JavaOS™ for Business™

JavaOS™ for Business™ Version 2.0

Planning and Installation

JavaOS™ for Business™ Version 2.0

Planning and Installation

Contents

Figures

About this book

This information describes the planning and installation steps for the JavaOS™ for Business™ operating system, including system bootup and user and network computer management.

Who should read this book

The information in this book is for people who will:

- Plan for and deploy networks of network computers
- Install JavaOS for Business on a Microsoft Windows NT Server 4.0
- Perform an initial test of a new version of JavaOS for Business before deploying it in their enterprise

This book is not for the users of the applications that are running on the network computers.

Conventions and terminology used in this book

This information uses the following typographical conventions:

italics Used to specify a variable. Substitute your variable for the word in italics. For example, the *user_ID* can be up to 24 bytes long.

bold Used to specify a command. For example, type **rdisk** to start a system dump.

`monocase` Used to show system output. For example, the error message `Add paper to the printer` is displayed.

Required and related information

This document describes the planning, installation, and operation of the JavaOS for Business operating system. The reader should be familiar with the following topics and concepts:

- Network administration
- operating systems
- Microsoft Windows NT Server 4.0 network and user administration concepts and tools
- Java Developer's Kit (JDK)
- Network communication methods
- Graphical user interfaces (GUIs)

Before using this information, you should be familiar with the content of the JavaOS for Business library:

Title **Audience and content**

JavaOS for Business Planning and Installation
People who require planning and installation steps for the JavaOS for Business operating system, including system bootup and user and network computer management.

JavaOS for Business Network Operations
System and network administrators who need to plan for, configure, and manage the JavaOS for Business system on a day-to-day basis.

JavaOS for Business Keyboard Reference
Administrators deploying JavaOS for Business in countries using different character sets and different keyboard layouts.

JavaOS for Business Device Driver Guide
: Programmers wishing to add a new device driver or modify an existing device driver and make that driver available to JavaOS for Business network computer users.

JavaOS for Business Application Development Guide
: Programmers wishing to create and deploy a new desktop application taking advantage of the features added to the JavaOS for Business operating system.

See any additional documentation supplied with your hardware platform for information about your specific hardware.

Chapter 1. Introduction to JavaOS for Business

The JavaOS™ for Business™ operating system is designed for network computers and based on Java technology produced by Sun Microsystems, Inc. While other Java environments run on top of existing operating systems, JavaOS for Business provides just enough operating system support services so that a network computer can manage its resources and support a 100% Pure Java environment.

JavaOS for Business provides better performance and a substantially reduced memory footprint because it was designed from the beginning to support Java applications and does not need to provide backward compatibility with legacy workstation applications.

Network computers

As corporations moved from mainframe computing to personal workstations, the size and complexity of enterprise networks increased proportionally. The cost of purchasing a full-function workstation is only a small fraction of the total cost of ownership, which includes the support and maintenance expenses that are incurred over the workstation's lifetime, such as installing and updating system and application software, technical support and troubleshooting, and end-user education. Add to these costs the cost of the networking infrastructure necessary to interconnect the workstations and the result is an expensive and complex operation over which enterprises need better control.

The network computer reduces the total cost of owning workstations, particularly for large corporations. A network computer contains no hard disk or application software. When the network computer boots, it loads its operating system and application software over the network and then runs them locally.

As a result, system and network administrators do not have to maintain each workstation individually. Because the system and application software resides on one or more servers, the software needs to be updated only once on the servers. The next time the network computer needs to run an application, the most recent version is obtained from the server, making software updates to network computers automatic. The JavaOS for Business operating system software and device drivers are also maintained this way, allowing network computers to refresh their operating system software simply by rebooting from the server.

Users benefit also. Because they are freed from backing up their own data and managing new operating system and application software updates, they can concentrate on their important tasks.

Features of JavaOS for Business

JavaOS for Business builds upon the prior versions of JavaOS by providing the following new and improved features:

- Support for JDK 1.1.4 applications and applets
- Improved performance and memory management
- Dynamically loadable device drivers and applications
- A layered architecture allowing pieces of the operating system to be independently updated and replaced
- Centralized administration of network computers and associated applications from the server
- Improved reliability, availability, and serviceability of the JavaOS for Business operating system and applications running on the network computers

Chapter 2. Network Planning for JavaOS for Business

A network computer running JavaOS for Business must interact with one or more server machines to access and use different network services. These network services can be provided by different kinds of servers on a network. The examples shown here assume that all of the boot and administration services for JavaOS for Business are provided from a single Microsoft Windows NT Server 4.0 system. This server is referred to as the primary server to distinguish it from other servers on the network. Through network connections, the JavaOS for Business network computers can attach to a variety of servers, including AS/400, RISC System/6000, and System/390.

As the system and network planner, you need to plan the integration of JavaOS for Business network computers into your computing environment. This section lists the tasks that need to be completed before you install JavaOS for Business.

A good network requires good planning. Network planning is divided into two categories, the physical network topology and the detailed planning required for each network computer. Both of these topics are described below.

Network topology

Network topology refers to the physical interconnections between machines in a network. Network topologies range from simple networks to complicated networks of networks. There are many different types of networks that can be implemented. This document addresses two basic types of networks, the stand-alone network, and the connected network. More complex networks can be created and maintained, but describing them is outside the scope of this document.

The stand-alone network is the simplest network, consisting of at least one server and one or more JavaOS for Business network computers connected to the same network by the same adapter hardware, either token-ring or Ethernet adapters. All machines reside in the same IP subnet and the entire network is self-contained. This is the preferred choice for a test environment or for demonstration systems.

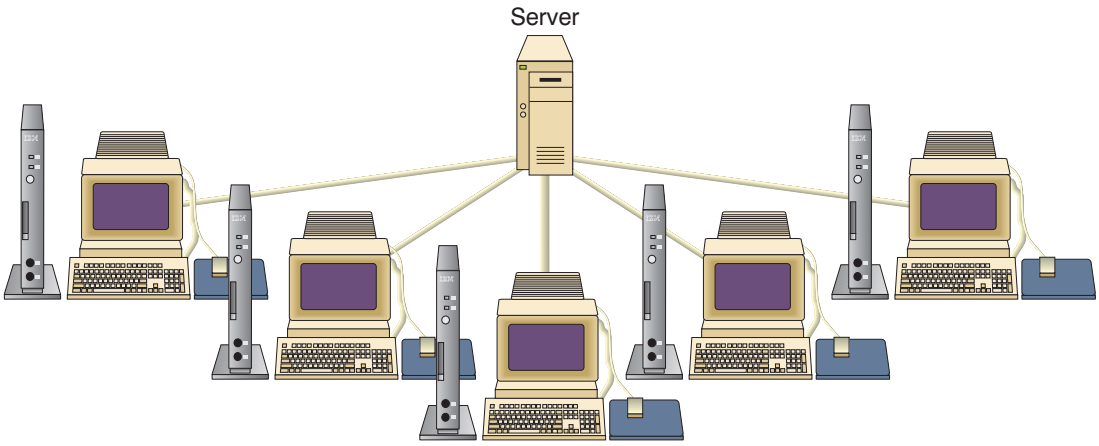

Figure 1. A simple stand-alone network

The connected network is a stand-alone network that is connected to the Internet or an intranet through an IP gateway. This network model assumes that the network computer and server are attached to a larger network and that the services provided by the larger network are therefore available to the server and network computers.

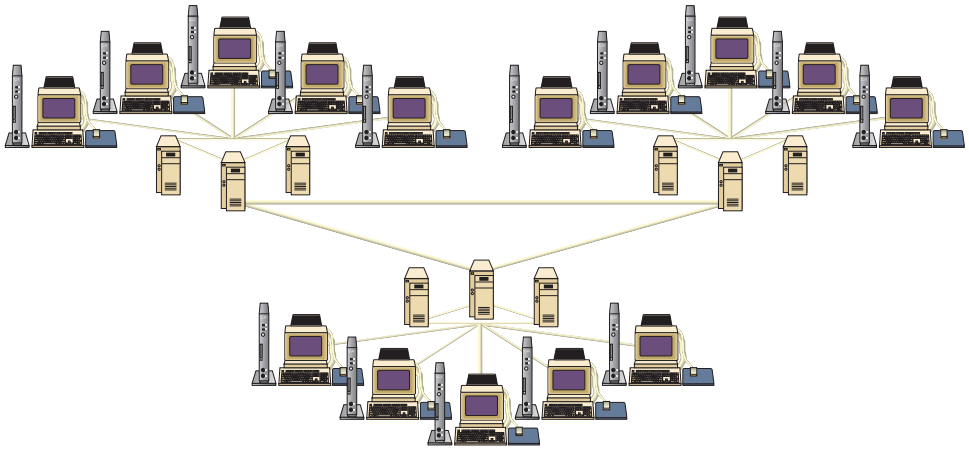

Figure 2. A connected network

In a connected network, the primary server and the network computer can reside on different subnets. When using these more complex configurations, be sure that DHCP relay is configured appropriately between the routers on the different subnets.

Network information gathering

After deciding on a network topology, collect the relevant configuration information for the network computers in the network. Depending on the complexity of the network selected, you will need the following information for each network computer in your environment.

One of the keys to success in a TCP/IP network is that each network computer must have its own unique address. This address is known as the Internet Protocol address, or IP address. The address must be globally unique, meaning that a network computer cannot have the same address as another network computer on the network. In the case of a stand-alone network, the network administrator is solely responsible for ensuring uniqueness. In a connected network, however, the network administrator must work with the owners of the connecting network to ensure that the addresses provided to the network computer are unique. If you want to connect to the Internet, the network addresses and domain names must be officially assigned by a central authority. The authority at the time of this writing is Network Solutions, Inc. Their address is:

```
Network Solutions, Inc.
InterNIC Registration Services
505 Huntmar Park Drive
Herndon, VA  22070
1-703-742-8411
Email:  hostmaster@internic.net
WWW: rs.internic.net
```

IP addresses, which are 32-bit addresses, are generally written as 4 decimal numbers separated by periods, such as 24.14.93.125. Each decimal number represents one byte of the 32-bit IP address, thus each value can range from 0 to 255. This IP address identifies the network and the network computer on that network. (Depending on the size of the network, either the first, second, or third set of numbers in the IP address identifies the network and the remaining numbers represent a particular network computer on that network. The examples in this book are Class C addresses in which the first 3 numbers represent the network and the last number represents the network computer on that network. Therefore, the examples in this book relate to a network of approximately 250 network computers.

The IP address is a software-controlled value that can be changed by the network administrator. However, there is an unchangeable hardware-related address, known as the Media Access Control (MAC) layer address. The MAC address, which uniquely identifies a network adapter card, can be used to uniquely identify a network computer on the network. The only way to change a MAC address for a given network computer is to replace the network adapter with another one. The MAC address is sometimes referred to as the Ethernet address or the token ring address.

Because the IP addresses are difficult for users and administrators to remember, a name can be given to both the network (domain in TCP/IP terminology) and the network computer (host in TCP/IP terminology.) Together, the host and domain names uniquely identify a network computer on the network. To map these names back to addresses, a domain name server, or DNS, is used. In stand-alone networks, the name server is usually the same as the primary server.

In connected networks, a special computer containing two network adapter cards called the router or gateway manages communications between the local network and the Internet or an intranet. In the case of a stand-alone network, the router is usually the same as the primary server.

The following example shows a fictitious network with a domain name of myjavaos.com that has several network computers connected. Two of those network computers have been assigned names: **duke** and **bigblue**. The primary server is called **josserv**, and there is also a nameserver and a router, or gateway.

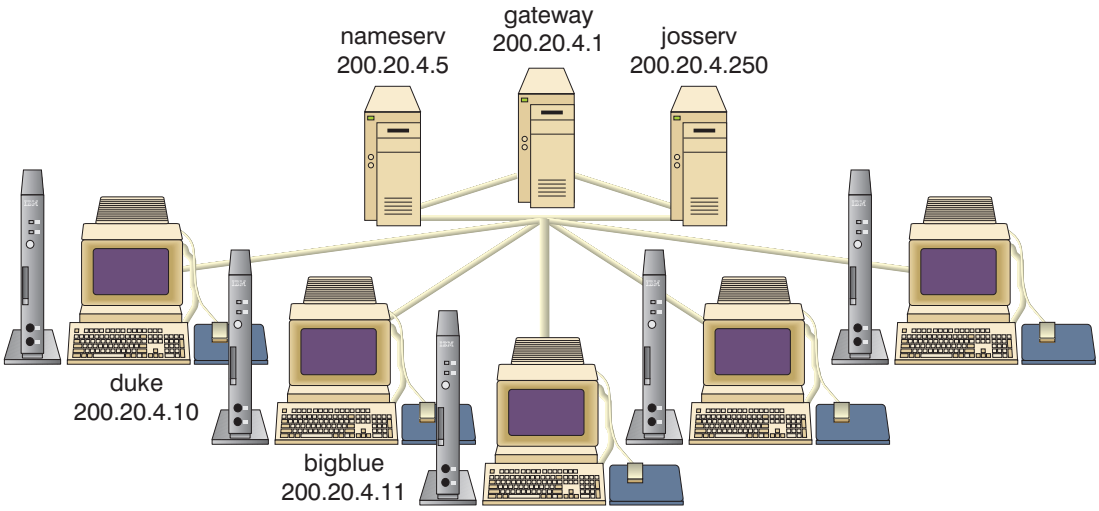

Figure 3. The myjavaos.com network

The following information is needed for planning and configuring the myjavaos.com network:

Host name	duke	bigblue	josserv	gateway	nameserv
MAC address	010060942551f9	010060942551e4	010060942551b2	01006094255111	01006094255109
IP address	200.20.4.10	200.20.4.11	200.20.4.250	200.20.4.1	200.20.4.5
Domain name	myjavaos.com	myjavaos.com	myjavaos.com	myjavos.com	myjavaos.com
Subnet mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Router or gateway	200.20.4.1	200.20.4.1	200.20.4.1	175.53.9.1	200.20.4.1
Domain name server	200.20.4.5	200.20.4.5	200.20.4.5	200.20.4.5	200.20.4.5

In a more complex example of a connected network, remember that if the network computer is located on a TCP/IP subnet which has a router between it and the boot server, you need to configure the router so that it forwards DHCP broadcast requests from that subnet to the boot server. The **dhcprd** command is generally used on a router to achieve this result.

Networking services and protocols

A network computer, by definition, has no persistent storage and no installed software other than for the BIOS or microcode that allows it to boot from a network server. Before a network computer can be used, the appropriate network services must be set up and configured on the Microsoft Windows NT Server 4.0 system. These services need not exist on a single network server, but are described that way in the examples that follow.

Microsoft Windows NT Server 4.0 does not provide all the essential TCP/IP services required to install and operate JavaOS for Business network computers. Therefore, the DHCP and TCP/IP services provided by IBM Network Station Manager must be installed.

The following networking services and protocols are needed by JavaOS for Business:

- Dynamic Host Configuration Protocol (DHCP) is a TCP/IP protocol that allows a network computer to request an IP address and the name of a file to load. DHCP provides a safe, secure, and reliable method of running a TCP/IP network by centrally managing IP addresses, which prevents address conflicts and conserves unused IP addresses. The Bootstrap Protocol (BOOTP) is a subset of DHCP that is not used by JavaOS for Business.

  The MAC addresses mentioned above can be used to create DHCP entries for assigning IP addresses, thus allowing each network computer to identify itself to the server. Alternately, DHCP can be configured to respond to any client's DHCP request through the use of the SupportUnlistedClients option. This option does not require the enumeration of MAC addresses for all network computers.

- Trivial File Transfer Protocol (TFTP) is a TCP/IP protocol that allows the transfer of files to and from a remote network server. TFTP is used in the initial transfer of the JavaOS for Business boot image from the server to the network computer.

- The Network File System (NFS) is a file sharing protocol designed for diskless workstations and network computers. NFS allows a server to make part of its file system available for use to its clients, that is network computers in the case of JavaOS for Business). Any reference to a file on the network computer results in an NFS request being sent to the server, the operation being performed on the server, and the results returned — all occur transparently to the network computer.

- The Line Printer Daemon (LPD) provides network computers with the ability to print to printers located on servers or other network computers.

Other protocols such as the Hypertext Transfer Protocol (HTTP), time services, and font services can also be provided on the server, depending on the network topology selected and the needs of the users on the network.

Chapter 3. Installing JavaOS for Business on the Server

JavaOS for Business requires specific hardware and software. This section describes the requirements and the steps you must take to install and configure the various components.

Server Hardware Requirements

The minimum hardware requirements for the server are:

- Microsoft Windows NT Server 4.0-compatible computer
- 64 MB RAM (128 MB RAM for better performance)
- 1 GB available disk space
- CD-ROM drive
- Network adapter card
  - Ethernet adapter
  - Token-Ring adapter

Server Software Requirements

The software requirements for the server are:

- Microsoft Windows NT Server 4.0
- Microsoft Windows NT Server 4.0 Service Pack 3
- Sun Java Developers Kit 1.0.2
- Sun Java Developers Kit 1.1.4
- Sun HotJava Browser 1.1.2
- IBM Network Station Manager TCP/IP 1.0
- IBM Network Station Manager 2.5
- IBM Network Station Manager 2.5 Service Pack 1

Service Pack 3 for Microsoft Windows NT Server 4.0 is currently available on the Internet from http://www.microsoft.com/ntserver/. IBM makes no representation or warranty that this service pack will continue to be available from Microsoft.

All of the other required software is included as part of the IBM Adaptation Kit for JavaOS for Business, which is referred to as the product CD in this book.

Some of the software needed is packaged as ZIP files. Use a file extraction utility that supports the creation of subdirectories when you need to extract files from a ZIP file. Currently, you can obtain an unzip utility from Info-Zip at http://www.cdrom.com/pub/infozip/Info-Zip.html. IBM makes no representation or warranty that an unzip utility will continue to be available from Info-Zip.

Server Software Installation

Making JavaOS for Business available to network computers requires the installation of several software packages and appropriate configuration changes on the server. These tasks are described in the following sections.

Installing Microsoft Windows NT Server 4.0

Install Microsoft Windows NT Server 4.0 on your server. You must refer to the Microsoft documentation that covers NT Server Setup in addition to the information provided in this document to ensure a successful installation. Because Microsoft Windows NT Server 4.0 does not always identify all installed hardware adapters on the server, have the latest device drivers for your video, network, and other adapters available on diskette during installation. Use the Have Disk option to load the drivers during installation.

Microsoft Windows NT Server 4.0 must be installed as a domain controller or as a stand-alone server due to the requirements of IBM Network Station Manager. If you intend to use protocols other than the Network File System (NFS), be sure to select the Microsoft Internet Information Server (IIS) to be installed. The TCP/IP protocol should also be selected in the networking options.

Create at least two partitions on your server. One partition, referred to as C: in this documentation, is formatted with the FAT file system and contains the Microsoft Windows NT Server 4.0 code. The other partition, referred to as D: in this documentation, must be formatted with the NTFS file system and contains the server support software and JavaOS for Business software. This partition arrangement can provide better recovery if a problem occurs in Microsoft Windows NT Server 4.0 or with the Windows NT Registry.

Configure TCP/IP appropriately on the server. If your server is acting as a gateway to another network, be sure to select **IP Forwarding**.

Install Microsoft Windows NT Server 4.0 Service Pack 3 on your server.

At this point, you should verify that your TCP/IP configuration is working. The easiest way to verify that your routing and domain name server (DNS) are configured properly is to use the **ping** command to test a connection to another computer on the network. If this command fails, correct your network connection before proceeding. Note that the **ping** command may be insufficient to completely verify your TCP/IP configuration because other considerations could cause other protocols, such as HTTP or TFTP, to fail.

Creating an Emergency Repair Disk

Create an Emergency Repair Disk at this point so that you can restore the Windows NT Registry, if necessary. To create one:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Run the **rdisk** program.
3. Select **Update Repair information**.
4. Select **Yes** to continue.
5. Select **Yes** to create an Emergency Repair Disk.

Whenever you add or remove software components in Microsoft Windows NT Server 4.0, it is a good idea to create a new Emergency Repair Disk.

Preparing to Load Server Software

The following server software products are provided on the IBM Adaptation Kit for JavaOS for Business CD in a file called NTSRVBIN.ZIP:

- Sun Java Developer's Kit 1.0.2
- Sun Java Developer's Kit 1.1.4
- Sun HotJava Browser 1.1.2
- IBM Network Station Manager TCP/IP 1.0
- IBM Network Station Manager 2.5
- IBM Network Station Manager 2.5 Service Pack 1
- IBM Network Station Manager DHCP Driver with Fixes

To prepare for the installation of these products, do the following:

1. Insert the IBM Adaptation Kit for JavaOS for Business CD in the CD-ROM drive.
2. Locate the **NTSRVBIN.ZIP** file on the CD.
3. Create a temporary directory on the NTFS drive on the server:

   ```
   d:
   md \temp
   ```

4. Use your file extraction utility to unpack the files in **NTSRVBIN.ZIP** to the temporary directory:

   ```
   cd \temp
   unzip e:\ntsrvbin.zip
   ```

Installing Java Developer's Kit 1.0.2

The IBM TCP/IP Configuration Utility requires that the Java Developer's Kit (JDK) 1.0.2 for Microsoft Windows NT 4.0 be installed on the server. Install it as follows:

1. Locate the self-extracting executable file **JDK102.EXE** in the **JDK102** subdirectory of the temporary directory you created in “Preparing to Load Server Software.”
2. Copy this self-extracting executable file to the root directory of the NTFS drive on which you wish to install JDK 1.0.2 and run it:

   ```
   d:
   cd \temp\jdk102
   copy jdk102.exe d:\
   cd \
   jdk102
   ```

   This file. when unpacked, creates a directory tree called **\java**.
3. After the files are extracted, you can delete the self-extracting executable file from the root directory because it is no longer needed.

   ```
   del jdk102.exe
   ```

To verify that JDK 1.0.2 was installed successfully, run the TicTacToe applet. One way to do this is:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Temporarily add the directory containing the JDK executable files to the PATH by using the SET command:

```
set path=d:\java\bin;%path%
```

3. Go to the drive where you installed JDK 1.0.2.
4. Change to the directory containing the TicTacToe sample

```
d:
cd \java\demo\TicTacToe
```

5. Run the sample:

```
appletviewer example1.html
```

If the applet does not run, correct your installation problem before proceeding.

Installing Java Developer's Kit 1.1.4

The tools used to administer JavaOS for Business on the server require Java Developer's Kit (JDK) 1.1.4 to be installed.

1. Locate the **JDK114.ZIP**, file in the temporary directory created in “Preparing to Load Server Software” on page 11.
2. Copy this file to the root directory of the drive where you will install the Java Developer's Kit.

```
copy d:\temp\jdk114\jdk114.zip d:\
```

3. Extract the files using your file extraction utility:

```
d:
cd \
unzip jdk114.zip
```

4. A directory called **\jdk1.1.4** is created on the target drive.
5. After the files have been extracted, you can delete the file from the root directory.

```
del jdk114.zip
```

To verify that JDK 1.1.4 was installed successfully, run the TicTacToe applet. One way to do this is:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Temporarily add the directory containing the JDK executable files to the PATH by using the SET command:

```
set path=d:\jdk1.1.4\bin;%path%
```

3. Change to the directory containing the TicTacToe sample:

```
d:
cd \jdk1.1.4\demo\TicTacToe
```

4. Run the sample:

```
appletviewer example1.html
```

Installing HotJava Browser 1.1.2

The JavaOS Configuration Tool, which is used to administer JavaOS for Business network computers, runs in the context of the HotJava Browser. The HotJava Browser 1.1.2 is provided with JavaOS for Business because it supports Java Runtime Environment 1.1.4. Install the HotJava Browser as follows:

1. Copy the file containing the HotJava Browser 1.1.2 (located off of the temporary directory created in

"Preparing to Load Server Software" on page 11) to the root directory of the drive where you want to install the HotJava Browser:

```
copy d:\temp\hj112\hj112.zip d:\
```

2. Extract the files using your file extraction utility:

```
d:
cd \
unzip hj112.zip
```

3. A directory called **\hotjava** is created on the target drive.
4. You can delete the zip file from the root directory when done.

```
del hj112.zip
```

When the HotJava Browser is invoked by the JavaOS Configuration Tool, it stores its properties in the **\javaos\jossrv** directory by default. Do not allow other instances of the HotJava Browser to use these properties.

Preparing for IBM Network Station Manager on National Language Versions

The IBM Network Station Manager requires that there be a group called **Administrators**, in English, with administrator permission. In some national language versions of Microsoft Windows NT Server 4.0 the name of this group is translated causing IBM Network Station Manager not to work as desired. On these versions of Microsoft Windows NT Server 4.0, you must create an **Administrators** group in English as follows:

1. Select **Start**, **Programs**, **Administrative Tools**, and then **User Manager for Domains**.

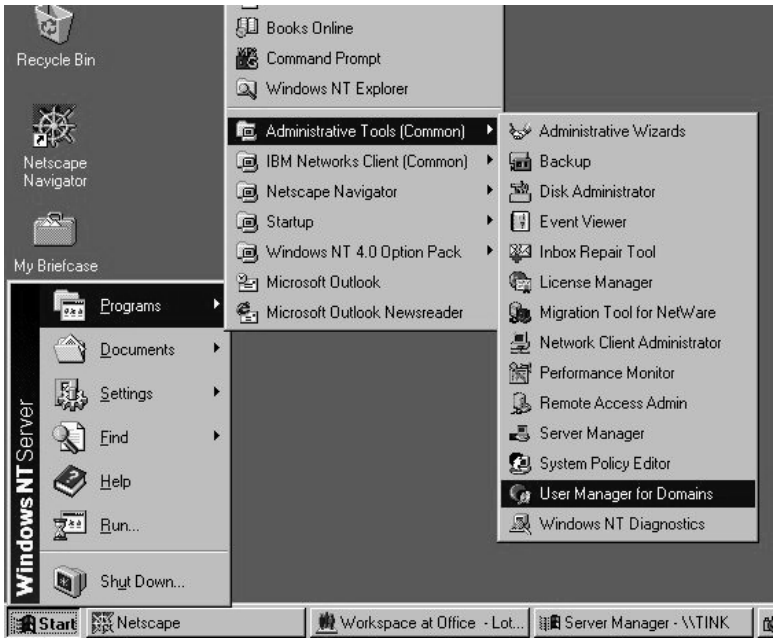

Figure 4. Defining an Administrators group for national language versions

2. Check for a group with the English name of **Administrators**. If one does *not* exist, continue with the following steps.
3. Create a new group called **Administrators**.

4. Give the new group full **Adminstrator** authority.
5. Add the userid for the Administrator to the group.
6. Close the dialog.

Installing the IBM Intermediate Support Driver

The DHCP (Dynamic Host Configuration Protocol) support that is included with Microsoft Windows NT Server 4.0 does not provide all the functions needed by JavaOS for Business. You must install the IBM Intermediate Support Driver to provide the necessary support. The driver must be installed before installing IBM Network Station Manager as follows:

1. Select **Start**, **Settings**, **Control Panel**, **Network** and then **Protocols**.
2. Select **Add** to add a new protocol.
3. Select **Have Disk** when prompted for the location of the protocol files.

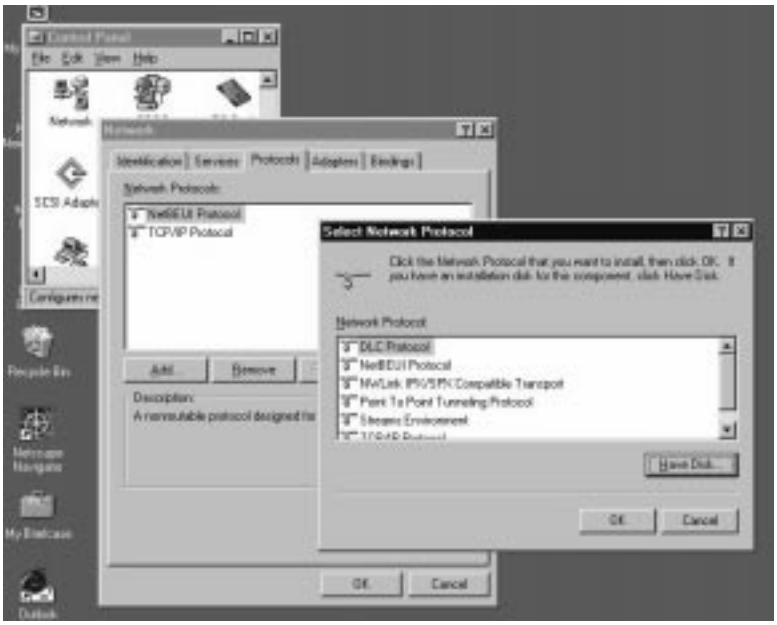

Figure 5. Installing the IBM Intermediate Support Driver

4. In the **Insert Disk** dialog, specify the path for the protocol files. These files were extracted from the Adaptation Kit CD in “Preparing to Load Server Software” on page 11 into this directory:

   ```
   d:\temp\wedge
   ```

5. Select the **IBM Intermediate Support Driver** and then select **OK**.
6. Select **Close**. When prompted to shut down and reboot, select **No**.

After the IBM Intermediate Support Driver is installed, the properties notebook for the TCP/IP protocol is not accessible. If you need access to this notebook, you will need to uninstall the driver, access the notebook, and then reinstall the driver as previously outlined. Instructions for uninstalling the IBM Intermediate Support Driver can be found in Appendix B, “Uninstalling the IBM Intermediate Support Driver” on page 55.

Installing IBM Network Station Manager

The IBM Network Station Manager provides additional function needed by JavaOS for Business to Microsoft Windows NT Server 4.0. To install this support:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Run the IBM Network Station Manager installation program from the temporary directory previously created:

   ```
   d:
   cd \temp\nsm
   setup
   ```

3. Select **OK** to confirm the installation.

Disregard any error messages from the installation program indicating that the system is not a Windows NT Server.

4. Select **Next** to continue.
5. Modify the destination directory to be **d:\nstation**.
6. Select **Yes** when prompted to create the destination directory.
7. Select **Next** to begin the installation.

You will get no notification that the installation program has completed. When the installation dialog is dismissed, the installation has completed. Do not shut down the server at this point. (If you do shut down the server, when the system reboots, error messages are displayed during bootup. These error messages will be resolved after the TCP/IP services are installed in "Installing IBM TCP/IP Services."

Installing IBM TCP/IP Services

The TCP/IP support in Microsoft Windows NT Server 4.0 does not contain all the function necessary for JavaOS for Business. To install the time daemon (TIMED), the trivial file transfer protocol daemon (TFTPD), the network file system daemon (NFSD) and PORTMAP, do the following:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Change to the directory containing the JDK 1.0.2 executable files:

   ```
   d:
   cd \java\bin
   ```

3. Run the TCP/IP installation program from this directory:

   ```
   d:\temp\nsmtcpip\install
   ```

4. Select **Install TCP/IP Applications** and select **Next**.
5. Select **Yes** if you agree with the terms and conditions of the license agreement.
6. Select **Next** to continue.
7. Select **No** to bypass reading the README for IBM Network Station Manager TCP/IP services. Refer to the README if you encounter problems with IBM Network Station Manager.
8. Change the drive to be the NTFS drive, **D:**
9. Select **Next** to begin the installation.

Disregard the error message indicating that the target file system does not support NT security permissions.

10. Select **Yes** to overwrite the target directory.

11. Select **Next** to confirm installation of the following services:
    - IBM DHCP Server
    - IBM TIMED Server
    - IBM TFTPD Server
    - IBM NFSD Server
    - IBM Portmap Server
12. Select **OK** to confirm that setup has completed.

The IBM Network Station Manager TCP/IP user interface is displayed. (This interface requires JDK 1.0.2 to be available and active on the server.)

13. Select **OK** to postpone the configuration until later.
14. Select **Yes** to confirm saving and exit.
15. Select **OK** to acknowledge that a shut down and reboot are necessary.
16. Shut down and restart the system.
17. After the system reboots, logon as Administrator.

Installing IBM Network Station Manager Service Pack 1

IBM Network Station Manager must have Service Pack 1 applied for use with JavaOS for Business. To install the service pack:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Run the Service Pack installation program from the temporary directory:

   ```
   d:
   cd \temp\nsm.sp1
   setup
   ```

3. Select **OK** to confirm that you are the system administrator, that Service Pack 3 for Microsoft Windows NT Server 4.0 is installed, and that IBM Network Station Manager is installed.
4. Select **Next** to begin the installation.
5. Select **OK** to confirm completion.
6. Shut down and restart the system.
7. After the system reboots, logon as Administrator.

JavaOS for Business Software Installation and Initial Configuration

After installing and configuring the server support software, you must install the JavaOS for Business boot image and support files.

Directory Structure Overview

The examples in this book assume that all the software specific to JavaOS for Business is installed in the **d:\javaos** directory on the Microsoft Windows NT 4.0 Server. An overview of that directory structure is provided in Figure 6 on page 17.

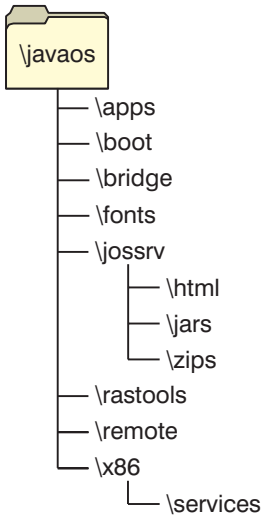

Figure 6. JavaOS for Business network computer binary tree

The **boot** subdirectory contains the bootable image of the JavaOS for Business operating system. This file is the one downloaded to the network computer during boot. This directory also contains the Master Configuration Files (*.MCF), and the PXE boot loader code.

The **apps** subdirectory contains the available desktop applications for the network computers. The hotjava.zip file, which contains the default desktop application and is a modified version of the HotJava Browser 1.1.2, resides in this directory.

The **jossrv** subdirectory contains the JavaOS System Database code, configuration beans for downloadable system services and device drivers, and the JavaOS Configuration Tool (JCT).

The **x86\services** subdirectory contains downloadable system services associated with the Intel® hardware platforms supported by JavaOS for Business.

The **fonts** subdirectory contains the available downloadable fonts

The **remote** subdirectory contains the Input Method Editors (IMEs), locales, code page converters, and keyboards.

Making the files available

A complete JavaOS for Business binary is provided on the IBM Adaptation Kit for JavaOS for Business CD, called **JOSBIND.ZIP** or **JOSBINE.ZIP**. **JOSBIND.ZIP** is the US domestic version; **JOSBINE.ZIP** is the export version. To install the binary image on the Microsoft Windows NT Server 4.0:

1. Insert the IBM Adaptation Kit for JavaOS for Business CD in the CD-ROM drive.
2. Locate the binary image file (**JOSBIND.ZIP** or **JOSBINE.ZIP**) on the CD.
3. Go to the root directory of the NTFS drive and unpack the files using your file extraction utility:

   ```
   d:
   cd \
   unzip e:\josbind.zip
   ```

   The directory structure similar to the one illustrated in Figure 6 is created.

Initial configuration tasks

There are several tasks that must be performed before defining specific users and network computers to JavaOS for Business. These tasks include:

- Configuring the IBM TCP/IP Configuration Utility
- Providing administrator access in national language versions.
- Creating an anonymous NFS user.
- Creating an anonymous Microsoft Windows NT Server 4.0 user
- Configuring IBM Network Station Manager TCP/IP Services.
- Configuring fonts for national language versions.
- Configuring DHCP.
- Starting the JavaOS System Database (JSD) server.

Configuring the IBM TCP/IP Configuration Utility

The shortcut for the IBM TCP/IP Configuration Utility must be updated to use JDK 1.0.2 by doing the following:

1. Select **My Computer**, **C Drive**, **winnt**, **Profiles**, **All Users**, **Start Menu**, **Programs**, and then **Network Station Manager TCP/IP**.
2. Highlight **Configuration Utility**, and click the right mouse button and select **Properties**.
3. Select the **Shortcut** tab, and modify the target field to be:

   ```
   d:\javaos\jossrv\tcpcfg.bat
   ```

4. Select **OK**.

Administrator Access in National Language Versions

In some national language versions of Microsoft Windows NT Server 4.0, the name of the **Administrators** group has been translated. If your national language version has a translated name, do the following to enable the proper operation of IBM Network Station Manager:

1. Select the **My Computer** icon on the desktop.
2. Select the **Drive D:** icon.
3. Highlight the **nstation** folder, but do not open it.
4. Use the right mouse button and select **Properties**, **Security**, and then **Permissions**.
5. Select the **Replace Permissions on Subdirectories** check box.
6. Select the **Replace Permissions on Existing Files** check box.
7. Select **Add**.
8. Select the translated Administrator's group.
9. Select **Full Access** as the type of access.
10. Select **Add**.
11. Select **OK**.

Creating an anonymous NFS User

An anonymous network file system (NFS) user must be defined to allow network computers to access the server's file system during the initial phases of boot processing. To define this user, do the following:

1. Select **Start**, **Programs**, **Network Station Manager TCPIP**, and then **NFS User Configuration**.

Figure 7. Starting the NFS User Configuration Program

2. Enter A to add a user.

Figure 8. Defining an anonymous NFS user

3. Specify a login name of **anonymous**, and press Enter for both the password and verify password.
4. Specify a UID of **60001** and a GID of **60001**. You may leave the Full User Name, Home Directory, and Shell fields blank.

5. Enter Q to quit user configuration and save changes.

Creating an anonymous Microsoft Windows NT Server 4.0 user

An anonymous Microsoft Windows NT Server 4.0 user must also be defined. To define this user, do the following:

1. Logon to the Microsoft Windows NT Server 4.0 as Administrator.
2. Select **Start**, **Programs**, **Administrative Tools (Common)** and then **User Manager for Domains**.

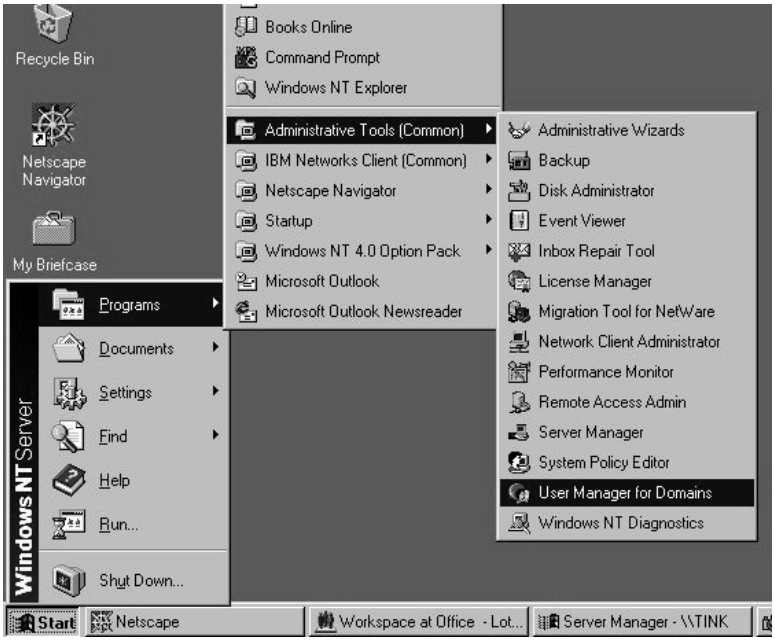

Figure 9. Using the User Manager for Domains

3. Select **User**, and then **New User**.
4. Specify a user name of **anonymous** and leave the password field blank.
5. Clear the check box for **User Must Change Password at Next Logon**.
6. Select **Groups**.
7. Select the **NSMUser** group.
8. Select **Add** to add the user to the NSMUser group.

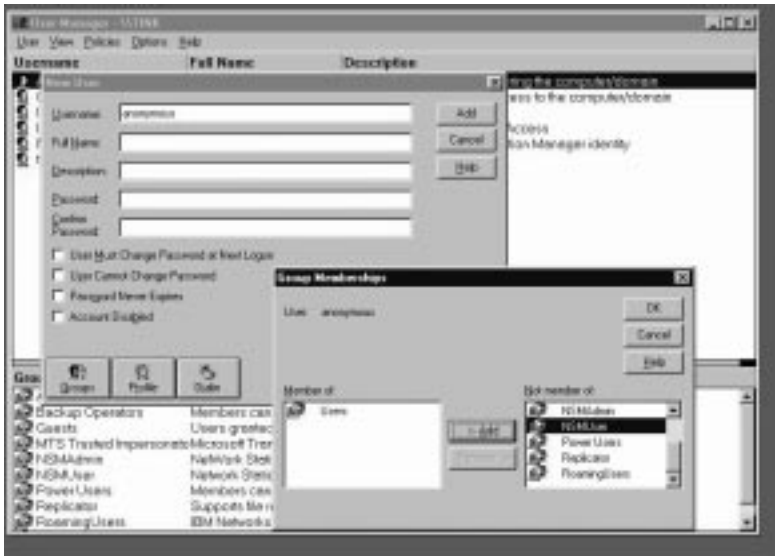

Figure 10. Creating a Windows NT User

9. Select **OK**.
10. Select **ADD** to add the user.
11. Select **Close** to close the window.

Configure IBM Network Station Manager TCP/IP Services

The trivial file transfer protocol daemon (TFTP), network file system daemon (NFSD), and the time daemon (TIMED) must be configured before use. Start the Configuration Utility by selecting **Start**, **Programs**, **Network Station Manager TCPIP**, and then **Configuration Utility**.

Figure 11. Starting the IBM TCP/IP Configuration Utility

Note: The DHCP server is configured by editing the **dhcpsd.cfg** file, not by using the Configuration Utility. A description of this procedure can be found in “Configuring DHCP” on page 29.

TFTP Configuration

To configure the Trivial File Transfer (TFTP) Daemon:

1. Select the **TFTPD** tab in the Configuration Utility.
2. Enable logging for improved diagnostics by selecting the Logging check box.
3. Set the Maximum Segment Size to 512 bytes.
4. Increase the Timeout value to 10 seconds.
5. Change the Retry Limit to 10.
6. Select **Add**.

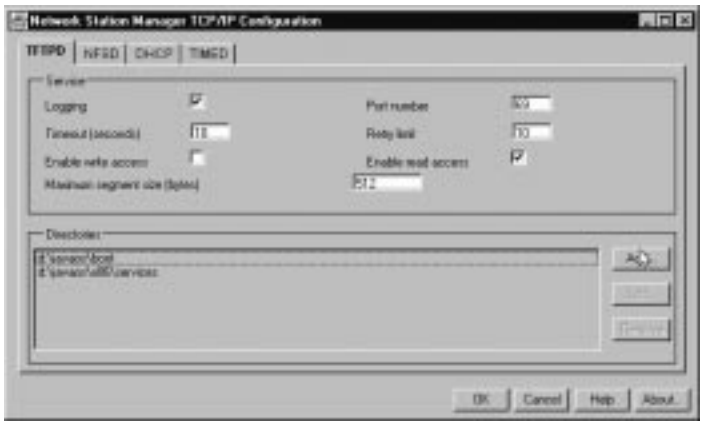

Figure 12. TFTPD Configuration

7. Enter the name of the JavaOS for Business boot directory in the Add TFTPD directory box:

   ```
   d:\javaos\boot
   ```

8. Select **OK**.
9. Select **Add** to add another directory.
10. Enter the name of the Intel® services directory in the Add TFTPD directory box:

    ```
    d:\javaos\x86\services
    ```

11. Select **OK**.

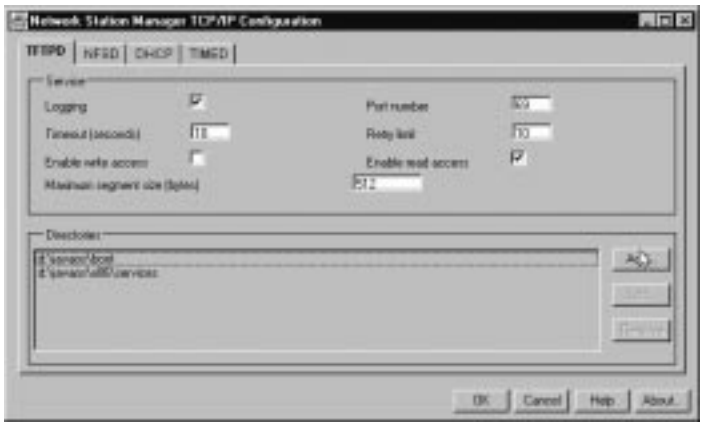

Figure 13. Boot and Services Configured

NFSD Configuration

To configure the Network File System (NFS) daemon:

1. Select the **NFSD** tab in the Configuration Utility.
2. Select the check box for **Use Windows NT Security**.
3. Select **Add** to add export directories for JavaOS for Business.
4. Add the following directory alias for downloadable system services and device drivers associated with the JavaOS for Business operating system:

directory	d:\javaos\x86\services
alias	/x86serv/
comment	JavaOS for Business x86 Services
access	read only

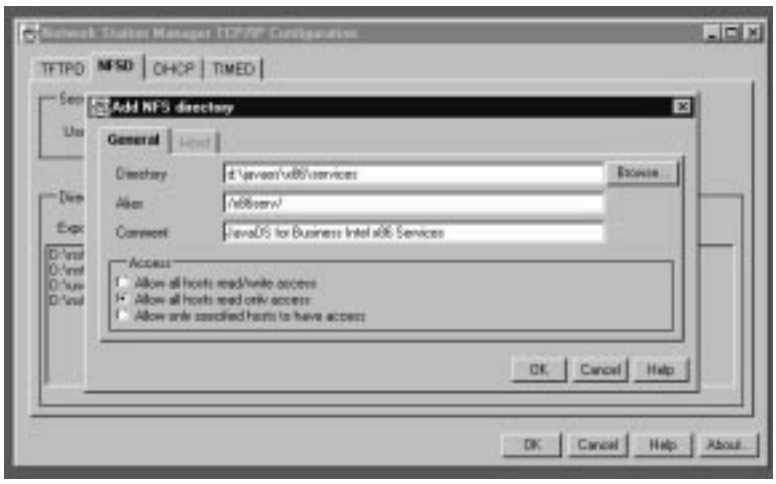

Figure 14. Making system services available

5. Select **OK**.
6. If you have made additional fonts available, set up an alias to the fonts directory:

   directory d:\javaos\fonts

   alias /fonts/

   comment JavaOS for Business Fonts

   access read only
7. Some national language versions of JavaOS for Business provide Input Method Editors (IME). If you have made IMEs or other remote services available to the network computers, define an alias for the remote services:

   directory d:\javaos\remote

   alias /remote/

   comment JavaOS for Business Remote Services

   access read only
8. In addition, you might want to add aliases for applications or other data that you want to share among users. For example, you could set an alias for the HotJava Browser 1.1.4 as follows:

   directory d:\javaos\apps

   alias /hotjava/

   comment JavaOS for Business HotJava Browser 1.1.4

   access read only

Figure 15. Making applications available

9. Select **OK**.

TIMED Configuration

To configure the Time Daemon:

1. Select the **TIMED** tab.
2. Clear the **Adjust to local time** check box, because JavaOS for Business uses GMT.
3. Select **OK** to exit the configuration tool.

Setting Windows NT File System Security Permissions

The **\javaos**, **\javaos\x86**, **\javaos\fonts**, and **\javaos\remote** directories on the server must be made available to network computers using JavaOS for Business.

To set the permissions on the **\javaos** directory for the administrator:

1. Select the **My Computer** icon on the desktop.
2. Select the **Drive D:** icon.
3. Highlight the **JavaOS** folder, but do not open it.
4. Use the right mouse button and select **Properties**, **Security**, and then **Permissions**.

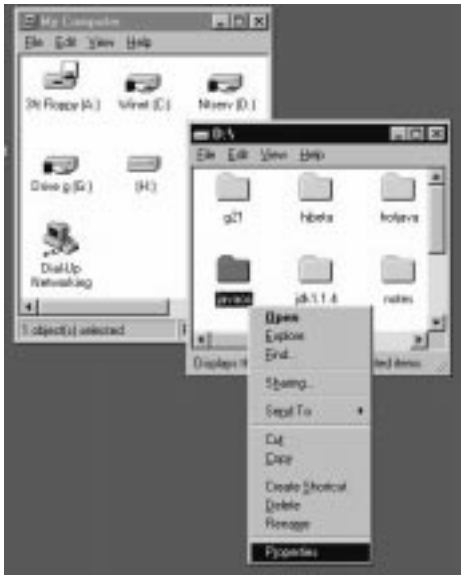

Figure 16. Setting Windows NT File System Security

5. Select the **Replace Permissions on Subdirectories** check box.
6. Select the **Replace Permissions on Existing Files** check box.
7. Select **Add**.
8. Select the Administrator's group.
9. If you have a national language version of Microsoft Windows NT Server 4.0 that has a translated Administrator's group, select the translated group also.
10. Select **Full Control** as the type of access.

Figure 17. Giving administrators access to \javaos

11. Select **Add**.
12. Select **OK**.
13. Select **Everyone**.
14. Select **Remove**.
15. Select **OK**.

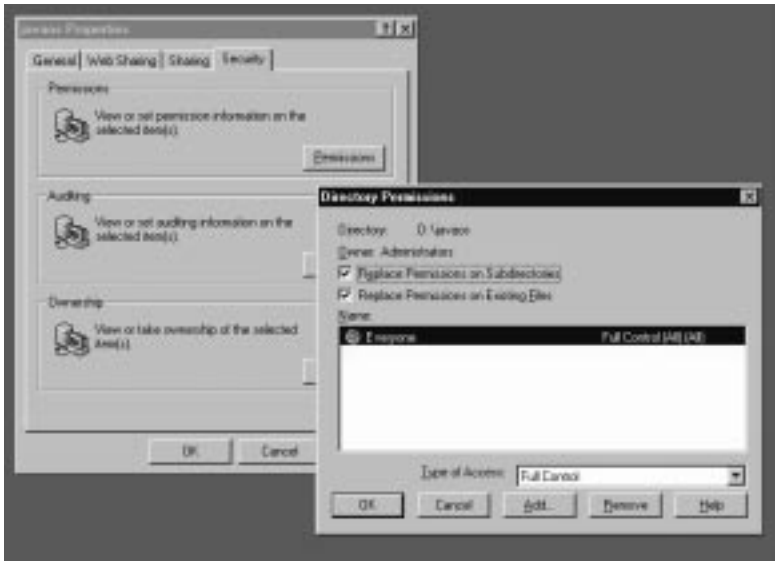

Figure 18. Removing everyone's access to \javaos

16. Select **Yes** to replace security information.
17. Select **OK**.

To set the permissions on the **\javaos\x86** directory:

1. Select the **My Computer** icon on the desktop.
2. Select the **Drive D:** icon.
3. Open the **JavaOS** folder.
4. Highlight the **x86** folder.
5. Use the right mouse button and select **Properties**, **Security**, and then **Permissions**.
6. Select the **Replace Permissions on Subdirectories** check box.
7. Select the **Replace Permissions on Existing Files** check box.
8. Select **Add**.
9. Select the **NSMUser** group.
10. Select **Read** access.
11. Select **Add**.
12. Select **OK**.
13. Select **OK**.
14. Select **Yes** to replace security information.
15. Select **OK**.

Figure 19. Giving the NSMUser group access

To set the permissions on the **\javaos\fonts** directory:

1. Select the **My Computer** icon on the desktop.
2. Select the **Drive D:** icon.
3. Open the **JavaOS** folder.
4. Highlight the **fonts** folder.
5. Use the right mouse button and select **Properties**, **Security**, and then **Permissions**.
6. Select the **Replace Permissions on Subdirectories** check box.
7. Select the **Replace Permissions on Existing Files** check box.

8. Select **Add**.
9. Select the **NSMUser** group.
10. Select **Read** access.
11. Select **Add**.
12. Select **OK**.
13. Select **OK**.
14. Select **Yes** to replace security information.
15. Select **OK**.

To set the permissions on the **\javaos\remote** directory:

1. Select the **My Computer** icon on the desktop.
2. Select the **Drive D:** icon.
3. Open the **JavaOS** folder.
4. Highlight the **remote** folder.
5. Use the right mouse button and select **Properties**, **Security**, and then **Permissions**.
6. Select the **Replace Permissions on Subdirectories** check box.
7. Select the **Replace Permissions on Existing Files** check box.
8. Select **Add**.
9. Select the **NSMUser** group.
10. Select **Read** access.
11. Select **Add**.
12. Select **OK**.
13. Select **OK**.
14. Select **Yes** to replace security information.
15. Select **OK**.

To set the permissions on the **\javaos\apps** directory:

1. Select the **My Computer** icon on the desktop.
2. Select the **Drive D:** icon.
3. Select the **javaos** folder.
4. Highlight the **apps** folder.
5. Use the right mouse button and select **Properties**, **Security**, and then **Permissions**.
6. Select the **Replace Permissions on Subdirectories** check box.
7. Select the **Replace Permissions on Existing Files** check box.
8. Select **Add**.
9. Select the **NSMUser** group.
10. Select **Read** access.

11. Select **Add**.
12. Select **OK**.
13. Select **OK**.
14. Select **Yes** to replace security information.
15. Select **OK**.

Repeat the above steps for any other common application directories.

National Language Font Configuration

The Japanese, Korean, Simplified Chinese, and Traditional Chinese national language versions of JavaOS for Business require some additional font configuration:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Change to the **\FONTS\LIB** directory.

   ```
   d:
   cd \javaos\fonts\lib
   ```

3. Based on the national language version, do the appropriate **XCOPY** command:

   Japanese

   ```
   xcopy font.properties.ja font.properties
   ```

   Korean

   ```
   xcopy font.properties.ko font.properties
   ```

   Simplified Chinese

   ```
   xcopy font.properties.zh font.properties
   ```

   Traditional Chinese

   ```
   xcopy font.properties.zh_tw font.properties
   ```

Configuring DHCP

DHCP must be configured with the appropriate options before it is used. This configuration requires that you modify the **dhcpsd.cfg** file, either directly using the text editor of your choice, or indirectly by using the graphical user interface (GUI). For details on using the GUI, refer to the IBM Network Station Manager documentation on the IBM Network Station Manager product CD.

The **dhcpsd.cfg** file resides in the \ibmtcpip\etc directory on the server. Figure 20 on page 30 shows a sample **dhcpsd.cfg** file using the network setup introduced in “Network information gathering” on page 4 for the *myjavaos.com* domain. In general, it is a good idea to start with a working **dhcpsd.cfg** file, make a backup copy, and then make modifications.

```
logFileName d:\joslog\dhcpsd.log
logFileSize 4
numLogFiles 10
logItem ACNTING
logItem EVENT
logItem WARNING
logItem INFO
logItem TRACE
leaseExpireInterval 3 Minutes
leaseTimeDefault 8 Hours
supportBOOTP true
supportUnlistedClients false

subnet 200.20.4.0 255.255.255.192 200.20.4.10-200.20.4.14
{
  Option 15 myjavaos.com
  Option 6 200.20.4.5
  Option 3 200.20.4.1
  Option 1 255.255.255.192
  Option 4 200.20.4.4
  Option 60 PXEClient
  client 1 0004ACEB0160  200.20.4.10 (alias=duke
  {
     Option 67 /javaos/boot/jospxe.bin
  }
  client 1 006094257AF6  200.20.4.11 (alias=bigblue
  {
     Option 67 /javaos/boot/jospxe.bin
  }
}
Vendor JavaOS.Generic
{
  Option  101 "-djavaos.mJSD=server:3333"
}
```

Figure 20. Sample dhcpsd.cfg File

Highlights of the **dhcpsd.cfg** file are explained below.

The subnet line indicates that that IP addresses 200.20.4.10 through 200.20.4.14 are available for network computers. The subnet mask is 255.255.255.192 for the subnet 200.20.4.0.

The options in this file refer to:

Option	Description
1	Subnet mask
3	IP address of the router or gateway
4	IP address of the time server, the Windows NT Server in our examples
6	IP address of the name server
15	Domain name
60	PXE Client
67	Path and file name of the binary boot image for JavaOS for Business

101 Location of the JavaOS System Database (JSD) and the port number to use

Each network computer can be listed in this file with either a client 1 (Ethernet) entry or a client 6 (token-ring) entry. The first client entry shown in Figure 20 on page 30 indicates that the network computer with MAC address 0004ACEB0160 should be assigned an IP address of 200.20.4.10. The comment indicates that the name of this network computer is duke.myjavaos.com, though this is actually set by the name server.

If you would prefer to have the server dynamically assign IP addresses instead of explicitly listing every network computer in this file, set the SupportUnlistedClients option to true. For more information on this option, refer to the TCP/IP documentation on the IBM Network Station Manager product CD.

After you have made modifications to the **dhcpsd.cfg**, you should validate that the file is syntactically correct. The DHCP GUI can be used for this purpose:

1. Select **Start**, **Programs**, **Network Station Manager TCPIP**, and then **Configuration Utility**.
2. Select the **DHCP** tab.
3. Select **Launch...**.
4. Select **File...** and then **Open**.
5. Select **dhcpsd.cfg**.
6. Select **Open**.
7. Correct any errors reported, and then close the utility.

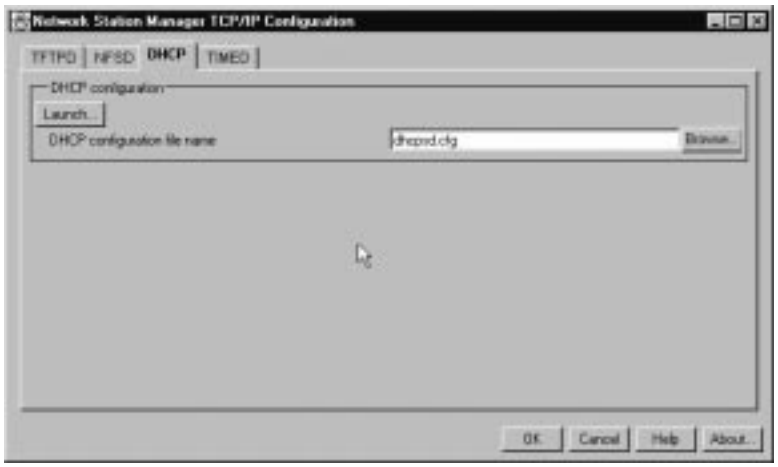

Figure 21. Verifying the correctness of dhcpsd.cfg

Starting the JavaOS System Database (JSD) Server

In order to use the JavaOS Configuration Tool (JCT), the JavaOS System Database (JSD) server must be started. The easiest way to start the JSD server is to create a shortcut on the desktop:

1. Click the right mouse button on the Desktop.
2. Select **New**, and then **Shortcut**.
3. Enter the following command:

   ```
   d:\javaos\jossrv\startjsd.bat
   ```

4. Select **Next**.
5. Enter some appropriate text, such as:

   ```
   Start JSD Server
   ```

6. Select **Finish**.

To start the JSD server, double-click the **Start JSD Server** icon on the desktop. The JSD server should start in a command window.

Note: The JSD is started after logging onto the server. If the user subsequently logs off, the JSD server stops.

To provide additional diagnostic information in the event of a problem with the JSD server, you might wish to modify the buffering of the command window. To do this:

1. Start the JSD server as outlined above.
2. Select the System Menu in the upper-left-hand corner of the window.
3. Select **Properties...**
4. Select **Layout**.
5. Adjust the Screen Buffer Size width to be 90 and the buffer height to be large, such as 1000. This width and length enables scroll bars in the command window and provides a scrollable window of 1000 lines of 90 characters.
6. Select **OK**.

Chapter 4. Network Computer Configuration

This section provides information on validating that the server installation was successful and that JavaOS for Business network computers can boot. Information on the recommended sequence of entering information into the JavaOS System Database is also provided.

Network Computer Hardware Requirements

The minimum hardware requirements for JavaOS for Business network computers are:

- Intel® Pentium®-based system
  - 166 MHz processor
  - PCI bus
  - BIOS dated 4/98 or later
- 32 MB RAM (64 MB RAM recommended for large applications or the running of multiple applets simultaneously)
- Video adapter
  - S3 Trio 64 V+
  - S3 Trio 64 V2/DX
  - Matrox Millenium MGA
- 1 MB Video RAM (2 MB or more recommended for applications requiring high resolution)
- PCI network adapter card such as the IBM Etherjet or Intel® EtherExpress™ Pro 100, that implements the Intel 82558 specification and supports PXE/DHCP boot. (The microcode level should be 1.46 or higher.)

A list of the tested network computer hardware configurations can be found in Appendix A, “Tested Network Computer Hardware Configurations” on page 53.

Notes:

1. In this release of JavaOS for Business, the bus manager supports only 8 cascaded PCI buses in a network computer.
2. Microsoft Windows NT Server 4.0 does not support network file services (NFS) over TCP connections. Network file services must use the UDP protocol when mounting to a Windows NT server.

Configuration Task Overview

The JavaOS System Database (JSD) is a repository for information about the JavaOS for Business operating system and its associated network computers. Information about individual machines, users, device drivers, applications, login attributes, and security settings are all stored in the JSD.

Access to the JavaOS System Database is provided through the JavaOS Configuration Tool, or JCT. The JCT allows the network administrator to add, change, delete, or view information in the JavaOS System Database. The JCT runs in the HotJava Browser 1.1.2 on the same Microsoft Windows NT 4.0 server that contains the JavaOS System Database server.

Users and Groups

Information related to a particular user of JavaOS for Business is contained in a user record in the JSD and possibly one or more group records. Each user of the system has a user record containing information specific about the particular user. In addition, the user must be defined to Microsoft Windows NT Server 4.0 using the same name that is used in the JSD.

Because multiple users of the system might share similar needs, such as access to the same desktop applications or a common keyboard or language, these similar traits can be stored in a group record in the JSD and the appropriate users can be associated with the group. This puts common information in one location, but allows it to effect multiple users.

A user can be a member of more than one group. For instance, a user in the human resources department in France requires access to the corporate jobs database. The user would be a member of the human resources group, with access to the necessary applications, and a member of the French branch office group, with access to the appropriate keyboard, fonts, and French language version of JavaOS for Business.

To expedite defining multiple users to the JSD, you should define the groups the users will belong to first, and then assign the users to the appropriate groups as you define them.

Machines, Profiles, and Platforms

Information about a particular network computer is stored in a machine record. Just as users can be combined into groups, individual network computers can be combined with other similar network computers into a platform, or possibly one or more profiles.

A machine record contains information associated with a particular network computer. This type of record contains information such as the Media Access Control (MAC) address and serial number.

A platform group represents a set of network computers of the same physical type. These may all be a particular model from a particular manufacturer, or all with the same hardware configuration, such as the same network adapter, sound card, display adapter, memory, and so on. A network computer should be a member of only one platform group.

A profile group is used to group a set of network computers in ways not necessarily related to physical type. For example, all the network computers in the Accounting department might be in a special accounting profile. Others located in a particular building or at a particular site may have specific attributes that can be grouped together in a profile. Profiles are optional. A machine does not need to be a member of any profile, or it could be a member of multiple profiles.

Network Computer Configuration

The following network computer configuration tasks are explained in this section:

- Starting the JavaOS Configuration Tool
- Adding a platform definition, if necessary.
- Importing a JSD file.
- Creating a machine record.
- Configuring required services.
- Building the Master Configuration File (MCF) for the machine.

- Updating **dhcpsd.cfg** (if you added or modified a machine record).

Starting the JavaOS Configuration Tool (JCT)

The easiest way to start the JavaOS Configuration Tool is to create a shortcut on the desktop:

1. Click the right mouse button on the Desktop.
2. Select **New**, and then **Shortcut**.
3. Enter the following command:

   ```
   d:\javaos\jossrv\startjct.bat
   ```

4. Select **Next**.
5. Enter some appropriate text, such as:

   ```
   JavaOS Configuration Tool
   ```

6. Select **Finish**.

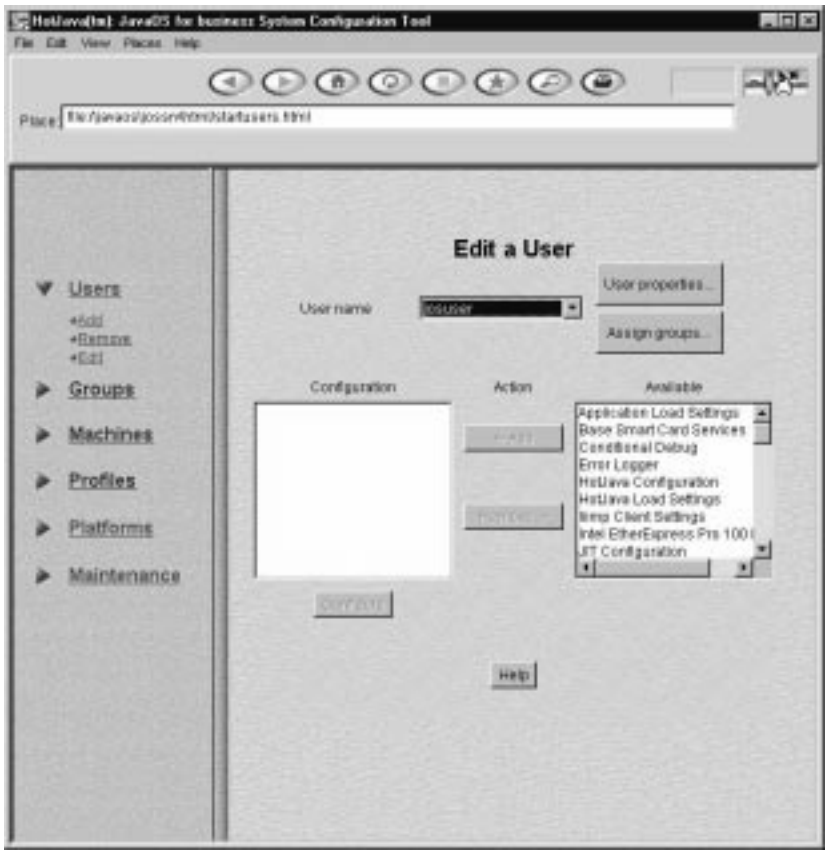

Figure 22. The JavaOS Configuration Tool

To start the JCT, double-click the **JavaOS Configuration Tool** icon on the desktop. The JCT starts the HotJava Browser automatically.

Note: The JCT must run on the same Windows NT Server that contains the JavaOS System Database. Do not configure socks or proxy servers in the HotJava Browser used for the JCT. Do not set the global *HOME* environment variable to point to the property files associated with the HotJava Browser for the JCT.

Creating a platform definition

Perform the following steps to create a new platform definition:

1. Start the JSD Server, if necessary. (See “Starting the JavaOS System Database (JSD) Server” on page 31 for details.)
2. Select **Start**, **Programs**, and then **Command Prompt**.
3. Start the JavaOS Configuration Tool (JCT).
4. Select **Platform**.
5. Select **Add**.
6. Fill in platform-specific information. The *Manufacturer Name* and *Platform Name* must be specified exactly as shown.

   Manufacturer Name com.ibm

   Platform Name x86PCRef

   Description x86 IBM PC Reference
7. Select **Create**.

Once the platform definition has been defined, you need to configure the required services.

Configuring required services

There is a set of required services that must be configured for a JavaOS for Business network computer. These services must be configured in a platform, a profile, or the machine record associated with the network computer. Early services are those services required at boot time. Standard services are used after boot. The required services are:

Early services:

- Network adapter driver, such as the Intel® EtherExpress™ Pro 100 Driver
- Location of JavaOS for Business binary boot image
- Network File System (NFS)
- Keyboard and mouse base driver
- S3 Trio V2+ or Super VGA display driver

Standard services:

- Keyboard driver
- Mouse driver
- NFS Automounter - SERVICES
- Login settings
- Network Station Login (NSL) Authenticator for Login
- Serial driver
- Video driver for resolution (optional)

Note: The serial driver can be established as an early service to make the serial communications port available during boot for debugging.

The tasks below assume that you are still in the JCT. The examples show these definitions being defined at a **Platform** level. These definitions can also be defined at a **Machine** or **Profile** level. The host name for the server used in the examples is **josserv**. You need to change this to the name of your server.

To begin configuring the services, select **Platform** and then**Edit**. Select the platform you wish to modify and then proceed.

Configuring the network adapter driver

1. Select the appropriate driver for the network adapter in the network computer. If you are using Ethernet, select the Intel® EtherExpress Pro™ 100 Driver.
2. Select **Add**.
3. Specify the fully qualified name of the network adapter driver:

   `file:/javaos/x86/services/EEPro100.jar`
4. Select **Save** and then **OK**.

Defining the location of the JavaOS for Business boot image

1. Select **System Image Location**.
2. Select **Add**.
3. Specify the fully qualified location of the binary boot image. For example:

   `file:/javaos/boot/javaos.x86`
4. Select **OK**.

Configuring Network File System (NFS)

1. Select **Network File System (NFS)**.
2. Select **Add**.
3. Specify the fully qualified name for the NFS driver, for example:

   `file:/javaos/x86/services/NfsFileSystem.jar`
4. Select **Save** and then **OK**.

Configuring the base keyboard and mouse driver

1. Select the **Keyboard and Mouse base driver**.
2. Select **Add**.
3. Specify the fully qualified name for the driver:

   `file:/javaos/x86/services/I8042.jar`
4. Select **Save** and then **OK**.

Configuring the video display driver

1. Select the appropriate video display driver, either S3 Trio 64 or Super VGA.
2. Select **Add**.
3. Specify the appropriate video driver.

   Super VGA or Matrox Millennium

   ```
   file:/javaos/x86/services/SVGAFrameBuffer.jar
   ```

   S3 Trio 64

   ```
   file:/javaos/x86/services/S3FrameBuffer.jar
   ```
4. Select **Save** and then **OK**.

Configuring the keyboard driver

To configure the keyboard driver:

1. Select the **Keyboard driver**.
2. Select **Add**.
3. Specify the name for the keyboard driver, for example:

   ```
   file:/SERVICES/I8042.jar
   ```
4. Select **Save** and then **OK**.

Configuring the mouse driver

To configure the mouse driver:

1. Select the **Mouse driver**.
2. Select **Add**.
3. Specify the name for the mouse driver, for example:

   ```
   file:/SERVICES/Uart16550.jar
   ```
4. Select **Save** and then **OK**.

Configuring the video resolution

By default, the video resolution is set to the highest one supported by the video adapter. If you want to specify a specific resolution, do the following:

1. Select the **Video driver**.
2. Select **Add**.
3. Set the desired resolution. A resolution of 1024 x 768 x 8 enables you to verify sufficient communications with the JSD.
4. Select **Save** and then **OK**.

Configuring the NFS Automounter for Services

To configure the NFS Automounter for services:

1. Select **NFS Automounter**.
2. Select **Add**.
3. Fill in the necessary information:

   Client mount type /SERVICES

   Protocol type UDP

   Mount path josserv:/x86serv
4. Select **Save** and then **OK**.

Configuring login settings

To configure login settings:

1. Select **Login Settings**.
2. Select **Add**.
3. Specify the default network login type, such as Network Station Login (NSL).
4. Select **Save** and then **OK**.

Configuring Network Station Login (NSL) Authentication for Login

To configure the NSL Authentication for Login:

1. Select **NSL Authenticator for Login**.
2. Select **Add**.
3. Set the Service URL to the location of the authenticator, for example:

   `file:/SERVICES/NSLAuthenticator.jar`
4. Select **Save** and then **OK**.

Configuring the serial driver

The serial driver provides access to the serial communications port. The serial port can be activated during boot by configuring the serial driver as an early service. Otherwise, you can configure it as a regular service. To configure the serial driver:

1. Select the **Serial driver**.
2. Select **Add**.
3. Specify the name of the serial driver based on its use:

   Early service:

   `file:/javaos/x86/services/Uart16550.jar`

   Standard service:

```
file:/SERVICES/Uart16550.jar
```

4. Select **Save** and then **OK**.

Defining a Machine

In addition to defining a platform, you may want to define individual machines. By making a machine a member of a platform, the machine definition inherits all the configuration aspects of the platform. You can then configure individual services for the specific machine.

Perform the following steps to create a new machine:

1. Start the JCT if necessary.
2. Select **Machines**, and then **Add**.
3. Fill in the appropriate information for the network computer. For example:

   Hardware Type Select a network type of Ethernet or token-ring.

   MAC address Enter the 12-character network adapter address in lowercase.

   Serial Number Optionally specify an identifier for the network computer.

   Location Optionally specify a location for the network computer.
4. Select **Create**.
5. Select **Machines**.
6. Select **Edit**.
7. Select the machine configured using the MAC address.
8. Select **Assign Platform**.
9. Select the appropriate platform for this machine.
10. Select **Save**.

Importing a JSD File

Instead of creating a new platform definition and then configuring all the necessary services, you can import an existing JSD file and then configure it with a minimal amount of effort. JavaOS for Business provides a **x86pcref.jsd** file as a starting point. It assumes the directory structure and alias names outlined in this book. To import this file, or any JSD file:

1. Start the JCT, if necessary.
2. Select **Maintenance**, and then **Import JSD File**.
3. Enter the fully qualified path to the JSD file, or use the **Browse** button to locate it.
4. Select **Save** to load the contents of the JSD file into the JavaOS System Database.

Figure 23 on page 41 shows the import of a JSD file.

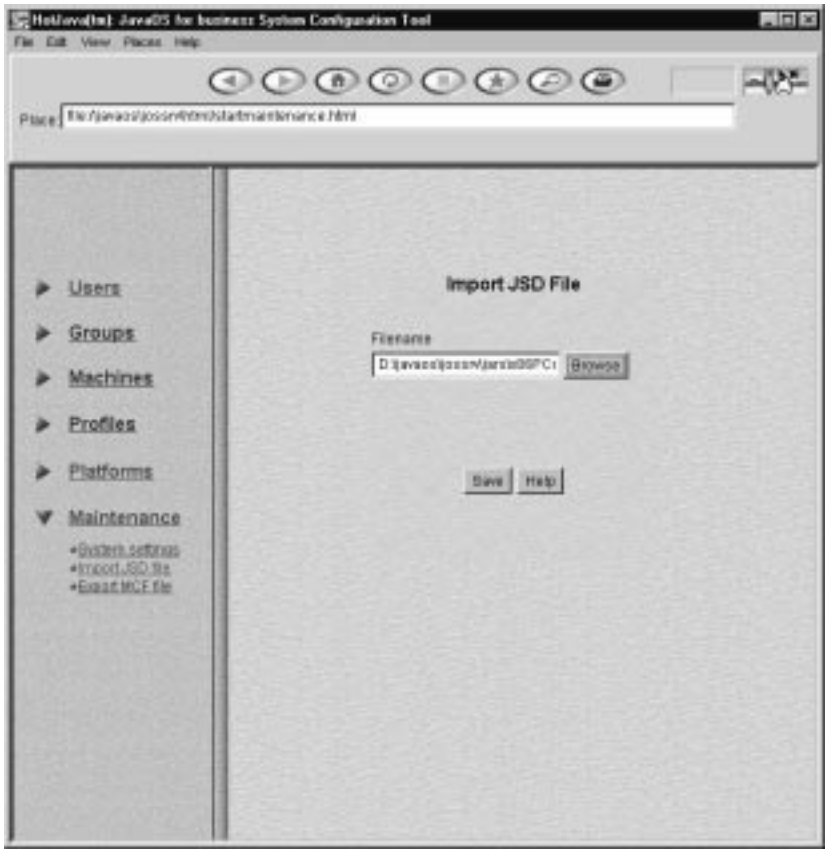

Figure 23. Importing a JSD File

JSD File Format

The JSD file is an ASCII file that contains configuration objects to be placed into the JavaOS System Database. These configuration objects are stored with their default settings. Figure 24 on page 42 shows the content of a sample JSD file.

```
Platform=com.ibm/x86PCref {

   LogonFw.jar
   nslauthenticatorcfg.jar
   I8042cfg.jar
   PCKeyboardcfg.jar
   PS2Mousecfg.jar
   EEPro100cfg.jar
   Uart16550cfg.jar
   NfsFileSystemcfg.jar
   MctCfg.jar
   S3cfg.jar
   SVGAcfg.jar
   SnmpManager.jar
   timezonecfg.jar
   AudioSBCompatiblecfg.jar
   Localecfg.jar
   keytablecfg.jar
   Parallel1284cfg.jar

}
```

Figure 24. A sample JSD File

The generic format of the JSD file consists of one or more entries in the following format:

```
namespace = name {
  name1.jar
  name2.jar
   .
   .
   .
}
```

where:

namespace is one of the following:

- User
- Group
- Profile
- Platform
- Identifier

name is a unique name associated with the **namespace**

name1.jar, *name2.jar*, **...** are the names of the JAR files associated with the configuration objects.

Service configuration

The **x86pcref.jsd** file provides much of the configuration necessary for a collection of JavaOS for Business network computers. However, you must:

1. Add an NFS automounter entry for the **SERVICES** alias.
2. Enable the login authenticator, if desired.
3. If you wish to use the serial port during boot, modify the mount point to specify the fully qualified name of the serial driver.

4. If the network computers reside in a different time zone than the server, configure the time zone.
5. Configure the SNMP manager, if needed.
6. Configure the audio driver, if needed.
7. Set the locale and keyboard if the default language is other than *US English*.

The other services default to the **SERVICES** alias and generally do not require configuration.

After importing the file and making the necessary changes, export the MCF file for the platform. (See "Creating the Master Configuration File.")

Creating the Master Configuration File

When a new machine or platform has been created, you must create a Master Configuration File (MCF) for it. The MCF gives the network computer access to files on the the server in the early stages of boot processing. To create the MCF:

1. Start the JCT if necessary.
2. Select **Maintenance**.
3. Select **Export MCF File**.
4. Select machine based on MAC address or manufacturer and platform.
5. Select **Build**.

Figure 25 shows a sample Master Configuration File.

```
;010060942551f9 configuration file
bootimage=/javaos/boot/javaos.x86
bootservice=file:/javaos/x86/services/EEPro100.jar
bootservice=file:/javaos/x86/services/NfsFileSystem.jar
bootservice=file:/javaos/x86/services/S3FrameBuffer.jar
bootservice=file:/javaos/x86/services/I8042.jar
bootproperties=/javaos/boot/010060942551f9\config.ser
```

Figure 25. A sample MCF for a JavaOS for Business network computer.

After defining machines, you must update the **dhcpsd.cfg** file. See "Configuring DHCP" on page 29 for a description of the contents of this file and instructions on modifying it and validating that it is syntactically correct.

Creating an Emergency Repair Disk

After installing all the necessary server support software for JavaOS for Business, it is a good idea to create an updated Emergency Repair Disk for the Microsoft Windows NT Server 4.0. To create one, follow the steps outlined in "Creating an Emergency Repair Disk" on page 10.

User Configuration

The following user configuration tasks are explained in this section:

- Create one or more groups in the JSD for users with common tasks, applications, or equipment.
- Create a user in Microsoft Windows NT Server 4.0.
- Create a home directory for the user on the server.
- Create an alias for the user's home directory.
- Give the user read/write authority to that user's home directory.
- Create a JavaOS for Business user in the JSD using the same name used for Microsoft Windows NT Server 4.0.
- Add the user to the appropriate groups in the JSD.

In the examples in this document, *josuser*, *josuser2* and similar names are used as sample userids. You can choose the userids for your system.

Detailed information on using the JavaOS Configuration Tool can be found in *JavaOS for Business Network Operations*.

Creating Groups

Use a group when you are adding a number of users with similar characteristics. A group consists of one or more users who use the same applications, require access to a specific printer, or use the same equipment. Groups are defined using the JavaOS Configuration Tool (JCT).

To create a group:

1. Start the JavaOS Configuration Tool, if it is not already started.
2. Select **Groups**.
3. Select **Add**.
4. Fill in the name of the group.
5. Select **Create**.
6. Select **Groups**.
7. Select **Edit**.
8. Select the group to configure, such as **HotJava**.
9. Select the services to configure and then configure them appropriately for the group. See “Configuring required services” on page 47 for a list of the services that must be configured.
10. Select **OK**.

Creating a user on the Microsoft Windows NT Server 4.0

Each JavaOS for Business user must be defined on the Microsoft Windows NT Server 4.0 in addition to being defined in the JavaOS System Database (JSD). To define the user on the Windows NT Server:

1. Select **Start**, **Programs**, **Administrative Tools (Common)**, and **User Manager for Domains**.
2. Select **User**.
3. Select **New User**.
4. Specify the user id and desired initial password for the user.
5. Clear the check box for **User Must Change Password at Next Logon**.
6. Select **Groups**.
7. Select the **NSMUser** group.
8. Select **Add** to add the group.
9. Select **OK**.
10. Select **Add** to add the user.
11. Select **Close**.
12. Select **Exit**.

To define other users with similar attributes, select **Users** and then **Copy** in the User Manager for Domains window.

Create a home directory

Create a home directory for the user on the server:

1. Select **Start**, **Programs**, and then **Command Prompt**
2. Create the home directory based on the userid of the user. For user *josuser*:

```
d:
cd \users
md josuser
```

The organization of directories for users is illustrated here:

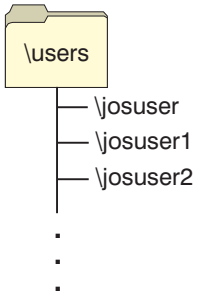

Figure 26. Organization of home directories

Defining an alias for the home directory

Define an alias for the user's home directory:

1. Select **Start**, **Programs**, **Network Station Manager TCP/IP**, and then **Configuration Utility**.
2. Select the **NFSD** tab.
3. Select the check box for **Use Windows NT Security**.
4. Select **Add** to add export directories for JavaOS for Business
5. Add a directory alias for the user's home directory. For the *josuser* user id:

   directory d:\users\josuser

   alias /josuser/

   comment Alias for JOSUSER home directory

   access read/write
6. Select **OK**.

Note: Before you can bring up the **josuser** network computer, you need to either:

- Reboot the server and restart the JSD server, or
- Stop all the services that you have changed (DHCP, TFTP, and so on) and then restart them.

Set Windows NT file permissions for home directory

Set the appropriate file permissions for the user's home directory:

1. Select the **My Computer** icon on the desktop.
2. Select the drive where the user directory resides.
3. Select the directory associated with the user.
4. Use the right mouse button and select **Properties**, **Security**, and then **Permissions**.
5. Select the **Replace Permissions on Subdirectories** check box.
6. Select the **Replace Permissions on Existing Files** check box.
7. Select **Everyone**.
8. Select **Remove** so that no one has access to the directory.
9. Select the **Replace Permissions on Subdirectories** check box.
10. Select the **Replace Permissions on Existing Files** check box.
11. Select **Add**.
12. Select **Show Users** and then select the appropriate user, such as *josuser*, the anonymous user id, and **Administrator**.
13. Select **Add**.
14. Select **Full Control** as the type of access.
15. Select **OK**.
16. Select **OK**.

17. Select **Yes** to replace security information.
18. Select **OK**.

Create a JavaOS for Business user

Perform the following steps to define the user previously created in Microsoft Windows NT Server 4.0 to JavaOS for Business:

1. Start the JavaOS Configuration Tool (JCT), if needed.
2. Select **Users**.
3. Select **Add**.
4. Fill in the User name, Full name, and Phone number fields. The information in these fields must match those specified in the Microsoft Windows NT Server 4.0 settings in “Creating a user on the Microsoft Windows NT Server 4.0” on page 45.
5. Select **Create**.
6. Select **Users**.
7. Select **Edit**.
8. Select the user to configure.
9. Follow the steps in “Configuring required services” to configure the required services.

Configuring required services

When a JavaOS for Business user has been created in the JSD, configure the minimum required services. These services must be configured in either the user record or in the record of a group that the user is a member of. The required services include:

- Establishing the home directory.
- Setting up a default desktop application.

In addition, some services previously configured in a platform or profile record can be overridden here. This makes it possible for a user to have a specific video resolution set, for example. Also, services which have not previously been configured can be established at a user level. For example, a proxy server could be set for a user or a group of users.

The tasks below assume that you are still in the JCT. Select **Groups**, and then **Edit**, and then proceed

Establishing the home directory

1. Select **NFS Automounter**.
2. Select **Add**.
3. Complete the necessary information for user *josuser*:

   Client mount name /HOME

   Protocol type UDP

   Mount path josserv:/josuser

Defining the HotJava browser as the default desktop application

1. Select **NFS Automounter**.
2. Select **Add**.
3. Complete the necessary information. For the HotJava Browser 1.1.4, possible values are:

   Client mount name /HOTJAVA

   Protocol type UDP

   Mount path josserv:/hotjava
4. Select **Save**.
5. Select **OK**.
6. Select **HotJava Configuration**.
7. Select **Add**.
8. Set the location of the default home page. For instance:

   `http://www.ibm.com/Java/`
9. Select **Save**.
10. Select **OK**.
11. Select **HotJava Load Settings**.
12. Select **Add**.
13. Set the location of the ZIP file

    `file:/HOTJAVA/hotjava.zip`
14. Select **Save**.
15. Select **OK**.

Choosing a proxy server

If your network is located behind a firewall, you will need to define a proxy server to allow users access to the Internet.

1. Select Proxies settings.
2. Select **Add**.
3. Enter the URL for the proxy server.
4. Select **Save**.
5. Select **OK**.

Creating the Master Configuration File

When a new machine or platform has been created, you must create a Master Configuration File (MCF) for it. The MCF gives the network computer access to files on the the server in the early stages of boot processing. To create the MCF:

1. Start the JCT if necessary.

2. Select **Maintenance**.
3. Select **Export MCF File**.
4. Select machine based on MAC address or manufacturer and platform.
5. Select **Build**.

Figure 25 on page 43 shows a sample Master Configuration File where the serial driver is configured as an early service.

```
;010060942551f9 configuration file
bootimage=/javaos/boot/javaos.x86
bootservice=file:/javaos/x86/services/EEPro100.jar
bootservice=file:/javaos/x86/services/NfsFileSystem.jar
bootservice=file:/javaos/x86/services/S3FrameBuffer.jar
bootservice=file:/javaos/x86/services/I8042.jar
bootservice=file:/javaos/x86/services/Uart16550.jar
bootproperties=/javaos/boot/010060942551f9\config.ser
```

Figure 27. A sample MCF with the serial driver configured.

After defining machines, you must update the **dhcpsd.cfg** file. See "Configuring DHCP" on page 29 for a description of the contents of this file and instructions on modifying it and validating that it is syntactically correct.

Printing

Network computers running JavaOS for Business can print to printers attached in the following ways:

- Print to a printer attached to the parallel port of the network computer.
- Print to a printer attached to a server.
- Print to a printer attached to another network computer running JavaOS for Business.
- Print from a server to a printer attached to the parallel port of the network computer.

Details on the configuration objects needed can be found in *Specifying printer information*.

Printing to a locally attached printer

To print to a printer attached to the parallel port of the network computer requires that the **Parallel Port** and the **Parallel Printer Configuration** objects be configured.

Printing to a printer attached to a server.

To print to a printer attached to a server requires that the **Parallel Port**, **Parallel Printer Configuration**, and **Remote Printer** configuration objects be configured. In addition, the Line Printer Daemon (LPD) must be started on the server.

Perform the following tasks to set up a remote printer on Microsoft Windows NT Server 4.0:

- Install Simple TCP/IP Services and Microsoft TCP/IP Printing Services.
- Configure both services to start automatically.
- Define a printer queue on the server.

- Give the desired network computers access to the printer.

Installing TCP/IP Printing Services: Providing remote printer access from Microsoft Windows NT Server 4.0 requires that both the **Simple TCP/IP Services** and the **Microsoft TCP/IP Printing Services** are installed. To check whether they are installed and install them if necessary:

1. Select **Start**, **Settings**, **Control Panel**, and then **Network**.
2. Select the **Services** tab.
3. Scroll through the list of services. If **Simple TCP/IP Services** and **Microsoft TCP/IP Printing Services** are not installed, install them by continuing with the following steps.
4. Select **Add** to add a service.
5. Select **Simple TCP/IP Services** and select **Add**.
6. Select **Microsoft TCP/IP Printing Services** and select **Add**.
7. Select **OK** to close the dialog.
8. Shut down and reboot the server when requested.

Configuring TCP/IP Printing Services: After the server reboots, logon as *Administrator* and then configure **Microsoft TCP/IP Printing Services** to start automatically.

1. Select **Start**, **Settings**, **Control Panel**, and then **Services**.
2. Scroll through the list and locate **Microsoft TCP/IP Printing Services**.
3. Press **Startup...** to adjust the startup properties.
4. Select **Automatic** to have the **Microsoft TCP/IP Printing Services** start automatically.
5. Press **OK** and close the dialog.

Defining a Remote Printer: To define a remote printer in Microsoft Windows NT Server 4.0:

1. Select **My Computer**, **Printers**, and then **Add Printer**.
2. Select **Add Printer** and press **Next**.
3. Select the check box associated with the port the printer is connected to, such as LPT1. Press **Next**.
4. Select the appropriate manufacturer and then the appropriate printer. Press **Next**.
5. Select **Yes** if you want this printer to be the default printer on the server. Otherwise select **No**. Press **Next**.
6. Select **Shared** and then select the operating systems that require access to the printer. Use **Windows NT 4.0 MIPS** for JavaOS for Business network computers.
7. Choose a share name. The share name is used as the *printer name* when installing a remote printer on JavaOS for Business. Press **Next**.
8. Select **Yes** to print a test page. If the test page does not print correctly, correct your printer configuration problem before proceeding. Press **Next**.

If you already have a local printer defined on the Windows NT server, you can make it available to network computers as follows:

1. Select **My Computer**, **Printers**, and then highlight the printer you want to make available.
2. Select the printer with the right mouse button and select **Properties**.
3. Select **Sharing**, press **Shared**, and then specify the share name for the printer.

Giving Users Access to the Printer: After the printer has been defined to Microsoft Windows NT Server 4.0 as a shared printer, you must give the users access to the printer. Access is granted by:

1. Select **My Computer**, **Printers**, and then highlight the printer you want to give users access to.
2. Select the printer with the right mouse button and select **Properties**.
3. Select the **Security** tab.
4. Press the **Permissions** button.
5. Give the following users **Full Control** access to the printer:
   - Administrators
   - Translated administrators group, if on a national language version of Windows NT
   - NSMUser group

Printing to a printer attached to another network computer

To print to a printer attached to another network computer running JavaOS for Business requires that the parallel port, parallel printer, and the remote printer configuration objects be configured. In addition, the network computer with the printer attached needs to be suitably configured.

Testing

At this point, all the appropriate software should be installed on the Microsoft Windows NT Server 4.0 and all the necessary configuration should be completed. To verify that a JavaOS for Business network computer can boot from the server, you'll want to turn on one of the network computers you have configured. A possible sequence is:

1. Verify that all the servers are running and that they are cabled to the network.
2. Connect the monitor, keyboard, mouse, power, and network cables for each network computer.
3. Start the JavaOS System Database (JSD) server if it is not already started. (See “Starting the JavaOS System Database (JSD) Server” on page 31.)
4. Turn on the network computer. Depending on the network computer, and how it is configured, you might see introductory information from the manufacturer followed by a memory test or other diagnostics.
5. The network computer then sends a DHCP request with its MAC address out to the network.
6. One of the servers on the network responds to the DHCP request based on the MAC address specified and you should see TFTP of the JavaOS for Business boot loader begin. If not, the transfer fails with an error message.
7. After the download of the boot loader, the Master Configuration File (MCF) is downloaded using TFTP along with the JavaOS for Business binary boot image and the downloadable system services specified in the MCF.
8. If logon authentication is enabled in JavaOS for Business, you will be prompted for a user id and password.
9. After a successful logon, the main application specified for the user is loaded. By default, this is the HotJava Browser 1.1.4.

Installation Troubleshooting and Common Problems

If you encounter problems during the inital installation and configuration of JavaOS for Business, you can find additional debugging information and solutions to common problems in the following places.

DHCP Error Log

The path to the DHCP error log is defined in **d:\ibmtcpip\etc\dhcpsd.cfg**. Look here if network computers can not boot from the server.

TFTP Error Log

The TFTP Error Log can be found by:

1. Select **Start**, **Programs**, **Administrative Tools**, **Event Viewer**, **Log**, and then **Application**.
2. Check for entries with the string `TFTP` in them.

NFS Error Log

The NFS Error Log can be found by:

1. Select **Start**, **Programs**, **Administrative Tools**, **Event Viewer**, **Log**, and then **Application**.
2. Check for entries with the string `NFS` in them.

Boot Failures Without DHCP, TFTP, or NFS Errors

If a JavaOS for Business network computer does not boot and you do not find any DHCP, TFTP, or NFS related errors in the respective error logs, try the following:

1. Verify that the DHCP, TFTP, and NFS services are started on the server.
2. Recreate the Master Configuration File (MCF) associated with the network computer or platform.
3. Check the Windows NT file system permissions. Re-apply the appropriate permissions to the boot and services directories, and the user's home directory.

If a null pointer exception is taken after the network computer logs on but before the HotJava Browser starts, verify that the HotJava Configuration entry has been established for the user, group, profile, or platform associated with the failure.

Appendix A. Tested Network Computer Hardware Configurations

The following section lists the hardware configurations and adapters known to work with this release of JavaOS for Business. This is not intended as an exhaustive list of all acceptable configurations.

Basic network computer configuration

All platforms tested were equipped with a standard US keyboard, a PS/2 mouse, and a UART 16550 serial port. Firmware levels of 3/97 and 4/98 worked consistently, but earlier versions did not. Configurations with 32 MB of RAM were also tested, but better video and overall performance was achieved with 64 MB or higher. A summary of the processors tested is found in Table 1.

Table 1. Processor and RAM information for tested configurations.

Processor Type	**Processor Speed (MHz)**	**RAM (MB)**
Pentium	166	64
Pentium	166	128
Pentium Pro	180	128
Pentium Pro	200	64
Pentium Pro	200	128
Pentium II	233	64

Video configurations

The network computers tested used one of the following adapters:

- Matrox Millennium MGA (4 MB)
- S3 Trio 64V+ (2 MB)
- S3 Trio 64V2/DX (2 MB)

Audio configurations

The network computers tested support the Soundblaster 16 series of audio adapters. The following models were specifically tested:

- CT1740
- CT1750
- CT1770

The following SoundBlaster 16 models should also work, though they were not explicitly tested:

- CT1730
- CT1759
- CT1779
- CT2230

- CT2230C
- CT2230S
- CT2239
- CT2239C
- CT2239S
- CT2290
- CT2299
- CT2291
- CT2740
- CT2749
- CT2750
- CT2759
- CT2770
- CT2830
- CT2839
- CT2910
- CT2911
- CT2919
- CT2260
- CT2800
- CT2810
- CT2840
- CT2860

JavaOS for Business does not support any Plug and Play versions of SoundBlaster 16 adapters, original 8-bit SoundBlaster or SoundBlaster Pro adapters, or the AWE 32 or AWE 64 adapters.

Network adapters

The following network adapters have been tested:

- IBM Etherjet with 82558 (PXE capable)
- Intel® EtherExpress™ Pro 100B with 82558 (PXE capable)

Printers tested

The following printers have been tested using the IEEE-standard SPP mode parallel printer port on the network computers:

- IBM LaserPrinter 4029-040 10L
- IBM LaserPrinter 4019-001
- IBM 4317
- Lexmark Optra E+
- Lexmark Optra S2450
- Lexmark 4049-12R LaserPrinter OptraR
- Lexmark LaserPrinter 4039-16L
- Hewlett Packard LaserJet 5L
- Hewlett Packard Color LaserJet 1200C

Appendix B. Uninstalling the IBM Intermediate Support Driver

After the IBM Intermediate Support Driver is installed, the properties notebook for the TCP/IP protocol is not accessible. If you need access to this notebook, you must uninstall the driver, access the notebook, and then reinstall the driver as previously outlined. To uninstall the IBM Intermediate Support Driver, do the following:

1. Select **Start**, **Programs**, and then **Command Prompt**.
2. Change to the temporary directory containing the extracted files in step 4 on page 14 of installing the IBM Intermediate Support Driver.

   ```
   d:
   cd \temp\wedge
   ```

3. Run the **wejcfgex** command twice, once with the **-disable** option and once with the **-remove** option.

   ```
   wejcfgex -disable
   wejcfgex -remove
   ```

4. Select **Start**, **Settings**, **Control Panel**, **Network**, and then **Protocols**.
5. Select **IBM Intermediate Support Driver** and select **Remove**. The network properties notebook is now accessible.

Index

Printed in U.S.A.