NT commands from OS/400 system (SBMNWSCMD)
- Mirroring NT Event Log to OS/400 message queue/job log
- Share CD-ROM drive if device is varied on
- Vary off inquiry message if OS/400 is using NT as LAN Adapter
- Storage spaces as drive sequence numbers

D.2 Version 4 Release 4 enhancements

The following enhancements were made at Version 4 Release 4:

- Updated the name to Integrated xSeries Server.
- Upgraded the processor to 333 MHz.
- Increased the maximum memory to 1 GB for Windows NT support.
- Increased the upper limit on the size of the system drive to 8 GB.
- Customized the installation.
- Added a new parameter to the INSWNTSVR command to override the default internal LAN TCP/IP address.
- Added a new parameter to the Vary Configuration (VRYCFG) command to give control of starting the External LAN.
- Installable from the integrated file system (IFS) directory.
- Added user auxiliary storage pool (ASP) support for network server storage spaces.

D.3 Version 4 Release 5 enhancements

Changes for OS/400 Version 4 Release 5 include:

- New Pentium III 700 MHz Integrated xSeries Server.
- Up to 4 GB main storage on the Integrated xSeries Server.
- Instead of serial and parallel ports, the new 700 MHz Integrated xSeries Server provides two Universal Serial Bus (USB) ports.
- All drives are user storage spaces (when new installed).
- Supports the Windows 2000 server.
- OS/400 integration for the Windows server is now a no charge licensed program, 5769-WSV instead of OS/400 option 29.
- The default installation drive for newly created Windows servers is the C: drive, instead of the E: drive.
- Redesigned the drivers to support the standard Microsoft provided HAL.
- Storage spaces can now be up to 64000 MB, with total network server storage up to 884.8 GB.
- File-level backup and restore using the QNTC file system.
- Operations Navigator plug-in to enable the administrator to start, stop, and access the status and properties of an Integrated xSeries Server.

Appendix E. Integrated xSeries and Netfinity Server support

Table 60 shows the integration functions supported by the Integrated xSeries Server- and Integrated Netfinity Server-based products (excluding IBM Firewall for AS/400).

Table 60. Supported integration functions

Integrated Netfinity Server-based applications	Windows 2000 Server	Windows NT Server 4.0	Warp Server for AS/400	Novell NetWare 4.1/4.11	Enhanced Integration for Novell NetWare [1]	Lotus Notes 4.1/4.5
User profile propagation	Yes	Yes	Yes	No	Yes	No
User profile enrollment	Yes	Yes	No	No	No	Yes
User profile authentication	No	No	No	No	Yes	No
Password sync (OS/400 server to Integrated PC Server)	Yes	Yes	Yes	No	Yes	Yes
iSeries disk management	Yes	Yes	Yes	Yes	N/A[2]	Yes
NWSSTG space backup [3]	Yes	Yes	Yes	Yes	N/A[2]	Yes
IFS file-level backup/restore [5]	Yes	Yes	Yes	No	Yes	Yes
IFS file system support and APIs [4]	Yes	Yes	Yes	No	Yes	No
iSeries tape support	Yes	Yes	No	Yes	N/A[2]	No
Tivoli Storage Manager support	Yes	Yes	Yes	Yes	N/A[2]	Yes
CD-ROM sharing	Yes	Yes	No	No	No	No

1. Enhanced Integration for Novell NetWare does not require an Integrated Netfinity Server for its operation. However, it is included here because it is often used with, and is complementary to, NetWare on the Integrated Netfinity Server.
2. This function does not apply to Enhanced Integration for Novell NetWare. It is part of the base NetWare integration.
3. Network server storage space is abbreviated to NWSSTG space.
4. Integrated file system APIs are C language APIs that enable AS/400 applications to access files stored in IFS directories.
5. AS/400 file-level backup using the IFS SAV and RST commands is only supported with Version 4 Release 5.

E.1 Integrated Netfinity Server hardware specifications

The new 700 MHz Integrated Netfinity Server is the latest in a line of Intel-based adapters that have been available on the iSeries since 1994.

Table 61 compares the characteristics of the different Integrated Netfinity Server models (previously known as Integrated PC Server and File Server Input/Output Processor) in terms of their hardware specifications.

Table 61. Integrated Netfinity Server hardware specifications

Integrated Netfinity Server type	486 DX2-66 (SPD)	Pentium 133 MHz (PCI)	Pentium 166 MHz (SPD)	Pentium Pro/ Pentium II 200/333 MHz (PCI)	Pentium Pro/ Pentium II 200/333 MHz (SPD)	Pentium III 700 MHz (PCI)
Minimum memory (MB)	16	32	32	64	64	128
Maximum memory (MB)	64	128	256	1024 [4]	1024 [4]	4096
CISC support	Yes	No	Yes	No	No	No
RISC support	SPD models	PCI models[6]	SPD models	PCI models[6]	SPD models	270/8xx
Token-ring 4/16 Mbps	Yes [5]	Yes	Yes	Yes	Yes	No
Token-ring 4/16/100 Mbps	No	No	No	No	No	Yes
Ethernet 10 Mbps	Yes [5]	Yes	Yes	Yes	Yes	No
Ethernet 10/100 Mbps	No	No	No	Yes [1]	Yes [1]	Yes
Maximum LAN adapters	2	2	2	2	3 [2]	3 [7]
AS/400 slots required	2	4 [3]	2	4 [3]	3	Up to 5 [3,7]
Serial ports	0	0	0	1	2	0
Parallel ports	0	0	0	1	1	0
USB ports	0	0	0	0	0	2

1. Only one 100 Mbps Ethernet adapter can be configured for this model of the Integrated Netfinity Server.
2. The third LAN adapter cannot be used by the iSeries. It can only be used by the Windows NT server.
3. In the PCI versions of the Integrated Netfinity Server, two slots are taken up by the processor and bridge cards. There are an additional two or three slots that can be filled with LAN adapters, depending on the model and configuration.
4. The maximum amount of memory supported with Lotus Notes/Domino, Novell NetWare, OS/2 Warp Server for AS/400, and AS/400 Firewall is 512 MB. The maximum amount of memory supported on the 200 MHz Pentium Pro is 512, where the 333 MHz Pentium II will support 1 GB.
5. The 486 DX2-66 Integrated Netfinity Servers support both token-ring and Ethernet. You do not need to order token-ring or Ethernet options specifically. For example, a 486 DX2-66 Integrated Netfinity Server with one “port” can support either one token-ring or one Ethernet LAN connection through one of the three physical connectors on the Integrated Netfinity Server.
6. Does not include iSeries Modes 270 and 8xx.
7. There is a maximum of two LAN adapters on the Model 270 and three LAN adapters on the Model 8xx. However, some 8xx configurations may only support two LAN adapters per Integrated Netfinity Server.

E.2 Products supported on the Integrated Netfinity Server

On the new Integrated Netfinity Server with Pentium III 700 MHz microprocessor, the only product that is supported is the Windows 2000 server. The following products are no longer supported on the Integrated xSeries Server at Version 4 Release 5:

- LAN Server/400
- OS/2 Warp Server for AS/400
- Novell NetWare
- Lotus Domino

Table 62 shows which products are supported on the various models of the Integrated Netfinity Server.

Table 62. Products supported on the Integrated Netfinity Server

Integrated Netfinity Server type	486 DX2-66	Pentium 133 MHz (PCI)	Pentium 166 MHz (SPD)	Pentium Pro II 200 and 333 MHz (PCI)	Pentium Pro II 200 and 333 MHz (SPD)	Pentium III 700 MHz (PCI)
LAN Server/400	Yes	No	No	No	No	No
OS/2 Warp Server for AS/400	Yes	Yes	Yes	Yes	Yes	No
Novell NetWare 4.1	Yes	Yes	Yes	Yes	Yes	No
Novell NetWare 4.11	Yes	Yes	Yes	Yes	Yes	No
Lotus Notes 4.0/4.1	Yes	Yes	Yes	Yes	Yes	No
Lotus Domino 4.5/4.51	Yes	Yes	Yes	Yes	Yes	No
AS/400 Firewall	Yes	Yes	Yes	Yes	Yes	No
Windows NT Server 4.0	No	No	No	Yes	Yes	Yes
Windows 2000 Server	No	No	No	No	No	Yes

E.3 OS/400 releases for Integrated Netfinity Server products

Table 63 shows which products are supported on the various OS/400 releases.

Table 63. Integrated Netfinity Server software support by OS/400 release

OS/400 release	V3R2	V3R6	V3R7	V4R1	V4R2	V4R3	V4R4	V4R5
Lan Server/400	Yes	Yes	Yes	No	No	No	No	No
OS/2 Warp Server for AS/400	No	No	No	Yes	Yes	Yes	Yes	No
Novell NetWare 4.1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Novell NetWare 4.11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Lotus Notes 4.0/4.1	Yes	No	Yes	Yes	Yes	Yes	No	No
Lotus Domino 4.5/4.51	Yes	No	Yes	Yes	Yes	Yes	No	No
AS/400 Firewall	No	No	No	Yes	Yes	Yes	Yes	Yes[1]
Windows NT Server 4.0	No	No	No	No	Yes	Yes	Yes	Yes

OS/400 release	V3R2	V3R6	V3R7	V4R1	V4R2	V4R3	V4R4	V4R5
Windows 2000 server	No	No	No	No	No	No	No	Yes

1. Firewall for AS/400 (5769-FW1) is supported at Version 4 Release 5, but not on the new 700 MHz integrated xSeries.

Appendix F. Special notices

This publication is intended to help IBM customers, Business Partners, service providers, and IBM personnel who need an in-depth understanding of how to implement Windows 2000 running on the Integrated xSeries Server for iSeries. The information in this publication is not intended as the specification of any programming interfaces. See the PUBLICATIONS section of the IBM Programming Announcement for more information about what publications are considered to be product documentation.

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Appendix G. Related publications

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

G.1 IBM Redbooks

For information on ordering these publications, see “How to get IBM Redbooks” on page 477.

- *iSeries and AS/400e System Builder*, SG24-2155
- *IBM AS/400 Printing V*, SG24-2160
- *AS/400 - Implementing Windows NT on the Integrated Netfinity Server,* SG24-2164
- *Inside AS/400 Client Access for Windows 95/NT Version 3 Release 1 Modification 2*, SG24-4748
- *Tivoli Storage Management Concepts*, SG24-4877
- *AS/400 Client Access Express for Windows: Implementing V4R4M0*, SG24-5191
- *The AS/400 NetServer Advantage,* SG24-5196
- *Integration Examples for Tivoli IT Director: A First Look*, SG24-5207
- *Managing Applications with Tivoli IT Director*, SG24-5282
- *Tivoli IT Director Automation*, SG24-5295
- *Slicing the AS/400 with Logical Partitioning: A How to Guide,* SG24-5439
- *A Practical Guide to Implementing TSM on AS/400*, SG24-5472
- *Managing AS/400 V4R4 with Operations Navigator*, SG24-5646
- *IBM Network Station Manager V2R1*, SG24-5844
- *Implementing Windows 2000 Terminal Services and Citrix MetaFrame on IBM Netfinity Servers*, REDP0030 (Redpaper)

The following publications are available in soft copy only on the Web at:
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- *AS/400 Consolidation/Strategies*, SG24-5186
- *Software Distribution with Tivoli IT Director*, SG24-5493

G.2 IBM Redbooks collections

Redbooks are also available on the following CD-ROMs. Click the CD-ROMs button at `ibm.com/redbooks` for information about all the CD-ROMs offered, updates and formats.

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IBM Transaction Processing and Data Management Redbooks Collection	SK2T-8038
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IBM RS/6000 Redbooks Collection	SK2T-8043
IBM Application Development Redbooks Collection	SK2T-8037
IBM Enterprise Storage and Systems Management Solutions	SK3T-3694

G.3 Other resources

These publications are also relevant as further information sources:

- *OS/400 Client Access for Windows 95/NT API and Technical Reference*, SC41-3513
- *OS/400 Integrated File System Introduction*, SC41-3711
- *National Language Support*, SC41-5101
- *OS/400 Backup and Recovery*, SC41-5304
- *TCP/IP Configuration and Reference*, SC41-5420
- *OS/400 Printer Device Programming V4R3,* SC41-5713

The following publications are available in soft copy only by using the search utility on this site: `http://publib.boulder.ibm.com:80/cgi-bin/bookmgr/LIBRARY`

- *OS/400 Security Reference*, SC41-5302
- *CL Reference*, SC41-5722

This redbook also referred to the following APARs, which you can locate on the Web at:

- Informational APAR II11119
- Informational APAR II11373 *Terminal Server and Client Access Support*
- Informational APAR II11435

G.4 Referenced Web sites

These Web sites are also relevant as further information sources:

- IBM Windows Integration site: `http://www.as400.ibm.com/windowsintegration`
- *IBM Network Station Manager Installation and Use* publication: `http://www.ibm.com/nc/pubs`
- IBM Printing Systems Company Web site: `http://www.printers.ibm.com`
- IBM AS/400 Support Line Knowledge Base: `http://as400service.rochester.ibm.com/supporthome.nsf/Document/10000051`
- IBM Server Consolidation solutions site: `http://www.as400.ibm.com/scon`
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- AS/400 Integration for Windows Server Service Packs: `http://www.as400.ibm.com/windowsintegration/ntsp.htm`
- AS/400 Integration for Windows Server Microsoft Service Packs: `http://www.as400.ibm.com/windowsintegration/ntmssp.htm`

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- Microsoft Web page for Windows NT Server Terminal Server Edition: http://www.microsoft.com/ntserver/terminalserver/default.asp
- Microsoft Office Resource Kit Toolbox site: http://www.microsoft.com/office/ork/2000/appndx/toolbox.htm
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- Windows 2000 Terminal Services Capacity and Scaling: http://www.microsoft.com/windows2000/library/technologies/terminal/tscaling.asp
- System requirements for other DBCS versions of the Windows server:
  - The Japanese version: http://www.microsoft.com/japan/windows2000/guide/server/sysreq/default.asp
  - The Korean version: http://www.microsoft.com/korea/windows2000/guide/server/sysreq/default.asp
  - The Chinese version: http://www.microsoft.com/china/windows2000/guide/datasheet/server.htm
- Tivoli Storage Manager information on the Tivoli Web site at: http://www.tivoli.com/products/index/storage_mgr
- Home page for Citrix Systems, suppliers of Citrix MetaFrame: http://www.citrix.com
- Home page for Network Computing Devices, suppliers of WinFrame for MetaFrame: http://www.ncd.com
- Remote Print Manager (RPM) from Brooks Internet Software: http://www.brooksnet.com/rpm.html
- Werx4Printers from Spinifex Computing Pty Ltd: http://www.spinifex.com.au
- Inside Out Networks home page: http://www.ionetworks.com
- Iomega home page: http://www.iomega.com

- PowerQuest home page where you can search for information on Server Magic 2.0: `http://www.powerquest.com/product/index.html`
- The Mensk home page offers links to more information about BXTOOLS: `http://www.mensk.com`
- Network Instruments NIPrint information: `http://www.netinst.com/html/niprint.html`

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This section explains how both customers and IBM employees can find out about IBM Redbooks, redpieces, and CD-ROMs. A form for ordering books and CD-ROMs by fax or e-mail is also provided.

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