

## **Introduction**

This document describes how to install, configure, and troubleshoot the 32-bit Data Link Control (DLC) protocol on a workstation running the Microsoft Windows 95 operating system. This information assumes that you are familiar with Windows 95 and with networking technical issues, as described in the *Microsoft Windows 95 Resource Kit*.

The DLC protocol is used primarily to access IBM® mainframe and AS/400 computers. Host terminal emulation programs use this protocol to communicate directly with mainframe computers. This protocol is not used for general networking with Windows 95.

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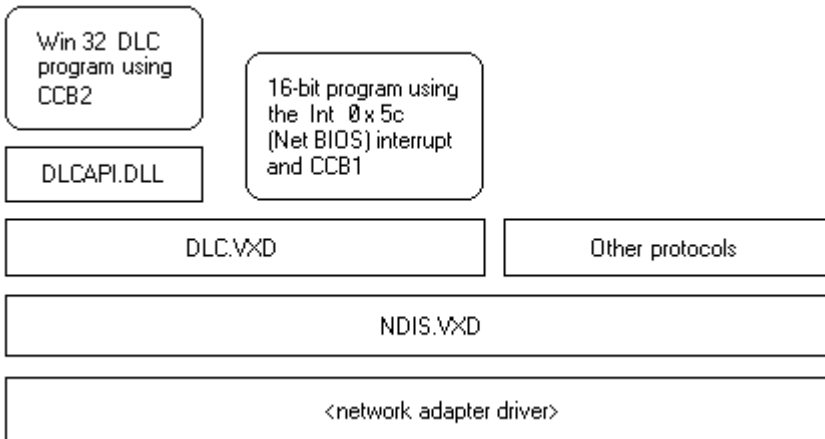
## Basics for the 32-bit DLC Protocol

The 32-bit DLC protocol software for Windows 95 enables a network administrator to add support for 32-bit and 16-bit programs that use the DLC protocol.

This protocol provides support for Windows-based 32-bit programs that use CCB2, but not for 32-bit programs created to run under OS/2. This protocol also supports 16-bit programs that use CCB1. It replaces the Microsoft 16-bit DLC protocol, and can also replace IBM's LAN Support drivers, making more conventional and upper memory available. For more information about switching from IBM's LAN Support drivers, see [Switching from IBM LAN Support](#).

For direct communication with a host computer, such as a mainframe or an IBM AS/400, you can install the 32-bit DLC protocol on the workstation that is running Windows 95. You can use this protocol with token-ring, FDDI, and Ethernet network adapter drivers.

**Note** You can also use the 32-bit DLC protocol to provide connectivity to local-area printers connected directly to the network. For example, you can use the DLC protocol to print to a printer (such as a Hewlett-Packard HP® LaserJet® 4Si) that uses an HP JetDirect® network adapter to connect directly to the network rather than to a port on a print server. The DLC protocol must be installed and running on the print server for the printer. The protocol does not need to be installed on the computers that send print jobs to the print server. To take advantage of the DLC protocol device driver, you must create a network printer in the Printers folder.



The 32-bit DLC protocol does not use a network redirector to communicate with the network. It does not have a NetBIOS interface. A 16-bit terminal emulation program can call the 32-bit DLC protocol by using the Int 0x5C (NetBIOS) interrupt vector. The 32-bit DLC protocol can coexist with other protocols, and it conforms to the Network Driver Interface Specification (NDIS) 3.1.

Using the 32-bit DLC Protocol for Windows 95

## Installing the 32-bit DLC Protocol

You can install the 32-bit DLC protocol on computers running Windows 95 by using the Network icon in Control Panel. You can also install this protocol by using statements in custom setup scripts when Windows 95 is installed on workstations. For more information, see [Automated Installation of Windows 95 with the 32-bit DLC Protocol](#).

**Note** Before you begin, make sure your Windows 95 Setup disk is available. During Setup, you are prompted for files located on the disk.

When you are prompted for your Windows 95 Setup disk, you must specify the folder on the Setup disk that contains the Windows 95 cabinet (.cab) files.

### To install Microsoft 32-bit DLC protocol

1. In Control Panel, double-click the Network icon, and then click Add.
2. Double-click Protocol.
3. Click Have Disk, and then type the drive name for the disk or network drive where the 32-bit DLC files are located.
4. Follow the instructions on your screen. When you are instructed to do so, shut down and restart the computer so the new settings can take effect.

**Note** To verify that the 32-bit DLC protocol has been bound to the adapter, double-click your network adapter, and then click the Bindings tab. You cannot check the bindings by double-clicking the 32-bit DLC protocol, because only clients and services can be bound to protocols.

Windows 95 Setup removes any previous configuration settings for 16-bit Microsoft DLC, and adds an entry in the Autoexec.bat file for Dlchlp.exe, the file that supports 16-bit DLC programs.

The following list describes the files provided to support the 32-bit DLC protocol.

| Filename     | Description   |
|--------------|---|
| Netdlc32.inf | The Windows 95 device information file, which provides settings used by Windows 95 Setup to install DLC.  |
| Dlc.vxd      | The Windows 95 device driver for DLC.   |
| Dlcapi.dll   | The DLL file that supports 32-bit DLC programs.   |
| Dlncdi.dll   | A DLL file used by Windows 95 Setup for custom installations.   |
| Trcdlc.exe   | A command-line trace utility for viewing DLC commands that are running 32-bit calls. This utility helps developers troubleshoot 32-bit DLC programs.                                    |
| Dlchlp.exe   | A TSR that allows 32-bit DLC to also support 16-bit DLC programs. This file is loaded in the Autoexec.bat file, but is not required if you do not need support for 16-bit DLC programs. |

**Caution** If you do not need support for 16-bit DLC programs, do not remove Dlchlp.exe from your Autoexec.bat file manually. Instead, disable support for 16-bit DLC programs by using the Support CCB1 setting. For more information, see [Disabling 16-Bit Support](#).

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## **Automated Installation of Windows 95 with the 32-bit DLC Protocol**

You can include the Microsoft 32-bit DLC protocol in automated installations that work with Msbatch.inf. For more information about automated installations, see Chapter 5, "Custom, Automated, and Push Installations," of the *Microsoft Windows 95 Resource Kit*.

To set up the Microsoft 32-bit DLC protocol during an automatic installation of Windows 95, you would need to carry out the following tasks:

1. Add the 32-bit DLC protocol to the list of protocols available from Msbatch.inf.
2. Include the 32-bit DLC protocol in Msbatch.inf.

### **To add the 32-bit DLC protocol to the list of available protocols**

1. Copy all the files for the 32-bit DLC protocol to the directory where you will store your Windows 95 .cab files.
2. Create a file named Custom.inf, and then copy the following lines and paste them into the file:

```
[version]
signature="$CHICAGO$"

[Custom_Precopy]
CopyFiles=PrecopyFiles

[DestinationDirs]
PrecopyFiles=2

[PrecopyFiles]
netdlc32.inf

[SourceDisksNames]
1=Disc_1_Desc,"",0

[SourceDisksFiles]
netdlc32.inf=1,,6000

[load_inf]
netdlc32.inf
```

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## **Server-Based Setup with the 32-bit DLC Protocol**

You can include the Microsoft 32-bit DLC protocol in server-based installations of Windows 95. For more information about server-based installations, see Chapter 4, "Server-Based Setup for Windows 95," of the *Microsoft Windows 95 Resource Kit*.

To include the Microsoft 32-bit DLC protocol in a server-based installation of Windows 95, you would need to carry out the following tasks:

1. Include the Microsoft 32-bit DLC protocol with a shared installation of Windows 95.
2. Set up users' computers with the shared installation. During the installation, add the Microsoft 32-bit DLC protocol.

### **To include the Microsoft 32-bit DLC protocol with a shared installation of Windows 95**

1. Set up Windows 95 on the server for remote installation. For more information about how to do this, see the *Microsoft Windows 95 Resource Kit*.
2. On the Windows 95 CD-ROM, change to the \Admin\Nettools\Netsetup directory, and then run Infnst.exe.
3. Click Set Path, and then type the location of the Windows 95 installation on the network server.
4. Click Install INF, and then type the path of the directory or network drive where you have stored the Microsoft 32-bit DLC installation files.

For more information about Infnst.exe, see the *Microsoft Windows 95 Resource Kit*.

When you are doing server-based installation, you can install the 32-bit DLC protocol in two ways:

Have it automatically installed by using Msbatch.inf.

Install it manually on each user's computer.

### **To set up a user's computer for server-based setup with the 32-bit DLC protocol automatically included**

1. Open the folder in which you created the Windows 95 installation.
2. Copy the following line to the [Network] section of the Msbatch.inf file:

```
protocols=32dlc
```

**Note** You can also include entries for other networking protocols on the protocols= line. Each protocol should be separated by a comma. For example:

```
protocols=32dlc,tcp/ip
```

2. Run Windows 95 Setup from the network drive.

### **To set up a user's computer for server-based setup and the 32-bit DLC protocol manually**

1. Run Windows 95 Setup from the network drive. Choose the Custom installation option.
2. On the Network configuration screen, click Add, and then click Protocol.
3. Click Microsoft, and then click Microsoft 32-bit DLC.

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## **Configuring the 32-bit DLC Protocol**

You can configure settings for the 32-bit DLC protocol by using the Network icon in Control Panel. In most cases, you do not need to change the default values.

### **To configure the 32-bit DLC protocol manually**

1. Double-click the Network icon in Control Panel.
2. Double-click the 32-bit DLC protocol.  
If you have multiple adapters in the computer, there is an instance of the protocol for each adapter.
3. Click the Advanced tab to modify settings for the 32-bit DLC protocol. For information about specific settings, see [Settings for the 32-bit DLC Protocol](#).
4. When you finish making changes, click OK. When you are prompted to do so, shut down and restart the computer for the changes to take effect.

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Configuring the 32-bit DLC Protocol

## Settings for the 32-bit DLC Protocol

The following list defines the settings you can configure by using the Network icon in Control Panel. These settings are used only for program support.

| 32-bit DLC parameter                              | Description  | Units        | Range    | Default |
|---|--|--------------|----------|---------|
| CCB Adapter Num (equivalent to LANANumber in NCB) | Specifies a unique number used by 32-bit DLC to identify each instance of a driver that is associated with a network card. For more information about setting the CCB number for an alternate or secondary network card, see <a href="#">Configuring a second network adapter to use the 32-bit DLC protocol</a> . | ordinal      | 1-15     | 0       |
| Ethernet DIX                                      | Sets the frame format. For 802.3 Ethernet format, set the value to 0. For Ethernet DIX 2.0 (Ethertype 0x80D5) format, set the value to 1 (enable). (Ethernet DIX frames have an extra type field.)   | Boolean      | 0- 1     | 0       |
| Max Grp Member                                    | Specifies the maximum number of SAPs that can belong to each Group SAP.  | members      | 1- 127   | 0       |
| Max Grp SAPs                                      | Specifies the maximum number of Group SAPs that can be opened simultaneously.  | SAPs         | 1- 126   | 0       |
| Max Links   | Indicates the number of link stations that can be opened simultaneously. For more information, see <a href="#">Max Links and Max SAPs Settings</a> .   | links        | 1- 255   | 20      |
| Max SAPs  | Indicates a server access point. For a description of SAPs, see the IBM <i>Local Area Network Technical Reference</i> . For more information, see <a href="#">Max Links and Max SAPs Settings</a> .  | SAPs         | 1- 255   | 3       |
| Maximum Adapters                                  | Indicates the maximum number of network adapter cards you can have in your computer.   | adapters     | 1- 16    | 4       |
| Maximum Frame Size                                | Indicates the maximum size of a frame that can be sent across the network. The maximum value of this setting depends on the network type. For more information, see your network documentation.  | bytes        | 96-17960 | 4464    |
| Maximum   | Indicates the maximum number   | adapter open | 1-40     | 5       |

|                      |   |                 |        |    |  |
|----------------------|---|-----------------|--------|----|--|
| Users                | of logical adapters that can be open at the same time. Typically, each 32-bit program opens a logical adapter of its own.   | handles         |        |    |  |
| NDIS Pkt Descriptors | Specifies the number of packets that the adapter driver can store in its packet buffer before sending them to the network.  | packets         | 24-128 | 24 |  |
| Support CCB1         | If this setting is set to 1, then 16-bit programs that use CCB1 are supported. If it is set to 0, then only 32-bit DLC programs are supported. For more information, see <a href="#">Disabling 16-Bit Support</a>   | Boolean         | 0-1    | 1  |  |
| Swap Addr Bits       | When DLC is bound to an Ethernet or token-ring driver, set this parameter to 1 (enable) to turn on address bit-swapping.  | Boolean         | 0- 1   | 1  |  |
| Timer T1 (1)         | Sets the retransmission-timer "short tick" value. This timer determines the delay before retransmitting a link-level frame if no acknowledgment is received. For more information, see <a href="#">Timer Settings</a> .   | 40 milliseconds | 1- 255 | 5  |  |
| Timer T1 (2)         | Sets the retransmission-timer "long tick" value. This timer determines the delay before retransmitting a link-level frame if no acknowledgment is received. For more information, see <a href="#">Timer Settings</a> .  | 40 milliseconds | 1- 255 | 25 |  |
| Timer T2 (1)         | Sets the delayed-acknowledgment timer "short tick" value. This timer determines the delay before acknowledging a received frame when the receive window has not been reached. For more information, see <a href="#">Timer Settings</a> .                            | 40 milliseconds | 1- 255 | 1  |  |
| Timer T2 (2)         | Sets the delayed-acknowledgment timer "long tick" value in units of 40 milliseconds. This timer determines the delay before acknowledging a received frame when the receive window has not been reached. For more information, see <a href="#">Timer Settings</a> . | 40 milliseconds | 1- 255 | 10 |  |
| Timer Ti (1)         | Sets the inactivity-timer "short tick" value. This timer determines how often DLC   | 40 milliseconds | 1- 255 | 25 |  |



checks an inactive link to see whether it is still operational. For more information, see [Timer Settings](#).

|              |   |                 |        |     |
|--------------|---|-----------------|--------|-----|
| Timer Ti (2) | Sets the inactivity-timer “long tick” value. This timer determines how often DLC checks an inactive link to see whether it is still operational. For more information, see <a href="#">Timer Settings</a> . | 40 milliseconds | 1- 255 | 125 |
| Trace Mask   | Indicates the default mask setting used by the Trcdlc.exe command-line utility. For more information, see <a href="#">Installing the 32-bit DLC Protocol</a> .  | –               | –      | –   |

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### **Configuring a second network adapter to use the 32-bit DLC protocol**

If you add a second network adapter to your computer, a new copy of the 32-bit DLC protocol is created and automatically bound to your secondary network adapter, if the adapter is compatible with the 32-bit DLC protocol. When you restart your computer, the CCB Adapter Number setting for that copy of the 32-bit DLC protocol automatically changes to a unique number.

**Note** If you remove your primary network adapter, the CCB Adapter number for the secondary adapter does not change.

For more information about the CCB Adapter Number setting, see [Settings for the 32-bit DLC Protocol](#).

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## Timer Settings

The Microsoft DLC protocol uses three timers:

t1 (retransmission)

t2 (acknowledgment)

ti (inactivity)

Each timer has a "short tick" rate and a "long tick" rate that individual commands use in determining timer values. A command such as `Dlc.Open.Sap` specifies a timer value with a number range of 1 through 10 units of milliseconds.

When the number is in the range of 1 through 5 units of milliseconds, the actual timer value is:

`(number selected) * (short-tick value) * 40 milliseconds`

When the number is in the range of 6 through 10 units of milliseconds, the actual timer value is:

`(number selected - 5) * (long-tick value) * 40 milliseconds`

Some network programs adjust these timer entries automatically. The `Dlc.Open.Adapter` command overrides the default value.

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## Technical Notes for the 32-bit DLC Protocol

This section contains technical information for the 32-bit DLC protocol.

The following 16-bit DLC protocol settings are still available with the 32-bit DLC protocol, although the names have changed.

| <b>16-bit DLC</b> | <b>32-bit DLC</b> |
|-------------------|-------------------|
| Swap              | Swap Addr Bits    |
| UseDIX            | Ethernet DIX      |
| SAPS              | Max SAPS          |
| Stations          | Max Links         |

The multi-vendor standard is known as the DIX standard, named from the initials of the three participants: Digital Equipment Corporation, Intel, and Xerox. There are two versions of Ethernet DIX: 1.0 and 2.0. Windows 95 supports Ethernet DIX 2.0.

The IEEE 802.3 CSMA/CD standard for Ethernet technology is based on the DIX Ethernet standard.

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## **Disabling 16-Bit Support**

If your users will use only 32-bit network programs, you can disable support for 16-bit programs. This speeds up network access.

### **To disable 16-bit program support**

1. Double-click the Network icon in Control Panel, and then click the Configuration tab.
2. Double-click the 32-bit DLC protocol, and then click the Advanced tab.
3. Click the Support CCB1 setting, and then set it to 0.

Disabling the Support CCB1 setting removes the reference to Dlchlp.exe from your Autoexec.bat file.

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## Switching from IBM LAN Support

If your site previously used IBM LAN Support and is now switching to the 32-bit DLC protocol, use the following chart to convert the Xmit\_swap setting in Dxme0mod.sys to the Swap Addr Bits and Ethernet DIX settings for the 32-bit DLC protocol.

| <b>Xmit_swap setting in<br/>Dxme0mod.sys</b> | <b>Swap Addr Bits setting</b> | <b>Ethernet DIX setting</b> |
|--|-------------------------------|-----------------------------|
| 0  | 1                             | 0                           |
| 1  | 1                             | 1                           |
| 2  | 0                             | 0                           |
| 3  | 0                             | 1                           |

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## **Max Links and Max SAPs Settings**

Each program requires a certain number of SAPs and link stations. Because each SAP or link station takes up memory, you should provide just enough for your program to run.

If you do not know the number of SAPs and link stations your program requires, and you want to minimize the memory your terminal emulation programs use, start with large values and gradually reduce them until the program no longer works.

The Microsoft 32-bit DLC protocol uses defaults of five SAPs, and 20 link stations. This should be sufficient for most programs. If needed, you can increase the number of SAPs and link stations. For more information about configuring 32-bit DLC settings, see [Configuring the 32-bit DLC Protocol](#).

For information about which SAP and link station settings to use with your DLC programs, see the documentation for those programs.

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## **Troubleshooting Tips for Microsoft 32-bit DLC**

This section provides troubleshooting tips for problems that might occur with the 32-bit DLC protocol.



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## **General Troubleshooting Tips**

### **Windows 95 reports a Dllchlp error message.**

This error message occurs if you have removed or renamed your Autoexec.bat file, or removed the reference to Dllchlp.exe from your Autoexec.bat file. To correct this error, add the Dllchlp.exe entry back into your Autoexec.bat file.

For more information about the purpose of Dllchlp.exe, see [Disabling 16-Bit Support](#).

### **Setting 32-bit DLC as the default protocol does not change the LANA number for NetBIOS protocols.**

The 32-bit DLC protocol does not use a LANA number, so there is no reason to set DLC to be the default protocol.

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## **Setup Issues**

### **My DLC program does not connect after upgrading from IBM LAN Support to the Microsoft 32-bit DLC protocol.**

The 32-bit DLC protocol cannot be upgraded over IBM LAN Support. If you add the 32-bit DLC protocol without first removing your IBM DLC protocol, you may not be able to connect to your host, and the Windows 95 computer could stop responding.

You must first remove the IBM DLC protocol from the Network properties in Control Panel, and then add the Microsoft 32-bit DLC protocol. For more information, see [Installing the 32-bit DLC Protocol](#). The IBM LAN Support program settings will not be migrated to the Microsoft 32-bit DLC protocol. Make sure that the settings for the Microsoft 32-bit DLC properties correlate to the prior settings for IBM LAN Support. For more information, see [Switching from IBM LAN Support](#) or [Settings for the 32-bit DLC Protocol](#).

**Note** Before upgrading over IBM LAN Support, record the parameters for the DXM driver line(s) so that you can configure the equivalent Microsoft 32-bit DLC protocol settings. For more information, see [Switching from IBM LAN Support](#).

### **How do I set up 32-bit DLC for an alternate adapter after upgrading from IBM LAN Support?**

You can configure the alternate adapter by using the CCB Adapter Num setting. For more information, see [Configuring a second network adapter to use the 32-bit DLC protocol](#).

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## **Compatibility and Configuration Issues**

### **Can 32-bit DLC bind to Dial-Up adapter?**

Currently, the Microsoft 32-bit DLC protocol cannot bind to the Dial-Up adapter. When the Dial-Up adapter is installed and you then install the 32-bit DLC protocol, the 32-bit DLC protocol appears to be bound to the Dial-Up adapter. However, after you restart your computer, Windows 95 removes the binding. This is by design.

### **Why can't I use Extra SAPs and Extra Stations settings?**

The Extra SAPs and Extra Stations settings are no longer necessary with the Microsoft 32-bit DLC protocol. Originally, these settings helped save conventional memory, which is no longer an issue.

### **After removing an adapter driver, my programs cannot connect to the host.**

When your computer is configured with multiple network adapters, removing an adapter driver might prevent the DLC program from connecting properly to the host. The connection fails when the removed network adapter driver is the adapter that the DLC program is configured for. To prevent this problem, if the DLC program is configured for the primary adapter, make sure the CCB Adapter Num is set to 0. If the DLC program is configured for the alternate (or secondary) adapter, make sure the CCB Adapter Num is set to 1. The 32-bit DLC protocol allows CCB2 adapter numbers 0 through F.

### **I cannot connect over Ethernet to my host after adding or upgrading to the 32-bit DLC protocol.**

The most common issues you will face when using the DLC protocol on Ethernet are problems with bit swapping and Ethernet DIX. Check to see whether the host uses frame type 802.3 or Ethernet DIX 2.0, and whether address swapping is required on your network. For more information about configuring the 32-bit DLC protocol, see [Configuring the 32-bit DLC Protocol](#).

### **After installing the 32-bit DLC protocol on a token-ring network adapter, my Windows 95 computer stops responding.**

Sometimes a token-ring network adapter has an RcvBufSize setting that is too small for the size of the frame being sent across the wire. If this happens, restart Windows 95 in Safe mode, and increase the RcvBufSize setting for the network adapter driver. For more information about the appropriate settings for your network adapter, see the documentation for your network adapter.

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## Technical Support Information

### Microsoft Information Access

#### Online or support service      Access procedures

|  |   |
|--|---|
| The Microsoft Network                                    | From the Microsoft menu, click Windows 95, and then click WinNews, or access the Microsoft Knowledge Base   |
| America Online®  | Use the keyword <b>winnews</b>  |
| CompuServe®  | Type <b>go winnews</b> . To access the Microsoft Knowledge Base for product information, type <b>go mskb</b>  |
| FTP on the Internet                                      | Type <b>ftp://ftp.microsoft.com /PerOpSys/Win_News</b>  |
| GEnie™   | Download files from the WinNews area in Windows 95 RTC  |
| Prodigy™   | Type <b>jump winnews</b>  |
| World Wide Web (Internet)                                | Type <b>http://www.windows.microsoft.com</b>  |
| Microsoft FastTips for Windows 95                        | Call (800) 936-4200, available seven days a week, 24 hours a day, including holidays  |
| Microsoft Download Service (MSDL)                        | Contact by modem at (206) 936-6735, seven days a week, 24 hours a day, including holidays   |
| Microsoft Solution Provider for installation and support | For a referral, call Microsoft at (800) SOLPROV [(800) 765-7768]  |
| Microsoft Text Telephone (TT/TDD) services               | Call (206) 635-4948, between 6:00 a.m. and 6:00 p.m. Pacific time, Monday through Friday  |
| Microsoft Product Support Services                       | <p>Standard support for non-networking issues: Call (206) 637-7098 between 6:00 a.m. and 6:00 p.m. Pacific time, Monday through Friday. After a 90-day free period, call (900) 555-2000 or (800) 936-5700. For support outside the U.S., contact your local Microsoft subsidiary.</p> <p>Priority support, including networking issues: Priority telephone access to Windows 95 support engineers 24 hours a day, 7 days a week, excluding holidays, in the U.S. In Canada, the hours are from 6:00 A.M. to midnight, 7 days a week, excluding holidays. Priority support phone numbers and availability can be found in <i>Introducing Windows 95</i> or in the Windows 95 readme file Support.txt.</p> <p>Networking issues are defined as setup, configuration, or usage of Windows 95 in a networked environment. This includes, but is not restricted to, the following: Setting up a computer to be used in a networked environment, network administration, dialing in to a computer, connecting to the Internet using a service provider, and using e-mail or fax from within Windows 95.</p> |

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