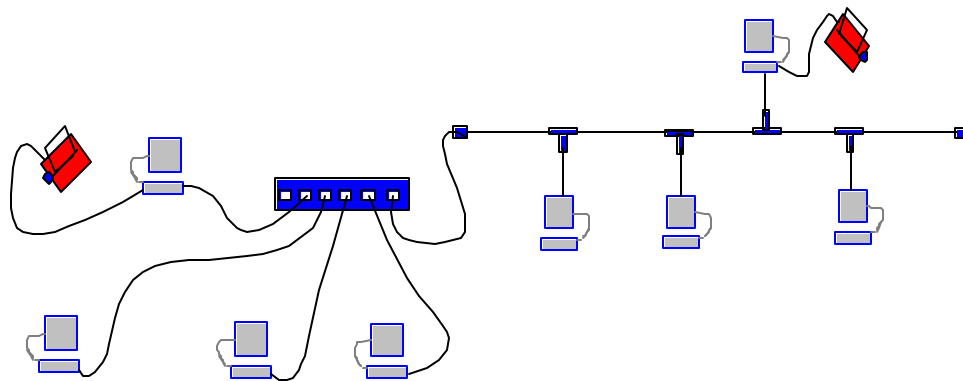# *"Intranets"*

based on
Windows95 Networking

by

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Table of Contents

Introduction

An *intranet* is simply a local area network (LAN) of two or more computers. Traditionally, intranets were used by medium to large size organizations to connect and share their computers and resources. Today, due to developments in computer industry which have reduced the cost and complexity of installing a network, individual users as well as small businesses can also take advantage of this important technology.

Affordable pricing and availability of microcomputers has allowed many users to accumulate a number computers with various hardware and software capabilities. Typically these computers are viewed as independent and isolated machines with such devices as printers, disk drives, modems, scanners and tape drives. Needless to say, most users find the prospect of networking these machines and sharing their resources highly appealing. Installing an intranet allows the user to share their data files[1], applications[2] and hardware resources[3]. The goal of this document is to provide a practical guide for installing a simple Windows95 network on two or more computers. The hardware configuration and installation aspect of this document can be easily applied to other networks such as Intel based Novel or UNIX systems.

Overview of the process

In order to install and configure a local area network one must perform the following:

- Decide what type of network to install.
- Purchase the necessary hardware components.
- Install the network adapters.
- Configure the network adapters (if necessary).
- Load the drivers for the network adapter (if necessary).
- Configure the Windows95 networking facilities.
- Share your devices with others in your work group.

The remaining sections will provide the reader with the necessary information to successfully install and use a Window95 network.

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[1] No more shuffling disks between computers.

[2] Many applications such as databases (MS-SQL), scheduling software (MS-Schedule), Web servers (MS-Personal Web Server, Omni, etc) and E-mail servers (Pegasus) run in client/server mode, allowing multiple users to access the information at the same time.

[3] Printers, plotters, backup drives, scanners and other such devices.

Deciding the type of network

The two most popular LAN technologies are Ethernet[4] and Token Ring[5]. A typical home or small business user usually prefers a 10Mbps[6] Ethernet network. Ethernet (also known as IEEE 802.3) is based on a broadcast mechanism. Ethernet provides an excellent combination of speed, cost and ease of installation. The most common and widely available choices are 10Base-T and 10Base-2 [7].

< 10Base-T

In case you were wondering, the _10_ in 10Base-T stands for 10 Mbps, _Base_ stands for baseband[8] and the _T_ stands for twisted. Here are some characteristics of the 10Base-T network:

’ Requires a Hub
’ Uses inexpensive unshielded twisted pair (UTP).
’ Uses a Star topology.
’ Each 10Base-T segment can be up to 100 meters long.

10Base-T (UTP)

HUB

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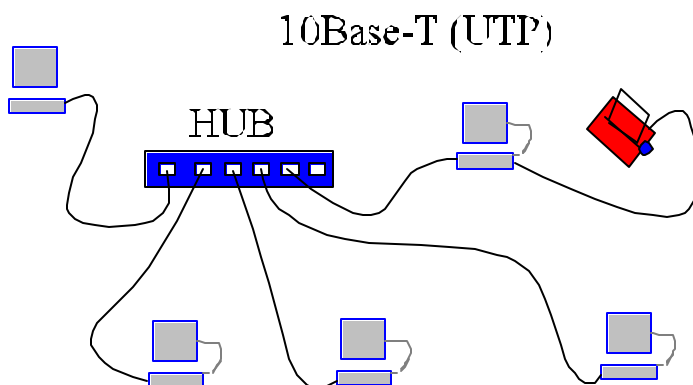
[4] Originally developed by Xerox, DEC and Intel, and later modified and standardized by IEEE (802.3)

[5] Developed by IBM and later standardized by IEEE (802.5)

[6] 10 million bits per second (about 1.2 MB/sec)

[7] There is a third method called 10Base-5, which is not appropriate for home or small business use, so it is not discussed in this document. The primary advantage of 10Base-5 is distance and resistance to noise, which sometimes makes appealing to industrial and manufacturing applications.

[8] Baseband transmission uses digital signals as oppose to Broadband which is used by cable TV industry and uses an analog signal.
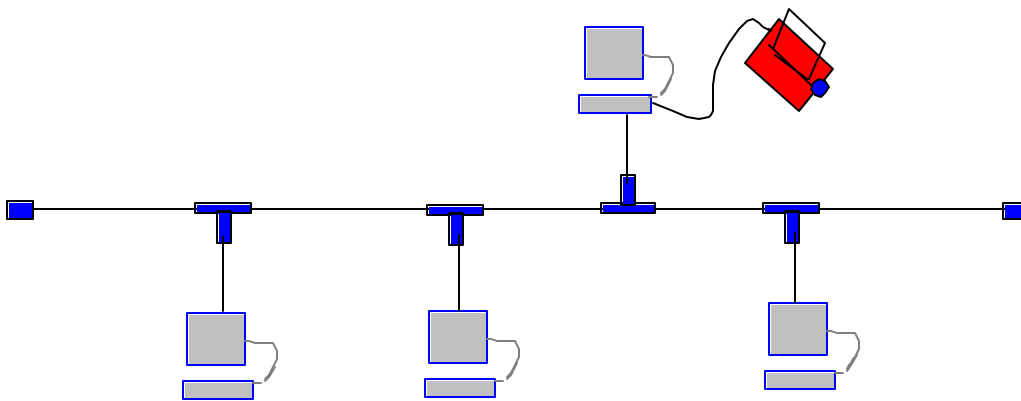
<   10Base-2

Also known as BNC, thinnet or thin coax. The "2" in 10Base-2 stands for 200 meters. Well, actually 185 meters!! (I am not quite sure why! IEEE people would have the answer to this)

Here are some characteristics of the 10Base-2 network:

    '   Accommodates up to 30 stations per segment[Palmer97] and devices must be at least 0.5 meters apart.
    '   Maximum segment length of 185 meters.
    '   Uses an inexpensive thin coaxial cable also known as IEEE RG-58.

10Base-2 (BNC)

Once again, for a home or small business user the cheaper of the two would be a network based on 10Base-2 or thin coax. This type of network is very simple and requires the least number of network components.

Purchasing the necessary hardware components

< **For a 10Base-T network you need:**
1) Network adapter which supports a 10Base-T connection. This type of adapter should have a port which looks very similar to an oversized phone jack.
2) A hub with appropriate number of ports (i.e. 4, 8, 16, ...)
3) 10Base-T Wire (also referred to as RJ-45). This type of cable and the associated connectors are very similar to telephone wires and connectors.
4) 10Base-T end connectors.
5) Tools for stripping, wiring and crimping end connectors. (May not be necessary if you buy the prefabricated cables.)

A typical 2 machine network requires two network cards (ISA or PCI), one 4 port hub, two 10base-T cable segments.

< **For a 10Base-2 or BNC network you need:**
1) Network adapter which supports a 10Base-2 (BNC) connection.
2) BNC (thin coaxial) cable. This cable looks very similar to the regular TV cable however, it is a little thinner. TV cables use 75 Ohms and the thin ethernet cable uses 50 Ohms.
3) BNC end-connectors (you need 2 end connectors per segment however, buying a couple of extra ones will not hurt.)
4) BNC T-connectors (one per worksation) The T-connctors usually come with your Ethernet card.)
5) BNC Terminators (these are basically a 50 Ohm resistors and you sho uld need only 2 for the whole network, however buy a couple of extra ones)
6) Tools for stripping, crimping and connecting the end-connectors to the wire. (May not be necessary if you buy prefabricated cables that come with end-connectors.)

A typical 2 machine network requires two network cards (ISA or PCI), two BNC T-connectors, one BNC cable with BNC end-connectors and two BNC terminators.

Note1: Perhaps before purchasing your network adapter you should make sure your computer has an open ISA (8 or 16 bit) or PCI (32 bit) slot available. Also make sure that you have an available IRQ which could be assigned to the network adapter (Described later).

Note2: When purchasing a network adapter, consider buying a card that provides both 10Base-T and 10Base-2 connectors. This will make your life easier if you ever decide to switch your network wiring, and generally it does not add much to the price of your card.

Note3: I would suggest buying a NE-2000 compatible card. NE-2000 is a Novel standard which most operating systems seem to have drivers for. (Including Windows95 and Linux RedHat)

Note4: Consider buying a Plug-and-Play (PnP) card. It will make your life a lot easier if you plan to use it with a Windows95 network. (On Linux and possibly other operating systems you may have to disable the PnP).

Installing the network adapter card in your computer

After purchasing two or more network cards you must physically install the cards in your computers. Install the cards now. **Please take appropriate measures to ensure you are grounded.** See IEEE standard document 109833884.7 on grounding yourself. (Just kidding)

Configuring the network adapters (if necessary)

PnP Cards:

Some network adapters do not require configuration. If your network adapter supports Plug and Play (PnP) you may not have to do anything. Simply allow Windows95 to detect the hardware and install the proper drivers[9]. If Windows95 appears to recognize your card and loads the proper drivers, you can proceed to the section titled **"Setting up Windows95 Networking"**.

Warning: On occasion PnP stands for "Plug and Pray". In other words having a PnP card does not guarantee a trouble free installation. Conflicts with other cards and system resources may still occur. If this happens you should follow the instructions provided below to detect and resolve these conflicts.

Non-PnP Cards:

Cards that do not support PnP, may require you to run the SETUP program which is often supplied by the manufacturer. Typically, the setup program allows the user to specify which *port*[10], what *IRQ*[11] and the what *base memory address* should be used by your network card to communicate with the computer. A typical network card may have the following default setting when it is purchased.

Typical Network Card Default Setting:	
Port =	10 base-T
IRQ =	5
Base Memory =	0300 - 031F

When installing your network card, you must ensure there are no conflicts with existing devices. The following section on "Finding Conflicts" will help you find and

---

[9] Keep your Windows95 CD close by.

[10] Many adapters provide both 10Base-T and BNC ports so you have to choose one.

[11] The Interrupt Request line used by your network card to communicate with the CPU.
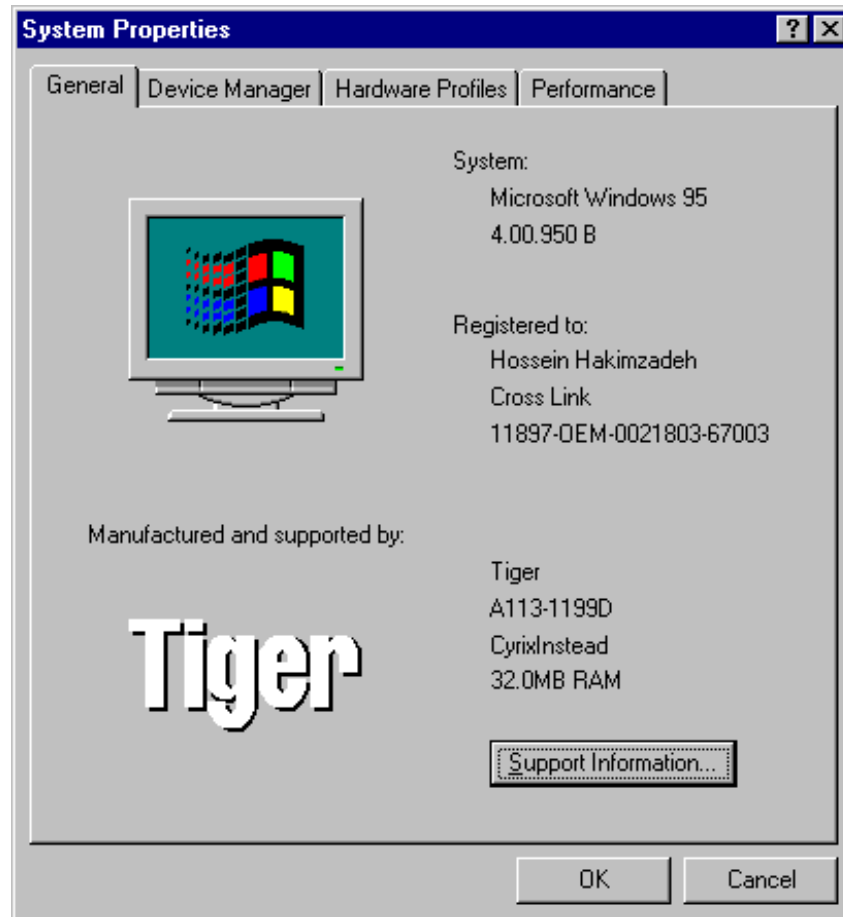
resolve any hardware conflicts. We accomplish this task by asking Windows95 to provide us with some details about our current system properties.

If you are already sure that the default settings used by your network card have no conflicts with any other devices, skip forward to the section on "Setting up Windows95 Networking".
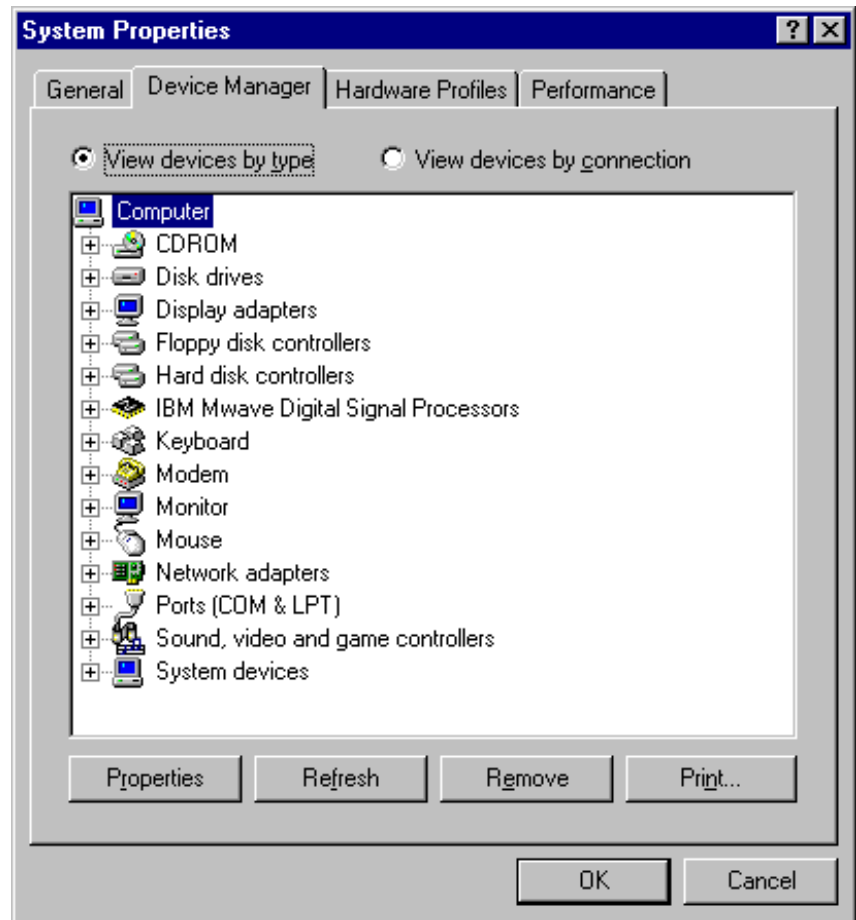
Finding conflicts:

Thanks to Windows95, finding conflicts is not that difficult. Here is how you do it:

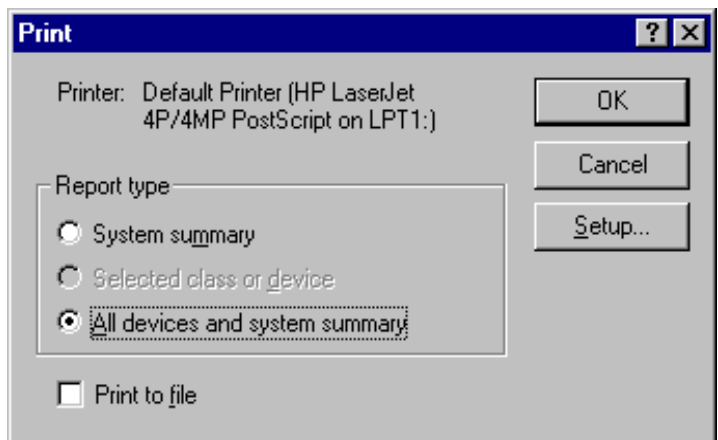1) From your desktop **_Right click_** on MY COMPUTER icon and then select **_Properties_**

2) Select the _**Device Manger**_ Tab.

System Properties

General | Device Manager | Hardware Profiles | Performance

○ View devices by type   ○ View devices by connection

- Computer
  - CDROM
  - Disk drives
  - Display adapters
  - Floppy disk controllers
  - Hard disk controllers
  - IBM Mwave Digital Signal Processors
  - Keyboard
  - Modem
  - Monitor
  - Mouse
  - Network adapters
  - Ports (COM & LPT)
  - Sound, video and game controllers
  - System devices

Properties | Refresh | Remove | Print...

OK | Cancel

3)   Click on the _**Print**_ button.

4)   Select the _**All devices and
        system summary**_ radio button
        and press _**OK**_.

Print

Printer: Default Printer (HP LaserJet
          4P/4MP PostScript on LPT1:)

OK

Cancel

Setup...

Report type
○ System summary
○ Selected class or device
● All devices and system summary

☐ Print to file

At this point Microsoft Windows will print
a report detailing all of your system
resources. As part of this report you will
find information such as **IRQ
SUMMARY** and **IO PORT SUMMARY**. Use this information during the SETUP of your network
adapter to ensure there are no IRQ or Memory conflicts. _(See Appendix - A for a sample
report produced by Windows95.)_

Loading the drivers for your network adapter (if necessary).

Once you install the hardware and turn your computer(s) back on, Windows95 will typically detect your card. If the hardware is detected you usually don't have to install the drivers and can skip to the next section[12]. However, if Windows95 does not seem to recognize your card you must manually tell the operating system about your device and install its drivers[13].

To do this you must:

1) Double click on **_MY COMPUTER_** icon.
2) Double click on **_CONTROL PANEL_** icon.

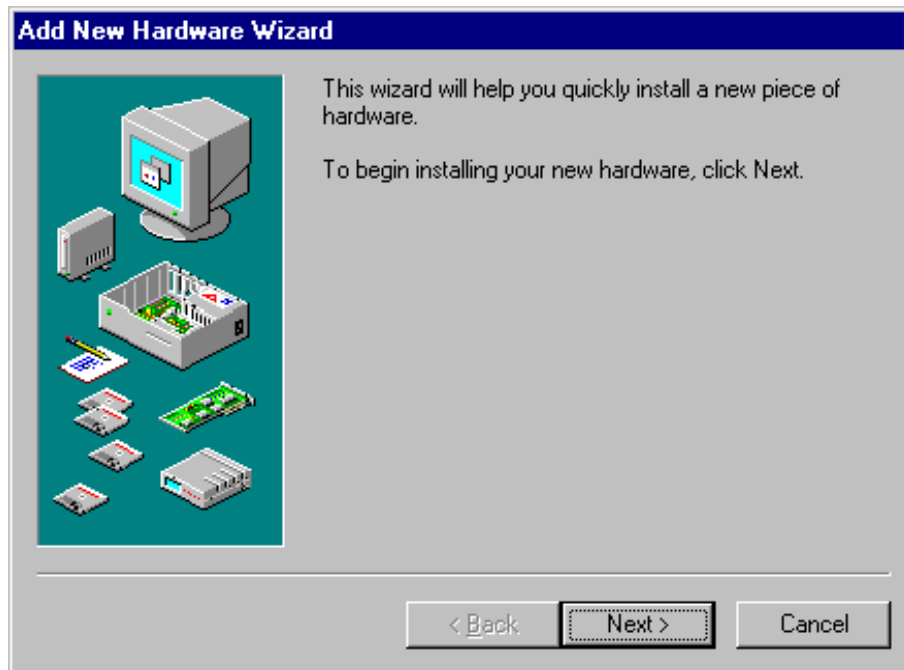[12]   On occasion the default driver used by Windows95 does not adequately support your network card's features. In such cases the documentation provided by the manufacture instructs the user to load the new drivers from the disk supplied with the card.

[13]   Drivers are usually supplied by the manufacturer on a separate diskette. (To install the drivers, you must read the documentation that comes with your network card.)

3) Double click on the ___ADD NEW HARDWARE___ icon.

Now you should see the following window:

Add New Hardware Wizard

This wizard will help you quickly install a new piece of hardware.

To begin installing your new hardware, click Next.

< Back   Next >   Cancel

Click the next button as prompted to let Window95 try to detect the hardware or simply click on the ___have a disk___ button to tell Windows95 that you have a disk containing the drivers.

If you choose to tell Window95 that you have a disk. You must know the directory and file name of your driver. (Consult your Network adapter card documentation for details.)

Setting up Window95 networking

Once you have successfully installed your network adapter and its driver, you are ready to proceed with configuration of Windows95 Networking:
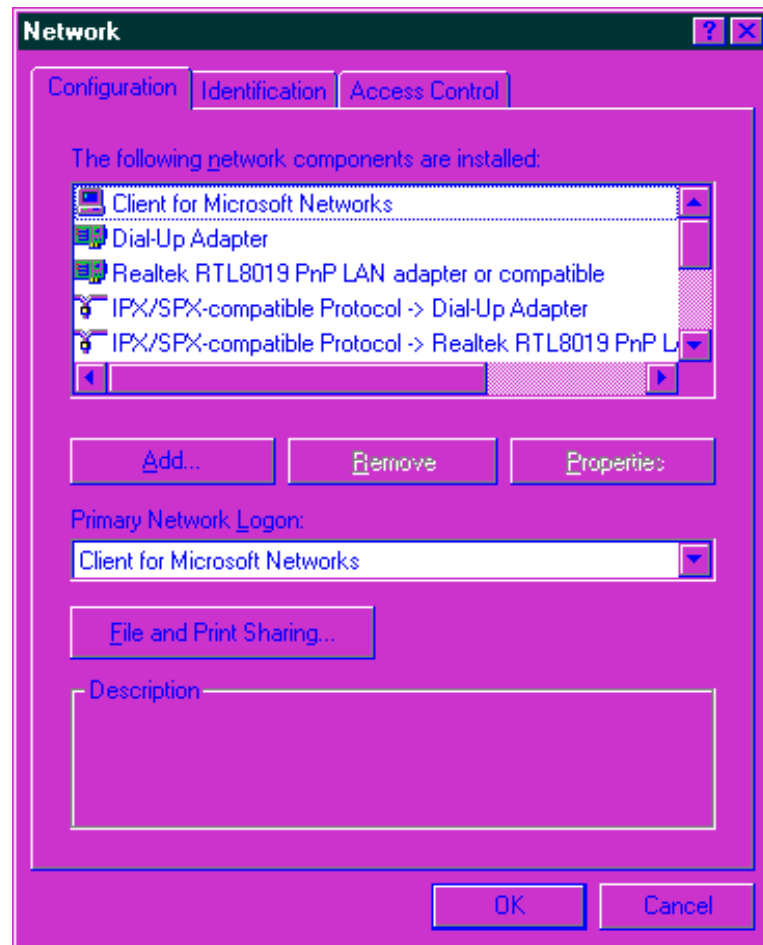
1) Double click on ***MY COMPUTER*** icon.
2) Double click on ***CONTROL PANEL*** icon.
3) Double click on ***NETWORKING*** icon.

The following window should appear:

Well, maybe not exactly. For now don't worry about the contents.
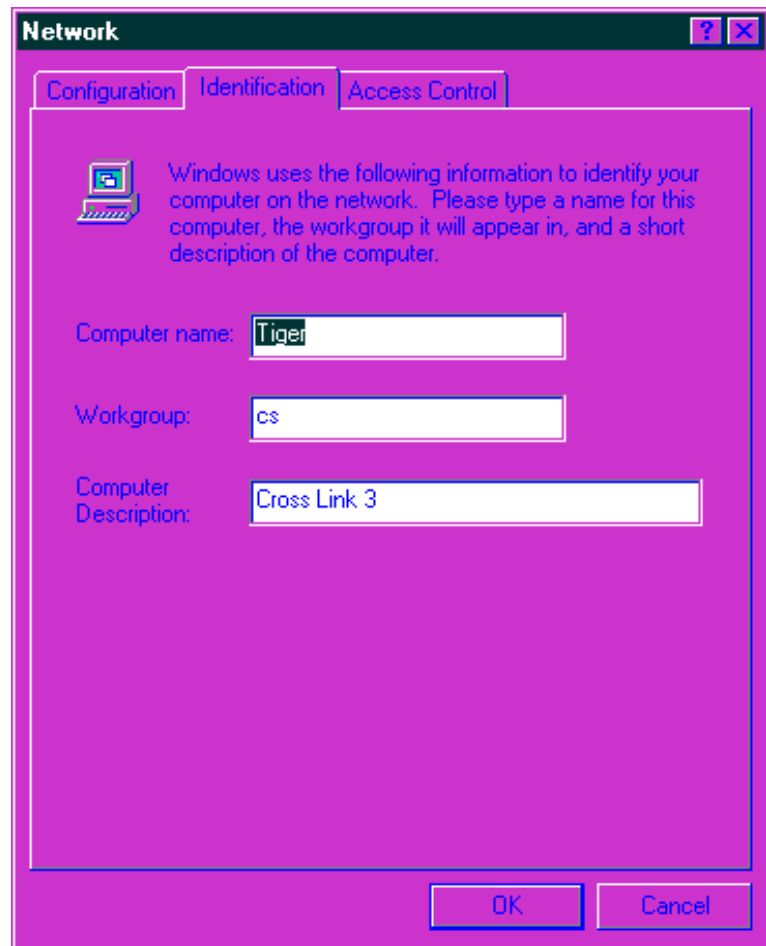
Click on the ***IDENTIFICATION*** tab.

See next page:

1) Give a **_NAME_** to your computer. This name is used by Windows95 to identify your computer to other computers on the network and in your workgroup.

2) Provide a **_WORKGROUP_**. (Note that the workgroup must be the same for all the computers which are going to share resources.)
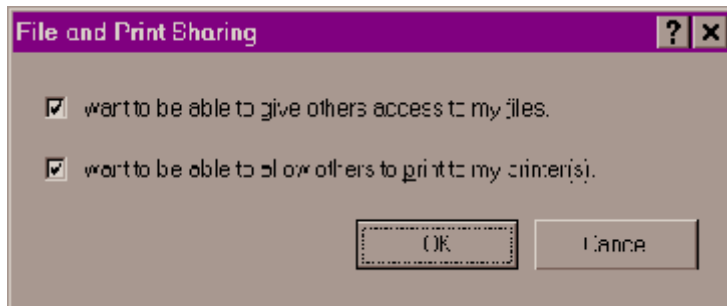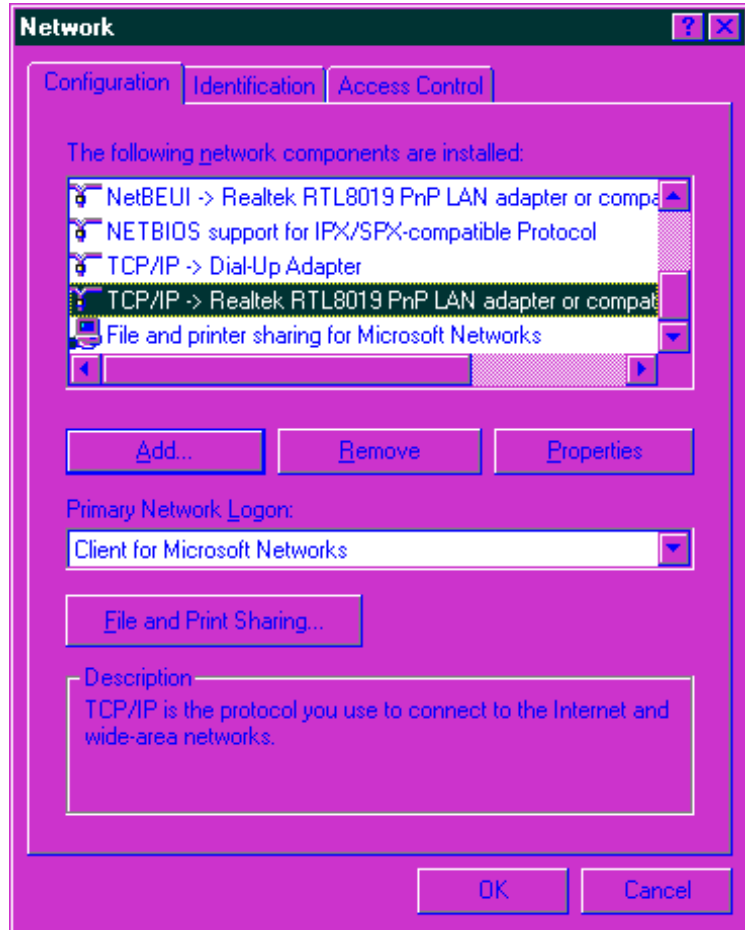
3) Give a description for your computer.

Next, click on the **_ACCESS CONTROL_** tab and make sure the **_Share-level access control_** is selected.
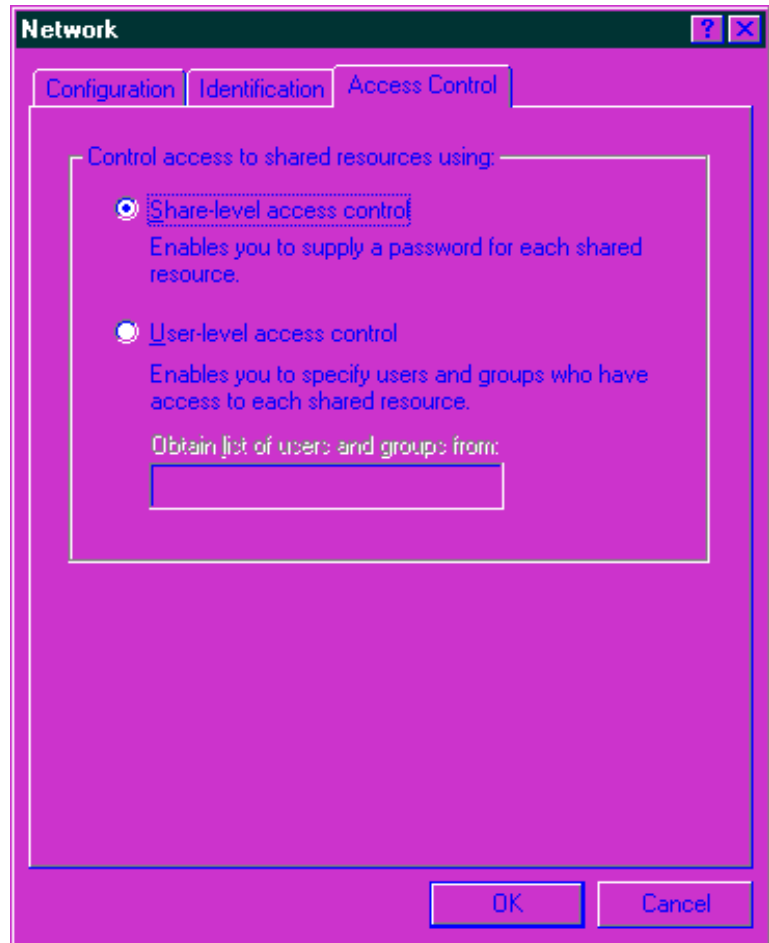
Let us go back to the configuration.
Click on the **CONFIGURATION** tab.

Starting from the bottom of the dialog box:

Network

Configuration | Identification | Access Control

The following network components are installed:

- NetBEUI -> Realtek RTL8019 PnP LAN adapter or compa
- NETBIOS support for IPX/SPX-compatible Protocol
- TCP/IP -> Dial-Up Adapter
- TCP/IP -> Realtek RTL8019 PnP LAN adapter or compat
- File and printer sharing for Microsoft Networks

[Add...] [Remove] [Properties]

Primary Network Logon:

Client for Microsoft Networks

[File and Print Sharing...]

Description
TCP/IP is the protocol you use to connect to the Internet and wide-area networks.

[OK] [Cancel]

1) Make sure to click on **File and Print Sharing** button. A new dialog box appears (see below). Select both check boxes to share your files and printers.

File and Print Sharing

☑ want to be able to give others access to my files.

☑ want to be able to allow others to print to my printer(s).

[OK] [Cancel]

2) Click on the list box titled **Primary network Logon:** and select **Client for Microsoft Networks**.

3) In the list box titled **The following network components are installed:** Scroll and find the **TCP/IP** protocol line. (Make sure you select the one bound to your network card.)[14]

---

[14] If a TCP/IP line does not appear in the list box, you must click the "**ADD**" button, then select "**Protocol**", then "**Microsoft**" and finally, select "**TCP/IP**".

Now Click the *__Properties__* button: (See next page)

You should now see a dialog box similar to the one below.

Click on the _**IP Address**_ tab and select the _**Specify an IP address**_ button. Enter the _**IP ADDRESS**_ and the _**SUBNET MASK**_.

The IP address is of course made up! The first 3 numbers 200.200.1 specify the Network ID. This is a typical class "C" IP address which allows up to 254 nodes[15]. (0 and 255 are reserved. 0 refers to the "this network" or "this host" [Tanenbaum96] and 255 is used for broadcasting.)

The only thing that is significant here is the last digit (3) which must be unique for each machine in your network.

For the Subnet Mask you can type the following number.:

    255.255.255.0

If you leave the mask empty the system will automatically fill it with the above number. When a node such as 200.200.1.1 wants to send a packet to another node, say 200.200.1.3 the subnet mask is ANDed with the destination's IP address. The resulting number is 200.200.1.0. Therefore the packet is sent on the 200.200.1 network.

The rest of the tabs should be left alone.

Now click OK to return to the network window. Click OK again to terminate the network configuration. At this point Window95 will prompt you to restart your computer. Go ahead and reboot your computer. When your computer boots and Windows95 is loaded, login as a user and provide a password. By providing a user name and password you logged into the network and can use the network facilities.

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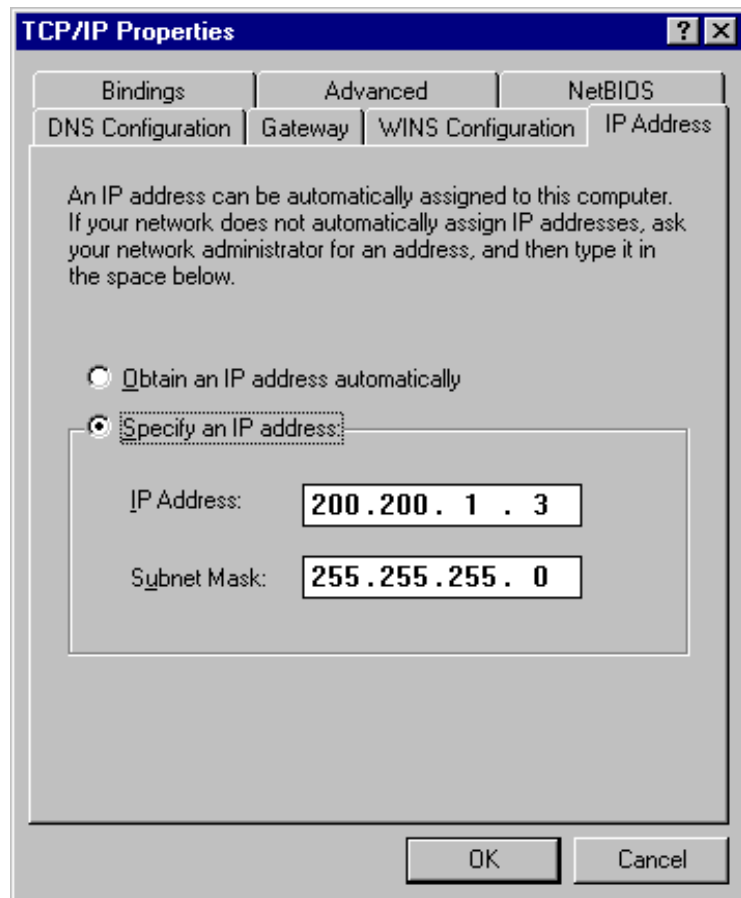
[15] To avoid conflicts real IP addresses are distributed by NIC (Network Information Center)

Sharing your devices with others

This step allows the user to specify which devices s/he is willing to share with other users. (i.e. disks, printers, etc..) To accomplish this task ***double click*** on the **MY COMPUTER** icon. (Not shown here)

Right click on the device you would like to share. (As an example let us use **Drive C:**) Once the menu pops up, (not shown here) select ***sharing....*** The following dialog box appears.

Select ***Shared As***:, give the ***Share Name:*** or accept the default. Now type the desired comments in the comment field (i.e. your computer's name!)

Specify the ***Access Type.*** As you can see I have chosen to provide ***Full*** access to others, as long as they have the appropriate password.

Now you need to specify the ***password*** that a network user needs in order to fully access your drive C:

Click OK. You should see a change in your dirve C: icon. (A HAND should appear under the drive icon. See figure at the top of the page.)

***Sharing other drives and printers is performed in a similar fashion.***
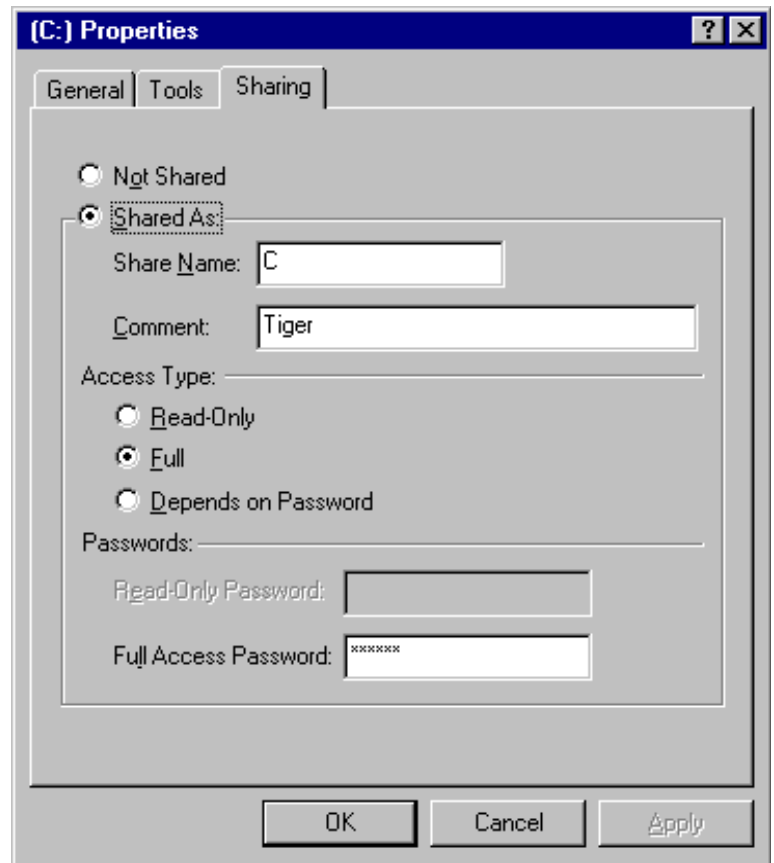
Testing the network

To test your network double click on the ***Network Neighborhood*** icon. After a few seconds you should see a list of machines that you have access to. You can double click on any of the machines to find out what specific devices or resources that machine is willing to share with you. Your network neighborhood may look something like this:
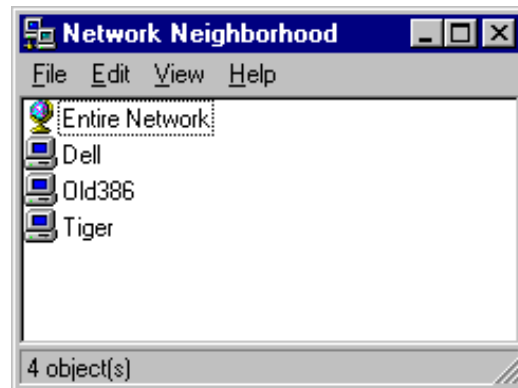
To access the resources of a given machine, we simply double click on its icon.

For example if I double click on the ***Dell*** icon the following window will appear.
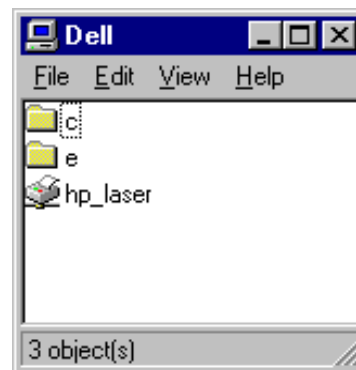
As you can see, this computer is willing to share its drive C: (hard drive), E: (Zip drive) and its printer with the rest of the network users.

If I double click on the ***E: folder*** I will see the following files. I can proceed to read, copy, delete, print and perform other kind of activities allowed on these   file s.

Happy Networking....

* The reader is encouraged to research the following topics:
- C   Mapping network drives
- C   Installing network printers

APPENDIX - A

Sample Report Generated by Windows95 Device Manager

The following report provides some details about the current state of your machine. When looking at the report you should keep in mind the hardware setting of your network card and then look for conflicts with existing devices. In the following report, I have highlighted and underline the ==**IRQ**== and the ==**Base Memory Address**== which was available on my machine. Your configuration may look different.

System Resource Report

******************* SYSTEM SUMMARY *******************
-Windows version: 4.00.950
-Computer Name: Unknown
-Processor Type: 80486DX
-System BUS Type: ISA
-BIOS Name: Award
-BIOS Date: 05/29/97
-BIOS Version: Award Modular BIOS v4.51PG
-Machine Type: IBM PC/AT
-Math Co-processor: Not Present
-Registered Owner: Hossein Hakimzadeh

-******************* IRQ SUMMARY *******************
-IRQ Usage Summary:
00 - System timer
01 - Standard 101/102-Key or Microsoft Natural Keyboard
02 - Programmable interrupt controller
03 - Mwave 33.6 Data Fax VOD Modem
04 - Communications Port (COM1)
05 - IBM Mwave DSP, Audio Control, and DOS Games
06 - Standard Floppy Disk Controller
07 - Printer Port (LPT1)
08 - System CMOS/real time clock
==**09 - NE2000 Compatible**==   *<-- in my machine IRQ-9 was avilable*
10 - IBM Mwave Digital Signal Processor
11 - IRQ Holder for PCI Steering
11 - S3 Inc. ViRGE PCI
12 - Standard PS/2 Port Mouse
13 - Numeric data processor
14 - Standard Dual PCI IDE Controller
14 - Primary IDE controller (single fifo)
15 - Standard Dual PCI IDE Controller
15 - Secondary IDE controller (single fifo)

```
-******************* IO PORT SUMMARY *******************
-I/O Port Usage Summary:
 0000h-000Fh - Direct memory access controller
 0020h-0021h - Programmable interrupt controller
 0040h-0043h - System timer
 0060h-0060h - Standard 101/102-Key or Microsoft Natural Keyboard
 0061h-0061h - System speaker
 0064h-0064h - Standard 101/102-Key or Microsoft Natural Keyboard
 0070h-0071h - System CMOS/real time clock
 0081h-0083h - Direct memory access controller
 0087h-0087h - Direct memory access controller
 0089h-008Bh - Direct memory access controller
 008Fh-0091h - Direct memory access controller
 00A0h-00A1h - Programmable interrupt controller
 00C0h-00DFh - Direct memory access controller
 00F0h-00FFh - Numeric data processor
 0100h-0107h - IBM Mwave Reserved
 0108h-010Bh - IBM Mwave DSP, Audio Control, and DOS Games
 0120h-0127h - IBM Mwave Reserved
 0128h-012Fh - IBM Mwave Control Port
 0130h-0137h - IBM Mwave DSP Base Address Setup Register
 0170h-0177h - Standard Dual PCI IDE Controller
 0170h-0177h - Secondary IDE controller (single fifo)
 01B0h-01BFh - IBM Mwave Digital Signal Processor
 01F0h-01F7h - Primary IDE controller (single fifo)
 01F0h-01F7h - Standard Dual PCI IDE Controller
 0200h-0207h - Gameport Joystick
 0208h-020Fh - Motherboard resources
 0220h-022Fh - IBM Mwave DSP, Audio Control, and DOS Games
 0274h-0277h - IO read data port for ISA Plug and Play enumerator
 02F8h-02FFh - Mwave 33.6 Data Fax VOD Modem
```

==0300h-031Fh - NE2000 Compatible==   *<--- This base address was the*
                                                 default on the card and available !

```
 0330h-0333h - Mwave MPU-401 Port for DOS
 0376h-0376h - Standard Dual PCI IDE Controller
 0376h-0376h - Secondary IDE controller (single fifo)
 0378h-037Fh - Printer Port (LPT1)
 0388h-038Fh - IBM Mwave DSP, Audio Control, and DOS Games
 03B0h-03BBh -  S3 Inc. ViRGE PCI
 03C0h-03DFh -  S3 Inc. ViRGE PCI
 03F2h-03F3h - Standard Floppy Disk Controller
 03F4h-03F5h - Standard Floppy Disk Controller
 03F6h-03F6h - Standard Dual PCI IDE Controller
 03F6h-03F6h - Primary IDE controller (single fifo)
 03F8h-03FFh - Communications Port (COM1)
 04D0h-04D1h - PCI bus
 0778h-077Bh - Printer Port (LPT1)
 0CF8h-0CFFh - PCI bus
 6000h-6007h - Standard Dual PCI IDE Controller
 6000h-6007h - Primary IDE controller (single fifo)
 6008h-600Fh - Secondary IDE controller (single fifo)
 6008h-600Fh - Standard Dual PCI IDE Controller
```

The report continues.....

APPENDIX B
NETWORK WIRING

< 10Base-T

    < Unshielded Twisted Pair (UTP)

        < Category 3 or better

        < 4 Pair twisted pair wire

    < Straight-through wire is used between the hub and the computer and other network components such as routers and bridges.

    < Each segment can be up to 100 meters long

    < Connectors are RJ-45

    < Requires a Hub if you are using more than two computers in the network.
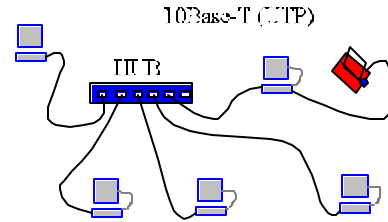
Pin No.	Wiring Scheme -1	Wiring Scheme -2
1	TX+ (Transmit Data Plus)	RX+ (Receive Data Plus)
2	TX- (Transmit Data Minus)	RX- (Receive Data Minus)
3	RX+ (Receive Data Plus)	TX+ (Transmit Data Plus)
4	Not Connected	Not Connected
5	Not Connected	Not Connected
6	RX- (Receive Data Minus)	TX- (Transmit Data Minus)
7	Not Connected	Not Connected
8	Not Connected	Not Connected

Note: Only 4 of the 8 wires are being used for transmission of data. Two for sending and two for receiving data.

Computer to Hub Connection:

In order to connect a computer to a 10Base-T hub, both ends of the cable must follow Wiring Scheme -1.

Computer to Computer Connection:

To connect two computers together without the presence of a hub, we must cross the send and receive wires. (Normally this is done by the hub). Therefore, one end of the cable should follow Wiring Scheme -1 and the other end should follow Wiring Scheme -2.

- < 10Base-2
    - < Also known as BNC, thinnet or thin coax.
    - < Maximum segment length is 185 meters
    - < Maximum of 30 stations per segment
    - < Minimum distance between devices must be at least 0.5 meters
    - < Uses an inexpensive thin coaxial cable also known as IEEE RG-58
    - < Requires 2 terminators (50 Ohms) per segment.

# 10Base-2 (BNC)
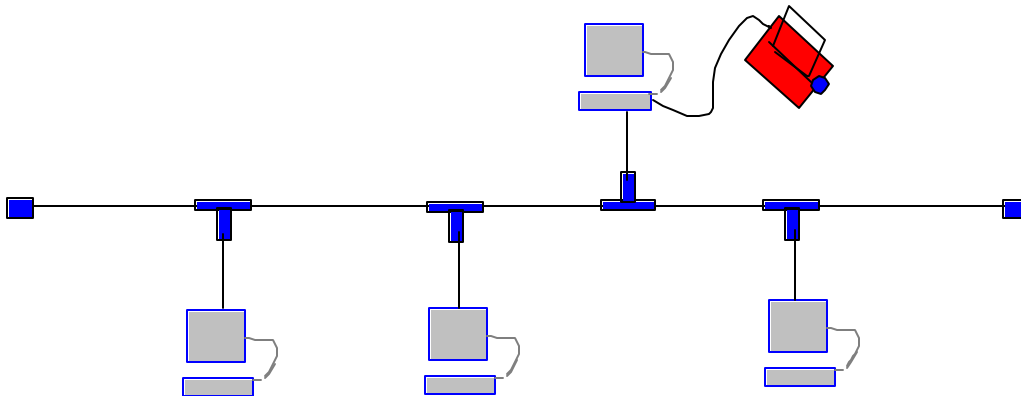
- ' 10Base-5
    - ' Also know as thick coaxial cable
    - ' Maximum segment length is 500 meters
    - ' Maximum of 100 stations per segment
    - ' Minimum distance between devices must be at least 2.5 meters
    - ' Uses an inexpensive thin coaxial cable also known as IEEE RG-58
    - ' Requires 2 terminators (50 Ohms) per segment.

- ' AUI Cable
    - ' Individually shielded twisted pairs with an overall shielding.
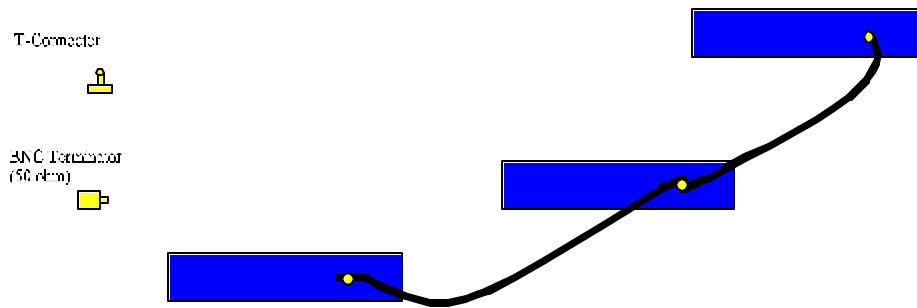   - ' Maximum cable length 50 meters
    - ' Connector: 15 pin DB-15

APPENDIX -C
CASCADING HUBS

10BASE-T Cascading
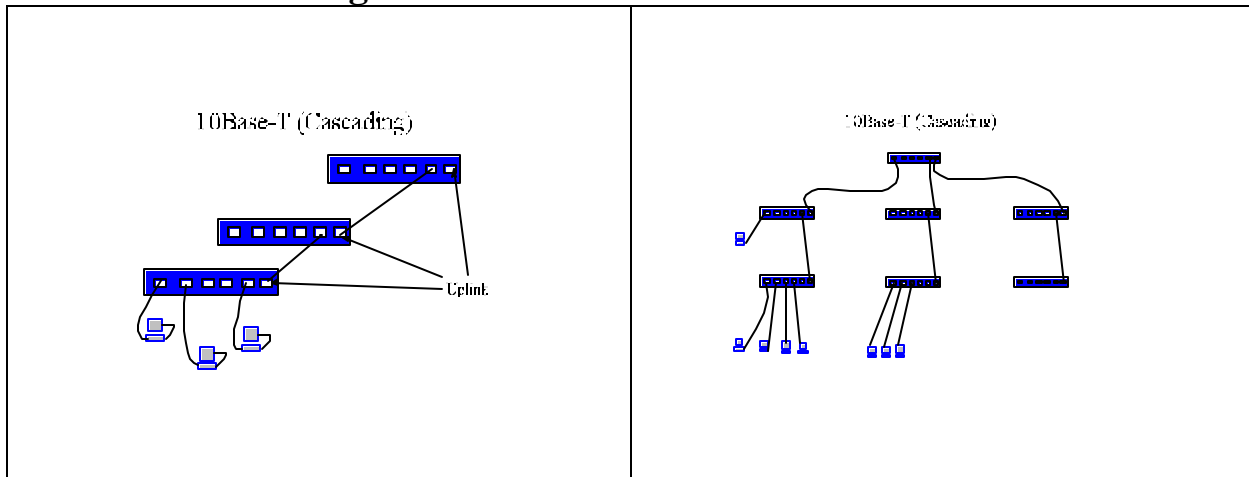
10 BASE-2 Cascading

10Base-2 (Cascading)

Bibliography

Windows95 Help facilities, Microsoft Corp.

Windows95 Device Manager, Microsoft Corp.

NETGEAR 8 Port, 10Mbits Ethernet Hub, Installation Guide, Bay Networks, Inc.

Tenenbaum, A. S., Computer Networks, 3rd edition, Prentice Hall, 1996.

NETGEAR, ADDTRON, Encore, 3COM, and other network adapter manuals and installation guides.

Currie, W. S., LANs Explained, A guide to local area networks, Halsted Press, a division of John Wiley & Sons, 1988.

Rains, A. L., Palmer, M. J., "Local Area Networking with NOVELL Software", Boyd & Fraser Publishing, 1994.

Palmer, M., Sinclair, R. B., "Advanced Networking Concepts", Course Technology Publishing, 1997