The Software

Windows 95/98 networking

YOU'VE INSTALLED THE HARDWARE, now you need to consider what software you'll need to make the network operational. This chapter will help you determine your software requirements. To learn more about using the network — such as implementing file sharing — see the Network Manangement chapter.

Windows 95/98 setup

Setting up a basic network between Windows 95 or 98 computers is pretty simple. Windows 98 is, overall, better than 95, but it differs in a few significant ways. Windows NT is somewhat more complex, but commensurately more capable.

ONE

Install your network card as described in the Hardware chapter. If it's a PnP card, Windows should have automatically detected it and installed a driver for it.

TWO

If you don't have a PnP card, select 'Add New Hardware' from the Control Panel.
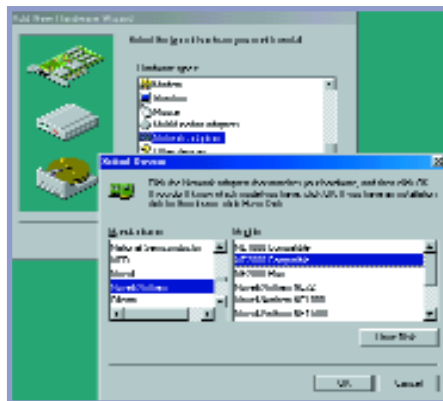
Windows 95 gives you an option to specify the kind of card you have at the outset, but Windows 98 automatically searches for new hardware. The auto-search function will probably find the card, but if you know what kind of card you have, selecting it from the list is faster with 95.

THREE

If Windows doesn't detect the card, it's probably because it's clashing with something
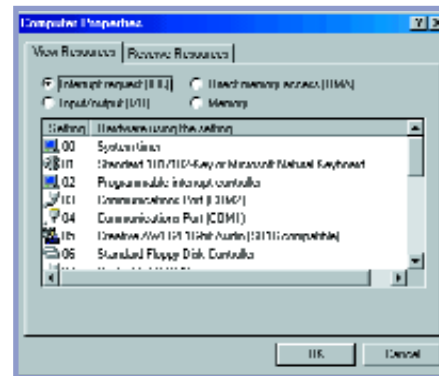

already in the system. You can try selecting it from the list (use the 'Have disk...' option if it isn't listed), but it probably won't work. Shut down, remove the card, start up again and check your Computer Properties by going to System Properties (right-click My Computer and select Properties, or open 'System' in the

Control Panel), selecting the Device Manager tab and double-clicking Computer at the top of the list. The 'Print...' button in Device Manager will let you make a hard copy of your system configuration, which is very useful at times like these. Use the default System Summary option if you want to save paper. Adjust the card's properties so it doesn't clash with any of the used resources.

FOUR

Once the card's driver is installed and you've restarted the computer, go to Device Manager and check the entry for your network card. If there's a problem, it'll be highlighted with an exclamation mark. If it isn't PnP, double-click it, select the Resources tab and make sure Windows has the right settings. If it doesn't, uncheck the Use Automatic Settings box
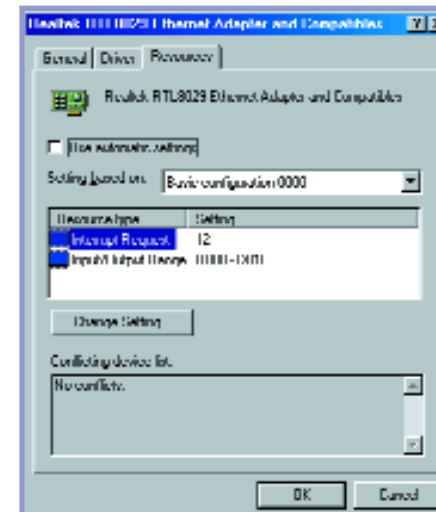

and use the 'Change Setting...' button to set it up correctly.

FIVE

If you're running Windows 95, going to Network Properties (right-click Network Neighborhood and select Properties, or open Network from the Control Panel) will reveal that 95 has, in its wisdom, installed a few clients and protocols. Windows 98 has a different default setting. You'll need to make sure you're using the right protocols and clients for your network. For example, if you want to use TCP/IP, make sure TCP/IP is installed. If you're not sure if you need all the default protocols listed, see 'Prune your protocols' on page 54 for more information.

SIX

Click the Identification tab in Network Properties and enter a computer name, a description if desired and a workgroup name, which must be the same as the workgroup name of any other Windows machines you want to connect to on the
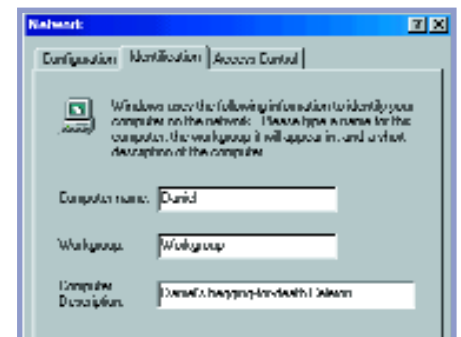
LAN. All computers in the same workgroup must have different computer names.

SEVEN

Restart and you'll be asked to enter a user name and password. You don't have to enter a password, but you do have to enter a user name or you won't be able to log on and access the network. For information on banishing the annoying logon box, see 'Bypassing the Windows logon' later in this chapter.

This is all you need to do if you want to access other people's shared data or programs on the network. To find out how to allow sharing of your own resources, see the Network Management chapter.

Changing protocols

Windows 95 and 98 install different protocols by default. Windows 95 installs NetBEUI, which, as we've mentioned, is an excellent bullet-proof protocol for the bulk of PC networks, and also IPX/SPX, which can be used by pretty much everything that doesn't work with NetBEUI — notably games.

Windows 98, on the other hand, installs TCP/IP by default. If you'd rather use NetBEUI, it's easy to change.

ONE

Go to Network Properties (accessible from the Control Panel, or by right-clicking the Network Neighbourhood icon and selecting Properties), select TCP/IP and click the Remove button. If you have Dial-Up Networking installed, you'll need TCP/IP, so
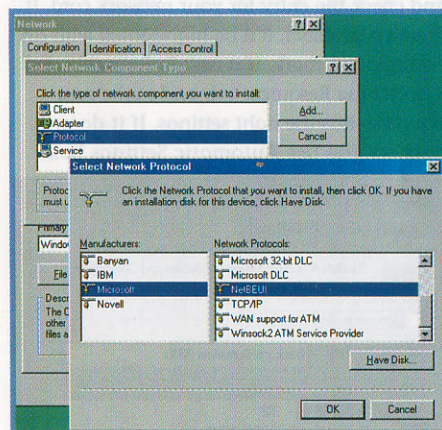
make sure you only remove the line where it says 'TCP/IP —> [your network card]'.

TWO

Click the 'Add...' button and select the protocol you want — probably, NetBEUI.

THREE

All the standard protocols are grouped under the Microsoft heading. Click the Apply and OK buttons until Windows says it wants to reboot. When you restart, you'll be using NetBEUI and will magically be able to see

every other computer on the network that uses NetBEUI without configuring anything else. If your network uses IPX and/or TCP/IP, you should install them or keep them so your network card can too.

If you have a Windows 95 computer with TCP/IP set up for its network card and you leave it on the default 'automatically obtain

an IP address' setting, the network to which the computer is connected must have a Dynamic Host Configuration Protocol (DHCP) server connected to it to dole out an address. In the Windows world, only Windows NT Server can perform this function natively; Windows 95 and 98 can do it too with third-party software like WinGate and Sygate, which are explained in more detail in the Hardware chapter.

Without a DHCP server, any 95 machines without addresses will fail to communicate over TCP/IP, and will furthermore slow the network down as they periodically yodel down the wire, hoping a server has appeared.

Windows 98 performs a little better. Machines set to automatically obtain an address which don't find a server will give themselves an address in the 'LINKLOCAL network' IP address space, which means an address starting with 169.254 and with two arbitrary numbers on the end. The LINKLOCAL space is a 'class B network', which means the network ID, indicated by the series of numbers or subnet mask, is the first two numbers. All 169.254.X.X computers can see each other provided the last two numbers

Picking your IP address

IF YOU DECIDE TO MAKE A TCP/IP LAN, you need to set it up correctly. On a private network, you can use any IP addresses you like, but your subnet masks must be the same or the computers won't be able to see each other. The subnet mask defines the portion of the IP address you're using to designate your local addresses. If your subnet mask is 255.255.255.0, all your IP addresses must have the same first three series of numbers, which means you're limited to only 254 discrete addresses; if you decide on 1.1.1 for the first three numbers, you can have 1.1.1.1 to 1.1.1.254.

If you give some machines a different address in the subnet area — say, 1.2.3 — they'll behave as if they're on a separate LAN even though they're plugged into the same wire and contributing to the same network traffic.

Two hundred and fifty-four computers is quite a lot for one LAN, but if your subnet mask is 255.255.0.0, you only need to make the first *two* numbers in the IP addresses the same — then you'd have more than 64,000 available addresses.

If you intend to connect your LAN to the Internet — which is becoming easier every day — you should use the block of IP addresses set aside for the purpose: 192.168.x.y, where *x* is whatever you want as long as it's the same for all computers on your LAN, and *y* is different for all computers on your LAN, and has a subnet mask of 255.255.255.0. There are no IP addresses on the Internet that start with 192.168, so it's easy for a network with an Internet connection to know that anything that isn't 192.168.x.y is an Internet IP address request.

When you set up your Internet connection, you need to tell the computer the Domain Name Server (DNS) IP address of the ISP. The computer uses the DNS location to translate names such as www.microsoft.com into the IP address, 207.46.131.13.

are different. Because the last two numbers can be from 0 to 255 and from 1 to 254 respectively, up to 64,515 computers can be on this network at once with minimal address clashes.

Using the magic random address generator, however, makes a 98 machine considerably slower to boot. And LINKLOCAL addresses are not legal for connections to the Internet (using ordinary Dial-Up Networking doesn't count, because it's a separate network adapter with its own IP address). So there's still justification for manually setting an IP address.

Prune your protocols

Windows 95/98 and NT sometimes install more protocols than necessary. This may be just what you want, but realistically you

A correctly pruned Windows 98 network setup for a computer with a modem for Internet access and a connection to a NetBEUI LAN: TCP/IP for the Dial-Up Adapter, NetBEUI for the network card, and no unnecessary duplications.

only need one, for example, if you only want a Dial-Up Adapter for Internet access, all you need is TCP/IP. If your network card is plugged into a LAN that uses NetBEUI, that's the only protocol it needs; everything else is clutter.

After setting up the protocols you want, get rid of those you *don't* want. In 95/98 this is easy enough.

Go to Network Properties (from the Control Panel, or by right-clicking the Network Neighborhood icon and selecting Properties), click on the unrequired protocol in the network components list and select Remove.

This lets you remove whole protocols from a given adapter. From Network Properties, you can also remove clients — if you have Client for NetWare Networks installed, for instance, and you aren't connected to a NetWare network, remove the extra client.

For greater efficiency you can also remove unnecessary bindings from a protocol that you *do* want for a given adapter. Double-click the protocol, and you'll see its properties, as shown below.

This computer is on a TCP/IP network and uses only TCP/IP, so both of the standard bindings — 'Client for Microsoft Networks' and 'File and printer sharing for Microsoft Networks' — are turned on. If you have a protocol installed which you need but which isn't your primary networking protocol (the classic example is a machine that uses NetBEUI or TCP/IP for regular networking but also has IPX/SPX installed for games),
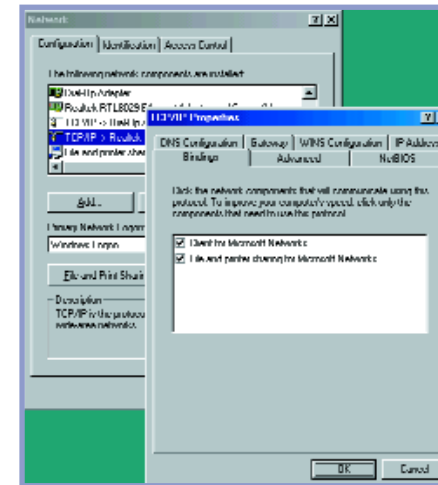
uncheck the Bindings boxes and click OK. Windows will prompt you to ensure you want to unbind everything; choose Yes.
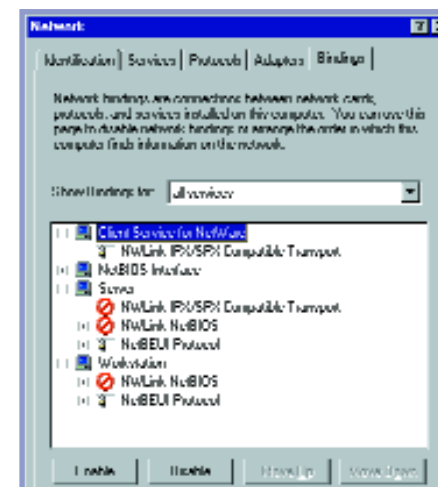
Windows NT is configured in the same way: you bind protocols to network adapters and services to protocols. But as usual NT makes everything look different. You can remove whole protocols from the Protocols tab in Network Properties, and turn off unnecessary bindings, using the Bindings tab.

Select the bindings you don't want to use and click the Disable button to turn them off.

95/98 and NT Domain Servers

It's easy to log on to a Windows NT Domain Server (a domain can contain multiple workgroups) from a Windows 95/98 box. Open Network Properties and double-click 'Client for Microsoft Networks'. Click the 'Log on to Windows NT Domain' box, enter the name

of the domain, and choose the 'Network logon options' you need. As long as you're defined as a user on the server and you log on to Windows 95/98 properly, you'll connect automatically.

Bypassing the Windows logon

If you install any kind of networking software in Windows NT or 95/98, you'll get a logon window when the computer restarts. On a 95/98 machine you can easily avoid this if you don't actually need to enter a user name and password; most users don't. Go to Network Properties and, in the initial Configuration tab, change Primary Network Logon to Windows Logon. Now all you need do is restart the computer and enter your name into the logon box with no password; you'll never see the logon box again. You have still officially logged on; if you don't log on at all (if you click Cancel in the logon box, for instance) you won't be able to use the network.

NT doesn't have this option. It's also no good for 95/98 users if you *do* need to log on to your Windows box with a password — so that you can connect to an NT server as a particular user, for instance.
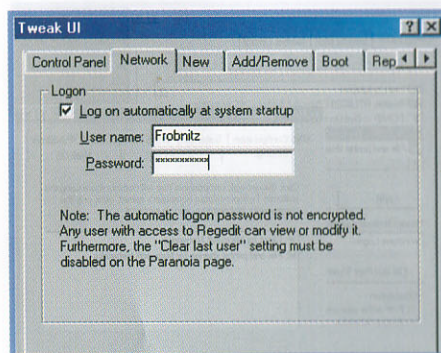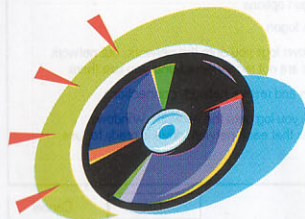
TweakUI allows you to bypass the login prompt.

Microsoft's TweakUI program solves this problem. You can find TweakUI for 95, along with other 95 Power Toys, at www.microsoft.com/windows95/downloads/contents/wutoys/w95pwrtoysset/default.asp. TweakUI for Windows 98 is on the 98 CD, in the tools/reskit/powertoy subdirectory.

One of TweakUI's many features is automated logon. Tell it your user name and password and it enters them for you on startup — this feature works fine under NT, as well. Don't, however, attempt to use TweakUI's other features if you are running NT.

Needless to say, automated logon is not a good thing if you want your system to be secure. In many situations, though, this isn't really a concern.

If you want to log in the old way again, you can disable auto-logon. To log on manually once, hold Shift when Windows is starting up.

Windows NT networking

SUPERFICIALLY WINDOWS NT 4.0 is similar to Windows 95/98, just as Windows NT 3.51 is similar to Windows 3.1. There are actually many differences under the bonnet, but for the average small office or home network the setup procedure for the 'industrial strength' Windows is often much the same as for 95 or 98.

Before undertaking any networking tasks with NT, make sure you're running the latest version. You can get Windows NT Service Packs from www.microsoft.com, or on CD from various sources, including the *APC* cover disks. When the Service Pack says you'll have to reinstall it if you 'change or add any components', it means it. If you change something and then start getting nonsense errors, you'll know the reason.

If you're not sure which Service Packs are installed on a given machine, run Windows NT Diagnostics, from Programs —> Administrative Tools (Common) in the Start Menu. The first screen will tell you which version of NT you're running.

Installing TCP/IP for Windows NT looks different from 95/98, but you do the same thing in the same order. Unlike Windows 98, NT cannot create its own IP address. So, as with 95, you should give it an address manually if you don't have a DHCP server. Again, you don't need to do this for Dial-Up Networking.

There's another standard rule for setting up an NT network which is wise to follow — don't do it as you install NT. Install NT on the computer, make sure it and all of its hardware are working, *then* set up

networking. It makes it easier to figure out what's going on if something goes wrong along the way.

The setup steps to connect to an Ethernet LAN from an operational NT 4 machine (as far as basic network installation goes, NT Server is much like NT Workstation) follow.

ONE

Before you start, make sure you know what system resources are already being used and what resources your network card is set to use.

TWO

Install the network card as described in the Hardware chapter.

THREE

Boot the computer as normal.

FOUR

Run Network from the control panel. NT will ask you if you want to install networking; select Yes.

FIVE

The Network Setup Wizard will ask you if you're 'wired to the network' or using a modem. Choose the first option.

SIX

Now you need to search for an NIC, or select one from a list, if you haven't already set up your NIC. Selecting from the list is faster if you know which card you have. If your card isn't on the list and it has an NT driver disk
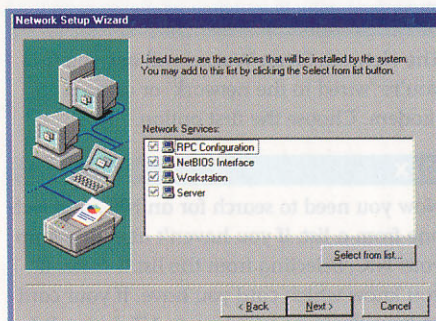
or CD, use the 'Have Disk...' button to tell NT the driver's location. If it's not on the list and you don't have a driver, you'll have to obtain an NT driver from the card vendor or the Internet.

SEVEN
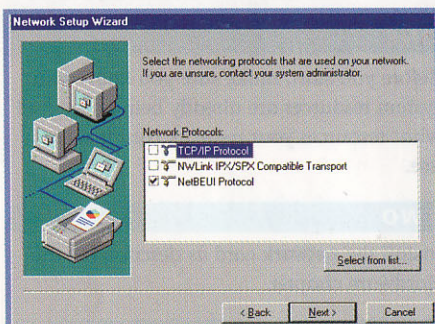
Now it's time to pick your protocol. If you're plugging into an existing network, use the same protocol it uses; otherwise, NetBEUI is a good choice for most networks.

EIGHT

You should agree to the default list of network services to install by clicking Next. You can't deselect any of these services and you don't need any more for basic networking.

NINE

Click Next on the following screen and NT will copy the files it needs from its install CD or directory.
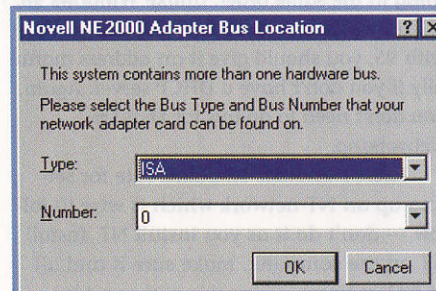
TEN

You may now need to enter the resources used by your network card. Simply choose from the drop-down menu.
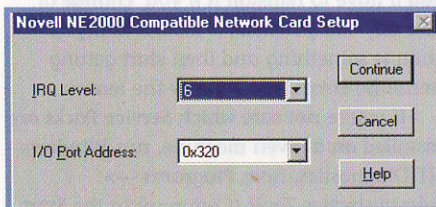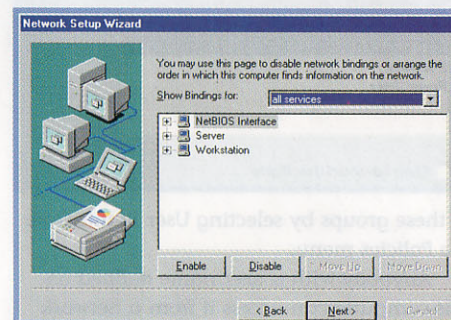

ELEVEN

If you're using an ISA network card, you'll have to choose the bus type and number.

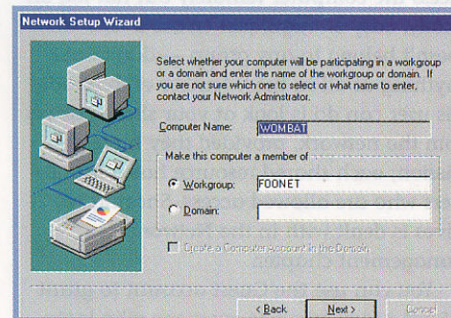You should be able to click OK or make a selection from the drop-down menu.

TWELVE

Now it's on to the Bindings stage. In this simple setup, there isn't a Dial-Up Adapter, so all of the bindings are necessary; click Next.

THIRTEEN

In the following screen click Next to start the network.

FOURTEEN

Enter your computer and workgroup names. If your network has an NT server, select the Domain button and enter the server's domain name instead of a workgroup name. As with 98, the computer name can be whatever you like, but if you use a workgroup name you can only communicate with computers that use the same one.

FIFTEEN

In the great tradition of Windows, you should now restart the computer.

SIXTEEN

After restarting, double-click the Services icon in the Control Panel to ensure everything's running properly.
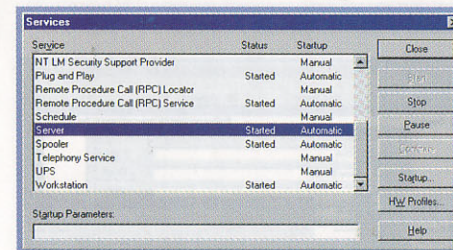
After doing all this, you'll be able to connect to other NT and 95/98 systems on the same network. If you want *them* to be able to connect to *you*, though, there are a few more steps.

Because NT has real security features, you need to tell it what users you want to allow to connect, and what each of them should be allowed to do. Here's how.

ONE

First, you need to be logged in as 'Administrator' or have administrator rights.

TWO

Now, run User Manager, which is located in the Administrative Tools (Common) subsection of the Programs section from the Start menu.

THREE

Create a 'New User' from the User menu. Enter a user name, a full name and the user's password; the description is optional. Set the other options to taste or leave them on the defaults. Click the Groups button to assign that user's permissions.

FOUR
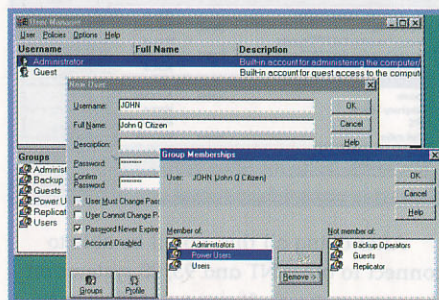
It is here that you assign group membership, which determines a user's access privileges. In this example, John Q Citizen is being given quite a lot of power: he's a member of the Administrators, Power Users and Users groups. You can view the privileges of each
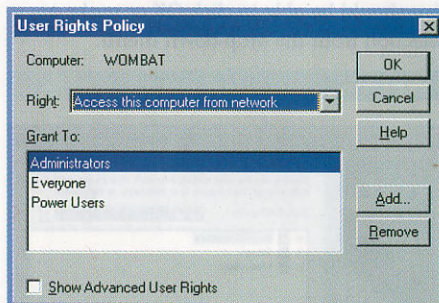
of these groups by selecting User Rights from the Policies menu.

Anybody with a user name defined on this computer can access it from a network — they belong to the 'Everyone' group. Note that the 'Everyone' group does not include people who aren't defined as users. Just because someone has access to the machine doesn't mean they can do anything; the rest of the permissions define what users can do. You can twiddle the groups as much as you like and it's possible to have users who don't belong to any of them.

Let's say you want to allow a user to access the computer remotely but not log on locally. Easy enough; just create a user who doesn't belong to any group — don't enter anything at all in the 'Member of' box. All this user can do is look at your shared drives from the network, provided they have permission; each shared resource has a list of users who are allowed access. Sharing NT drives is dealt with in the Network Management chapter.

You can use the Guest account to grant default access levels to everyone who looks

at the NT machine. This eliminates the need to define individual users.

The Guest account is created by default when you set up NT networking (as is the Administrator account). Guest access is disabled, so you have to turn it on manually. Here's how.
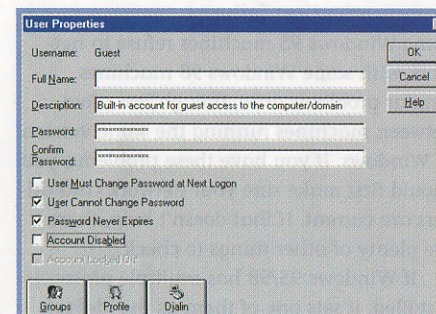
ONE

Run User Manager as above and double-click the Guest account.

TWO

Click the check-box next to Account Disabled to clear it.

THREE

By default no password is defined; add one if you want one. Without a password, everyone

who doesn't log on with a valid user name and password will immediately be granted Guest access. If you give the Guest account full rights, as described above, you've just created a good imitation of 95/98's practically security-free networking. If you assign a password, you're not *quite* left wide open.
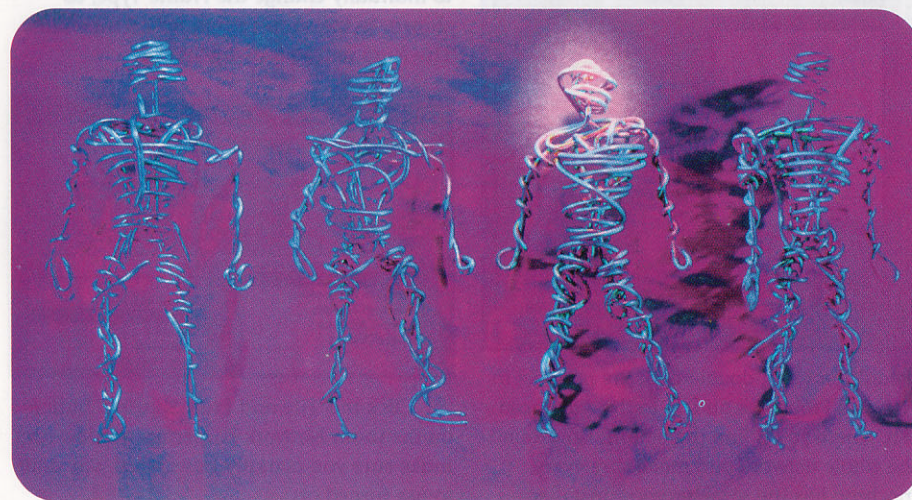
Windows pitfalls

Communication failures

Some Windows 95 machines refuse to network with some Windows 98 machines. Similar problems arise, though less often, between machines running the same version of Windows. If you have these problems, you should first make sure your network card drivers are current. If that doesn't help, there are plenty of other things to check.

If Windows 95/98 has multiple protocols installed, it sets one of them as the 'default protocol', and the default protocols must be the same across the network. To set the
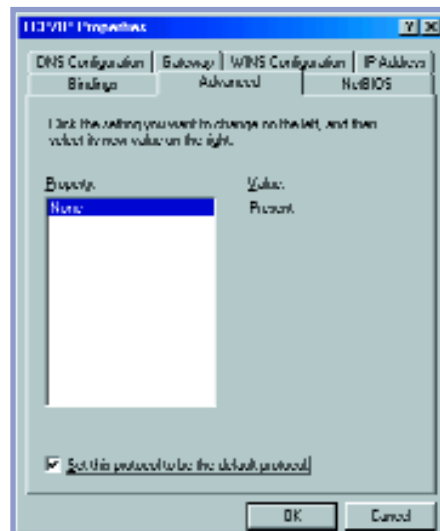

default protocol, double-click the protocol in Network Properties and go to the Advanced tab, where you'll find the option. Go around the whole network and make sure every machine has the same protocol installed,

and that it is set as the default. If there's only one protocol installed, this problem won't arise.

If NetBEUI isn't working on a mixed 95/98 network, remove it and try IPX/SPX. Double-click the IPX/SPX protocol in Network Properties, go to the NetBIOS tab and select the 'I want to enable NetBIOS over IPX/SPX' box. Again, set up all the machines like this and the problem may well be solved.
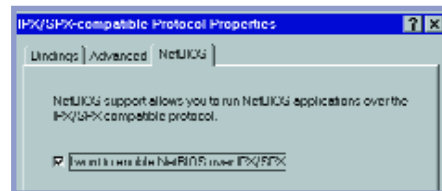

If you're using IPX/SPX, it's a good idea to manually change the Frame Type, as shown, to the same setting for all machines. The Auto setting is dodgy at best.
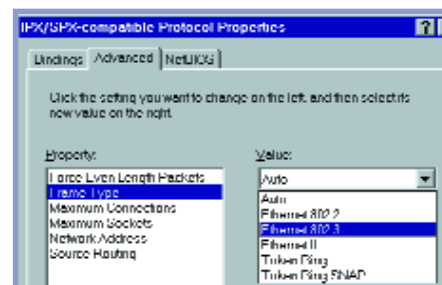
Click the 'File and Print Sharing' button on the main Network Properties window and make sure you actually have what you want to use turned on.
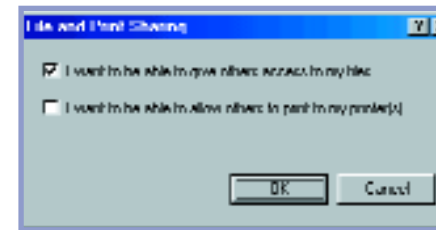
Make sure every machine on the network has the same Workgroup set, in the Identification tab of Network Properties. There's nothing wrong with the default name 'Workgroup', as long as everyone's using it. Remember, it's harder to get a short and simple workgroup name wrong.
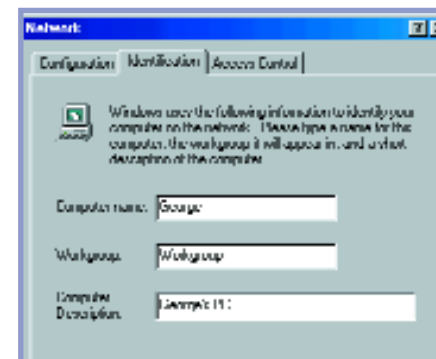
On recent machines that have an Accelerated Graphic Port (AGP) slot, there's commonly a conflict if you install an AGP graphics card and a PCI network card, with the network card in PCI slot 1 (the one closest to the AGP slot). Usually, just moving the card to a different slot will solve the problem.

'Connect To...' interruptions

If you're running Windows 95/98 and have TCP/IP installed for both your Dial-Up Adapter and your network card, you may find frequent 'Connect To' windows popping up when you're trying to access local network resources. To stop this, you have to do two things.

First, open Dial-Up Networking in My Computer and select Settings from the Connections menu. Click the button next to 'Don't prompt to use Dial-Up Networking'.
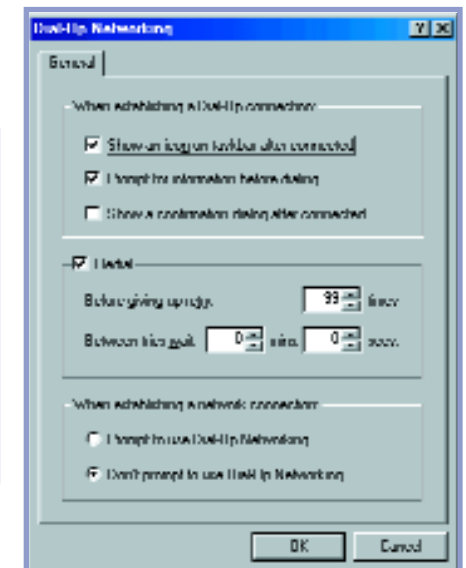
If you're running Internet Explorer (IE), you'll probably see a *different* dial-up window when you try to access network resources. This one is courtesy of IE. Select
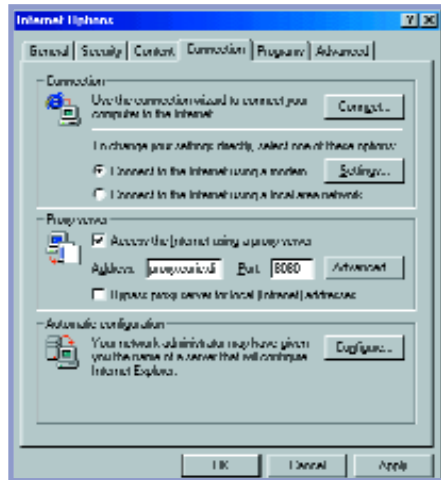
the Internet option in the Control Panel, then select the Connection tab and deselect

the 'Connect to the Internet as needed' box if you're using Internet Explorer 3. If you're

using Internet Explorer 4, switch from 'Connect to the Internet using a modem' to 'Connect to the Internet using a local area network'. Don't worry; you can still connect to your ISP in the usual, manual way; this will just stop the Connect To window coming up every time the system thinks you want to access the Net.
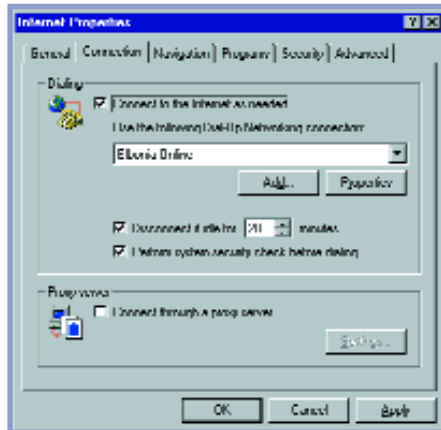
Sluggish response to network changes

When Windows machines are networked, they 'elect' one of their number to be a Browse Master by default. The Browse Master — which must have both File and Print Sharing for Microsoft Networks installed and one of its own resources shared — keeps track of which computers are connected to the network and what they have shared.

If the Browse Master is removed from the network or turned off, the remaining machines will conduct another election and figure out who's boss again. Windows NT Server machines automatically take precedence over NT Workstation computers, followed by 95/98 boxes, and Windows 3.1 computers. If a higher ranking computer joins the network, the process is repeated and eventually it wins.

If you wait a few minutes, any changes to the network since the new Master was assigned will suddenly show up. If you can't wait too long, you can manually connect to a computer by using the Find —> Computer option from the Start menu and typing in the name of that computer.

This, by the way, is a good reason to keep your computer names short and simple.

Mac networking

Installing drivers

One of the big advantages of the Macintosh is that all recent models include an Ethernet port as standard. Accordingly, the appropriate driver software is installed as part of the operating system.

It may be necessary to install an extension when an old machine or a clone has been fitted with a third-party Ethernet interface, but this operation is a fairly simple process.

Just follow the instructions accompanying the add-on hardware; in most cases, all you'll need to do is run an installer program and restart the computer.

Installing and configuring protocols

The software responsible for handling both the AppleTalk and TCP/IP protocols is normally installed as part of recent releases of the operating system. This is certainly true for systems after 7.5.

If a custom installation of Mac OS or an over-zealous pruning of the System Folder has resulted in the absence of one or more of the components, you should carry out a custom reinstallation, selecting only the relevant items.

ONE

With Mac OS 8.5 you should run the main installer.

TWO

Click the Customise button when you reach the Install Software window, then deselect all the components except Mac OS and choose
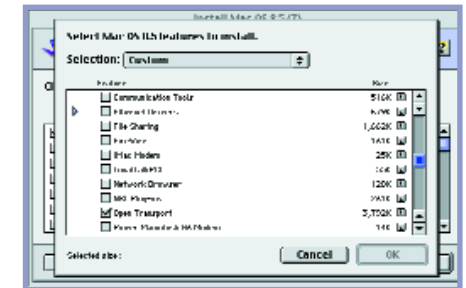
Customised Installation from its Installation Mode pop-up menu.

THREE

In the resulting dialog, 'dink' the Networking and Connectivity item, scroll down to the Open Transport item within that section, select it and then press OK.

FOUR

Click the Start button to begin the installation. If your Mac OS CD-ROM isn't quite up to date, you should also install the relevant updates.

Prior to System 7.5.3, the Macintosh handled AppleTalk and TCP/IP separately (so-called 'classic networking'). The AppleTalk software was always included, while the MacTCP control panel wasn't included with the OS prior to System 7.5. Unless you were running TCP/IP over a LAN, you also needed a Point-to-Point Protocol (PPP) — or prior to that, a Serial Line Internet Protocol (SLIP) — module so that MacTCP could talk across a modem link to an ISP.

Systems 7.5.3 and 7.5.5 gave users the choice of 'classic networking' (the old AppleTalk and MacTCP described above) or the new Open Transport networking software that superseded it. Despite some teething problems, Open Transport soon settled down to provide quick and reliable service, and later releases include a PPP module (though alternatives such as FreePPP can still be used). Open Transport took over completely from Mac OS 7.6 onwards.

If you have a choice between Open Transport and classic networking, we would generally recommend Open Transport, though its greater RAM requirements may cause a problem on certain configurations.

The AppleTalk component is effectively self-configuring. Its premise is to be able to plug a computer into a network and get to work. You simply need to make sure it is set to use the LocalTalk ('printer') or Ethernet interface as appropriate. If you have a choice, you should use Ethernet, but in some circumstances it is appropriate to choose the low-speed LocalTalk, for example, to avoid adding expensive hardware to an old PowerBook, or to share certain low-end printers. Note that iMacs and the translucent G3 do not have a LocalTalk port.

To choose the interface, open the AppleTalk control panel and select Ethernet (or the port appropriate for your circumstances) from the 'Connect to:' pop-up menu. Close the control panel and you're done.

The 'Current zone: (no zones available)' section of the AppleTalk control panel is used

to select Zones. Zones are used to break up AppleTalk networks into more manageable chunks. For example, a large network might be divided into zones so that all the devices on one floor of a building are in the same zone. Users can then easily see the printers on their floor when they open the Chooser. Printers on other floors are still accessible, but only by exploring other zones. A small network generally will not need zones, which are created with routers.

Setting up TCP/IP is a little more complicated. We'll create an intranet with no Internet gateways or other complexities.
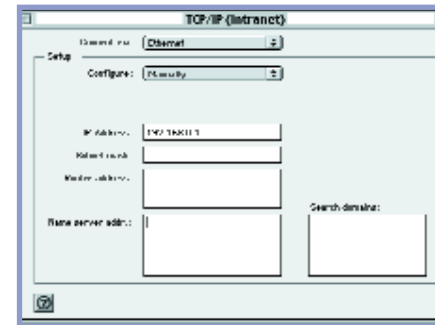
ONE

Open the TCP/IP control panel and create a new configuration based on Default.

TWO

Set 'Connect via:' to Ethernet, 'Configure:' to Manually, and the IP address to one in the 192.168.0.x range, where x is between 1 and 255, and different to any other address already assigned on your network.
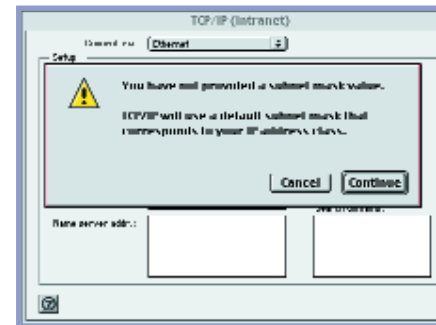
It's a good idea to start with 1 and use successive numbers for each of your com-

puters, keeping a record of which machine has which address. You can leave the other fields blank.

THREE

Save your changes then close TCP/IP. TCP/IP will automatically set the subnet mask when you click Continue in the warning dialog.

That's all there is to it if you are prepared to refer to machines by their numeric addresses. If you want to use names, you'll need to set up a DNS (domain name server)

and specify its IP address in the 'Name server address' field of each Macintosh's TCP/IP control panel.

If you add some kind of Internet gateway to your network, you'll need to specify the address of your gateway in the 'Router address' field of the TCP/IP control panel of each Macintosh.

Ensuring it works

When you're satisfied that your network is configured correctly, you need to make sure it's working.

AppleTalk

AppleTalk is very easy to test. If you have a networked printer (assuming it's switched on and the driver software is installed on the Mac), simply open the Chooser from the Apple menu, and click on the icon in the left-hand pane for that type of printer. If your network is configured correctly, the printer's name will appear in the right-hand pane.

If there isn't a printer on the network, the simplest approach is to turn on File Sharing on one Mac (see the Network Management chapter) and try to connect to it.

If you can't see anything on the network, make sure the software is correctly installed and all connections have been properly made. If you can see some items but not others, running a program such as MacPing (again, see the Network Management chapter) on your various computers may help determine the location of the problem. For example, if all the Macs connected to one

hub can see each other but nothing else, it's likely that the fault is in the link between that hub and the rest of the LAN.

TCP/IP

While you can use a testing program, it's possible to use the Mac OS software to check that your TCP/IP network is functioning. The basic idea is to run some kind of server software on one Mac and a corresponding client on the others. An obvious choice is to use Web Sharing as the server and Microsoft Internet Explorer or Netscape Navigator as the client(s).

Turn on Web Sharing by opening its control panel and clicking the Start button. Move to another computer on the network, open your preferred browser and type in the URL http://192.168.0.1 (or the IP address you gave the Mac) and you should see Web Sharing's default page (probably the Personal NetFinder page).

Fault finding strategies are basically the same as for AppleTalk: establish which network nodes can communicate with which others, then determine the location of the problem logically.

Printing

Macintoshes most commonly communicate with network printers via AppleTalk. These days, the physical connection is normally Ethernet, but some LocalTalk devices are still in circulation. Recent releases of Mac OS also support printers that use the LPR (line printer) protocol over TCP/IP. Examples include certain Apple LaserWriters such as the 12/600PS
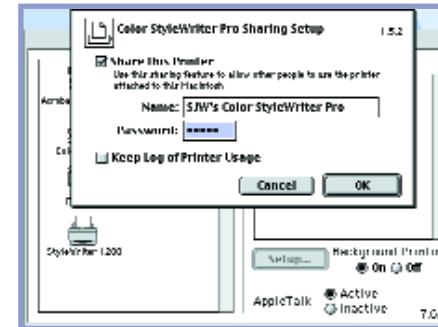
as well as a variety of models from other manufacturers.

If you want to connect one or more LocalTalk printers to an Ethernet, you can either use a software or hardware bridge. Apple's LaserWriter Bridge software does this job; LocalTalk Bridge also allows LocalTalk-connected Macs to print to Ethernet-connected printers. Neither is fully compatible with Mac OS 8.5 and require the LocalTalk PCI 1.2 extension when used with Mac OS 8.1 on a G3 Mac. Sonic Systems' PowerBridge (distributed by AC&P and Macsimise) supports a single device (Macintosh or printer), while SuperBridge handles up to 10 devices.

Hardware bridges include Sonic's microPrint, Farallon's iPrint (distributed by Lidcam) or Asante's AsanteTalk (distributed by Conexus). These are all small boxes that link an Ethernet and a LocalTalk network. They each cost around $300 and save putting the conversion load onto one of your Macs.

To select a printer, open the Chooser and click on the appropriate icon in the left-hand pane. The majority of networked printers in Mac environments are PostScript capable and use either the LaserWriter or AdobePS drivers, but a few inkjet printers have been offered with LocalTalk interfaces. A list of available and compatible printers will appear in the right-hand pane; double-click on the one you want to use.

Certain models of personal printer (such as the StyleWriter family) can be shared by the Mac to which they are attached. In the Chooser, select the appropriate driver, then click the Setup button. In the resulting dia-

log, check Share this Printer, and give the printer a unique name — the default isn't very informative. The name will show up in the Chooser when any networked user selects the corresponding printer driver. If you want to restrict access, you can add password protection.

While software exists that lets a Windows computer see shared Mac printers and vice versa, there is a catch. Although this method works well with personal PostScript printers and those intended for cross-platform use, you often don't get Mac drivers for directly connected PC printers, and vice versa.

Security

In most SOHO environments, network security isn't particularly important. If anyone can walk up to a machine and use it, there's no point being paranoid. The main reason for security features is to make it harder for people to make mistakes, such as deleting a file from the shared disk which they thought was a local version. If you connect to the

Internet via a gateway, there are more practical reasons for security.

Network security on the Mac is controlled in the Users and Groups control panel. We'll go into this and other aspects of access control in more detail in the Network Management section, but for now keep these points in mind:

- Only share items that need to be shared (don't share a whole disk when a single folder will suffice).

- Only provide the necessary level of access to those items (if, for example, someone needs to be able to read a file but you don't want them to be able to alter its contents, make sure they have read-only access).

This is about as hard as it gets to set up a Mac network. The Network Management chapter will cover the various tools and programs you can use to manage a Mac network.
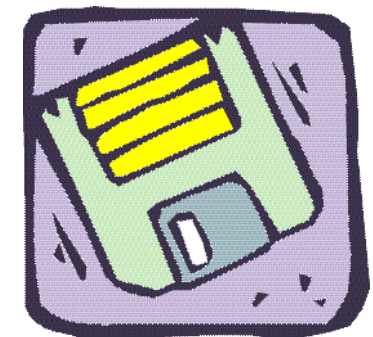
Linux networking

THIS SECTION IS DESIGNED for experienced users who know how to edit files under Linux and possess a basic understanding of networking. Although there are plenty of GUI-based tools to configure networking, these tools differ from distribution to distribution. As a result the methods covered here use the trusty (and, some would say, more difficult) command prompt.
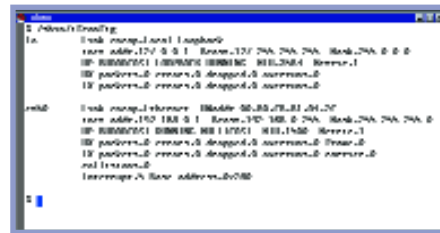
Installing drivers

Network drivers under Linux are part of the Linux kernel. The drivers can either be compiled into the kernel where they permanently reside, or compiled as modules, which will be loaded as necessary.

The output from ifconfig after an Ethernet card has been configured. ifconfig will also display the status of other network connections such as PPP.

the message 'eth0: unknown interface' is displayed, the network card driver is not loaded or the network card could not be found.

ONE

To check whether your network card is already recognised by Linux, type ifconfig eth0 (you may need to supply the full path to ifconfig by typing /sbin/ifconfig ... if you get a message such as 'command not found'). If

TWO

Most Linux distributions will supply a kernel with all the Ethernet card drivers compiled as modules, and if you're using a newer distribution you've likely got the correct module already detected and running.

Common card types and driver names

CARD TYPE	DRIVER NAME
3Com 3c503	3c503
3Com 3c509	3c509
3Com 3c590, 592, 595, 597 ('Vortex')	3c59x
NE2000 and clones	ne
PCI NE2000 (RealTek/Winbond)	ne2k-pci
SMC Ultra	smc-ultra
Digital 210XX, 211XX-based cards	tulip or de4x5
SMC EtherPower II	epic100
SMC Elite16, Western Digital WD8003/8013	wd

To see the available networking modules, look in the /lib/modules/*kernel-version*/net directory. If you need to load a module, you can modify /etc/conf.modules and add a line such as:

alias eth0 smc-ultra

THREE

You will sometimes need to specify the I/O Base Address and IRQ of the card. In general you won't need to do this for PCI cards, but you may need to for ISA cards if the driver can't auto-detect the IO address. If you have an ISA NE2000 or clone, you will definitely need to specify the IO address and IRQ. For example, to load the NE2000 driver for a card at IO address 320, IRQ 5 you would place these two lines in your conf.modules file:

alias eth0 ne
options eth0 io=0x320 irq=5

Note the leading '0x' in front of the IO address — this means that you are entering the number in hexadecimal rather than decimal.

FOUR

If you have an NE2000 ISA PnP card, you should reconfigure it using the DOS setup program supplied with the card. Turn off PnP support and assign a particular IO Base Address and IRQ to the card. Although it may be possible to use these cards in PnP mode using the Linux 'isapnptools' program,

it is generally a lot easier to set the configuration yourself and tell Linux what you've set it to.

FIVE

Once Linux recognises your Ethernet card you can test to make sure it's working by running ifconfig eth0. This should result in a message like:

```
eth0   Link encap:Ethernet  HWaddr
       00:80:C8:81:A4:2C
       inet addr:0.0.0.0  Bcast:0.0.0.0
       Mask:0.0.0.0
       BROADCAST MULTICAST  MTU:1500
       Metric:1
       RX packets:0 errors:0 dropped:0 over-
       runs:0 frame:0
       TX packets:0 errors:0 dropped:0 over-
       runs:0 carrier:0
       collisions:0
       Interrupt:5 Base address:0x280
```

This means that the card can now be configured with an IP address.

If you have a PCI Ethernet card, but are unsure about what sort it is, typing cat /proc/pci | more will give you a list of the PCI devices that you have installed. If you have an ISA Ethernet card, the Ethernet-HOWTO has some tips on identifying your card.

For more information about Ethernet card drivers for Linux, see the Ethernet-HOWTO and the Linux Ethernet drivers Web page at http://cesdis.gsfc.nasa.gov/linux/drivers/.

Configuring IP from the command prompt

Once Linux recognises your network card, the next step is to assign an IP address to it. Again, newer distributions allow you to do this during the install process, but for reference you can do this using the ifconfig and route commands. If you want to assign an IP address of 192.168.0.1 with a netmask of 255.255.255.0, simply run:

```
ifconfig eth0 192.168.0.1 netmask
    255.255.255.0 broadcast 192.168.0.255
route add -net 192.168.0.0
```

At this point you need another machine to test whether your network is functioning. The easiest way is to ping the other machine. If the other machine has been assigned an IP address of 192.168.0.2, you would type:

```
ping 192.168.0.2
```

The ping command then starts sending out packets to the other machine requesting a response if it is there. If no packets are received from the other machine nothing will be displayed. Packets will continue to be sent once per second until you stop the process by pressing Control-C.

If you get messages such as:

```
ping: sendto: Network is unreachable
ping: wrote 192.168.0.2 64 chars, ret=-1
```

then you either didn't run the route add -net command shown above or you haven't

assigned the two computers IP addresses within the same network (for example, if your netmask is 255.255.255.0, assigning IP addresses that don't have the same first three numbers).

If you get no response at all, check your cables and network cards as discussed in the Hardware section.

If your network has a default gateway, then you configure this with the route command also. For example, if your default gateway is 192.168.0.7, you could type:

```
route add default gw 192.168.0.7
```


The UserNet tool from Red Hat provides a graphical interface to start and stop network interfaces.

Configuring IP through configuration files

When you run the ifconfig and route commands, it will only change the settings until you reboot. If you want to make the changes permanent, you'll need to define them in a configuration file, the location of which depends on your distribution. For Red

Hat Linux, the file is /etc/sysconfig/network-scripts/ifcfg-eth0, which will need contents such as:
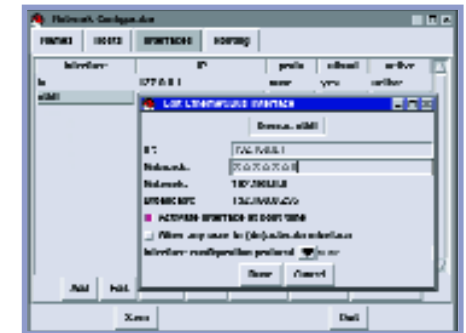
```
DEVICE="eth0"
USERCTL="no"
ONBOOT="yes"
BOOTPROTO="none"
IPADDR="192.168.0.1"
NETMASK="255.255.255.0"
NETWORK="192.168.0.0"
BROADCAST="192.168.0.255"
```

If you have a default gateway setting, you'll also need to modify /etc/sysconfig/network and add these two lines:

```
GATEWAYDEV=eth0
GATEWAY=192.168.0.7
```

Leave USERCTL (user control) at its default of 'no', otherwise anyone with an account on your system will be able to disable your Ethernet; leave ONBOOT at 'yes' so that it will automatically be configured when you boot. BOOTPROTO can be set to 'dhcp' or 'bootp' if you have a DHCP or BOOTP server on your network — in this case, the IP address and associated parameters in that file will be ignored.

Instead of editing these files directly, you can use the popular linuxconf configuration program (follow the menus Config, Networking, Client tasks, Basic host information, Adaptor 1) or, if you're using the Red Hat distribution, the netcfg network configuration program (select Interfaces, eth0, Edit).
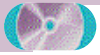

Configuring eth0 using the netcfg interface.

To configure the default gateway setting with linuxconf, follow the menu choices to Client tasks, Routing and gateways, Default. With netcfg, just click on 'Routing'.

For the Debian GNU/Linux distribution, IP configuration is done from the /etc/init.d/network file, which will look something like:

```
#!/bin/sh
ifconfig lo 127.0.0.1
route add -net 127.0.0.0 dev lo
IPADDR="192.168.0.1"
NETMASK="255.255.255.0"
NETWORK="192.168.0.0"
BROADCAST="192.168.0.255"
GATEWAY=""
. . .
```

Just change the settings in the sample file to what they should be. You should leave the second and third lines; these set up the internal 'loopback' interface (the loopback

interface is used when a computer makes a connection to itself, such as when you telnet to your own computer), which always has the IP address 127.0.0.1.
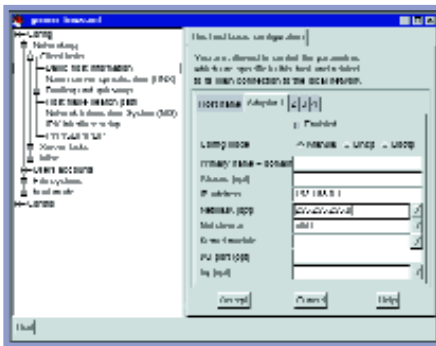
Configuring eth0 using the Gnome linuxconf interface.

Configuring host names

Once you have basic IP connectivity working, you'll probably want to assign names to the computers so you don't have to use IP addresses. There are two steps to this; the first is to assign a name to the computer; the second is to list the names and IP addresses of all the computers on your network.

To set the host name of your computer from the command prompt, type host name followed by the name you want to assign. Any changes will be lost when you reboot. In order to make the change permanent you'll need to modify either /etc/sysconfig/network and /etc/HOST NAME (for Red Hat Linux) or /etc/host name (for Debian GNU/Linux). The /etc/HOST NAME or /etc/host name files

should contain only one line which has just the host name in it, but /etc/sysconfig/ network should contain a line such as:
HOST NAME="my-host-name"

If you have a domain name, this should be included as part of the host name.

Now that your computer knows its name, it needs some way to find the IP addresses of the other computers on your network. If you have a lot of computers on your network, the most efficient way to do this is to run a nameserver.

If you have a domain name server, you can edit /etc/resolv.conf to contain these two lines (replacing 'your-domain-name' with your actual domain name, and 192.168.0.3 with the IP address of your domain name server):

search your-domain-name
nameserver 192.168.0.3

If you don't have a nameserver, or your nameserver doesn't know about the hosts on your network, then you can add any hosts to the /etc/hosts file. This file contains one line per host, the IP address occurring first, then one or more host names. For example:

127.0.0.1   localhost.localdomain localhost
192.168.0.1 my-pc my-pc.my-domain
192.168.0.2 another-pc another-pc.my-domain

Once you have /etc/hosts set up, you will be able to ping the name of a machine intstead of its IP address.