

LAN-TO-GO[®]
Wireless LAN PC Card
User's Guide

Federal Communications Commission (FCC) Statement

RADIO FREQUENCY INTERFERENCE STATEMENT

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any special accessories needed for compliance must be specified in the instruction manual.

Warning: A shielded-type power cord is required in order to meet FCC emission limits and also to prevent interference to the nearby radio and television reception. It is essential that only the supplied power cord be used.

Use only shielded cables to connect I/O devices to this equipment.

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.



LAN-TO-GO PC Card

User's Guide

**Computer & Communication Research Laboratories
Industrial Technology Research Institute
Chutung, Hsinchu, Taiwan 310, Republic of China**

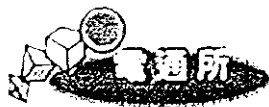


Table of Contents

Introduction

Card Installation

Installing Driver and Utility under MS-DOS

Installing Driver and Utility under Windows 95

Troubleshooting

Specifications

Index



Copyright

©1997 CCL/ITRI. All rights reserved. No part of this manual may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language (natural or computer), in any form or by any means without the prior written permission from CCL/ITRI. CCL/ITRI reserves the right to revise this publication at any time without notice. Information found in this manual is believed to be accurate and reliable. However, no responsibility is assumed by CCL/ITRI, either implied or expressed, for its use.

Trademarks

Throughout this publication are commercial names of products made by other manufacturers or developers. Many of these product names are either registered or unregistered trademarks of their manufacturers or developers. **LAN-TO-GO** is trademark of CCL/ITRI. All other trademarks are the property of their respective owners.

FCC Registration

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. However there is no guarantee that interference will not occur in a particular situation. Operation of this device is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received including interference that may cause undesired operations.

This device generates and uses radio frequency (RF) energy and, if not installed and used in strict accordance with the manufacturer's instructions, interference to radio and television reception may result. Interference can be determined by turning this device off and on while monitoring radio or television reception. The user may be able to eliminate any interference by one or more of the following measures:

- Reorient or relocate the affected device and/or its receiving antenna.
- Increase the distance between the affected device and this device.
- Plug the computer equipped with this device into an outlet on a different branch circuit from that used by the affected device.
- Consult the dealer or an experienced radio/TV technician for help.

NOTE: *Please be sure using our antenna. If you want to use other antenna, the antenna should be proved by the FCC.*

The user may find the following booklet prepared by the Federal Communications Commission helpful:
The Interference Handbook

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402. Stock No. 004-000-00345-4. You can also access this booklet via World Wide Web at <http://www.fcc.gov/cib/Publications/tvibook.html>.



Introduction

Congratulations on your purchase of the LAN-TO-GO PC Card! The LAN-TO-GO PC Card is a wireless network interface card (NIC) for any computing device (hereinafter referred to as a *computer* in this Guide unless otherwise specified) equipped with a Personal Computer Memory Card International Association (PCMCIA) Type II or Type III slot. LAN-TO-GO PC Card conforms to the PCMCIA release 2.x standard and is designed to meet the IEEE 802.11 wireless LAN (WLAN) standard ratified in June 1997. As a result of the completion of the standard, customers can assure themselves that their investment in WLAN infrastructure will be secured and interoperability among multiple vendors will be guaranteed.

Wireless LANs are a complementary extension to existing wired LANs, offering complete mobility while maintaining continuous network connectivity to corporate Intranet. They add a new level of convenience for LAN users. This is accomplished through the use of a device known as an access points (AP), something referred to as a wireless bridge.

LAN-TO-GO PC Card operates in the unlicensed 2.4 GHz Industrial, Scientific and Medical (ISM) band (FCC 15.247). To overcome the effects of interference and multi-path fading and allow co-existence with other wireless systems in the same geographical area, LAN-TO-GO PC Card incorporates state-of-the-art Frequency Hopping Spread Spectrum (FHSS) radio technology. The term, spread spectrum, indicates a radio frequency modulation technique where the radio energy is spread over a much wider bandwidth than needed for the data rate. FHSS provides superior noise immunity to broadband interference which is overwhelming in civilian environments such as office and home.

Package Contents

Your LAN-TO-GO package comes with the following items:

- A LAN-TO-GO PC Card (PCMCIA Type II).
- An antenna module with a mounting bracket and a connecting cable.
- Two 3 1/2" disks - one containing DOS driver and utilities, and the other containing Windows 95 driver and utilities.
- This LAN-TO-GO User's Guide.
- A registration card.



If you like, you can use the auxiliary mounting bracket to fix the antenna to your computer. First, slide the antenna module onto the mounting bracket. When you have determined the place to affix the bracket, remove the protective strip from the adhesive pad and press firmly in position. You can now remove the antenna module and remount it whenever you like.

If any of these items are missing or damaged, please immediately contact your authorized reseller or our Technical Support for replacement.

NOTE: *If you need to return the **LAN-TO-GO** PC Card to CCL/ITRI, you must pack it in the original (or equivalent) packing material, or the warranty will be voided.*



Installing the LAN-TO-GO PC Card

The exact installation procedure for the **LAN-TO-GO** PC Card varies depending on the model of computer you are using. Refer to the manual that accompanied your computer for additional instructions. The **LAN-TO-GO** PC Card can be inserted into a computer whether the power is ON or OFF. Follow these steps:

1. Hold the **LAN-TO-GO** PC Card such that the 68-pin connector is next to the PCMCIA Type II or Type III slot of your computer and the printed label is facing up.
2. Insert the **LAN-TO-GO** PC Card into the slot in the computer and slide it in until it is firmly seated.
3. Plug the connector on the end of antenna's connecting cable into the **LAN-TO-GO** PC Card.
4. Slide the antenna module onto the mounting bracket.
5. Affix the mounting bracket with the antenna unit to the computer housing, using the adhesive tape on the bracket.

CAUTION: *Do not force the **LAN-TO-GO** PC Card into the slot, or severe damage to the computer may occur. It may be easier to attach the antenna cable to the **LAN-TO-GO** PC Card prior to inserting the **LAN-TO-GO** PC Card into the computer.*



Installing Driver under MS-DOS

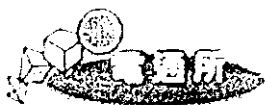
This chapter describes how to install the network driver and utility in a computer running the MS-DOS operating system with Card and Socket Services installed. If Card and Socket Services are installed on your computer, you can quickly and easily install **LAN-TO-GO** PC Card using the **INSTALL** program on the **LAN-TO-GO** MS-DOS Installation Disk. If your computer does not have Card and Socket Services installed, then you will need to manually configure the **LAN-TO-GO** PC Card by using the **UTILITY** program explained below.

INSTALL is quite user-friendly and intuitive. Follow the instructions that appear on the screen. **INSTALL** provides a familiar Windows-like interface that can be accessed with a mouse. It runs under MS-DOS version 3.1 or higher. If your system does not include a mouse, use the keys described in the following table to navigate through the program and select functions.

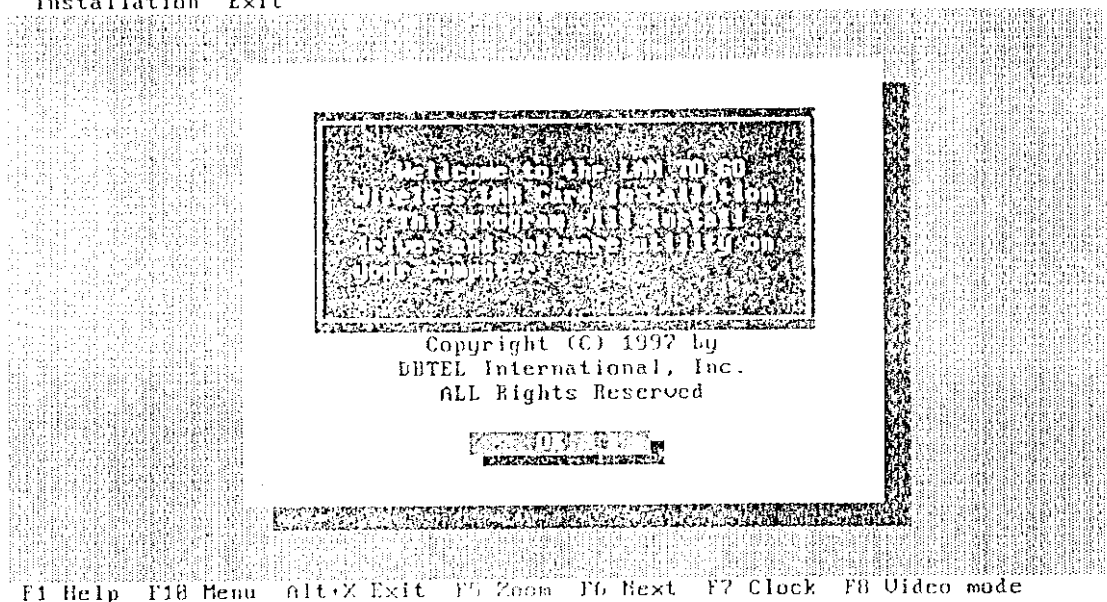
Function	Key
Help	<F1>
Next selection in a menu bar	<Down arrow>
Previous selection in a menu bar	<Up arrow>
Move to the next field or button	<Tab>
Move to the previous field or button	<Shift+Tab>
Select the highlighted function	<Enter>
Select a function that is not highlighted	<Alt> plus highlighted character For example, <Alt+X> for Quit

Follow these steps:

1. Make sure that the **LAN-TO-GO** PC Card has been properly installed in your computer.
2. Make sure that your computer is running DOS version 3.1 or higher.
3. If Card Services and Socket Services are available but not installed yet, install them first.
4. Place the **LAN-TO-GO** DOS Driver and Utility diskette in a floppy drive on your computer, switch to that drive.
5. At the DOS prompt, type **INSTALL** and then press <Enter>. Click on the "OK" button or press <O> when the first Welcome screen appears.

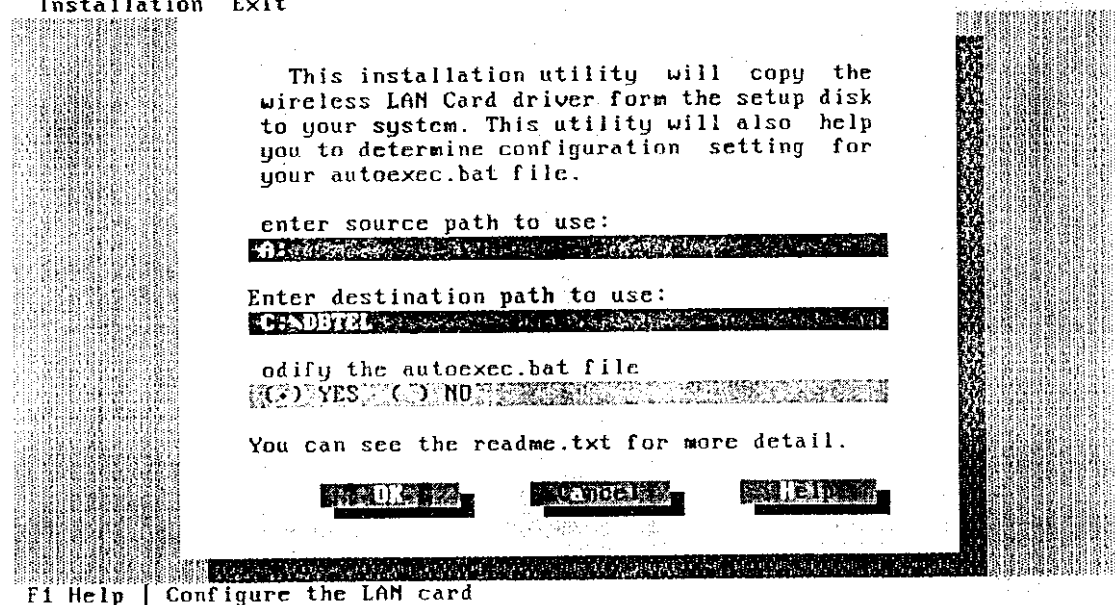


Installation Exit

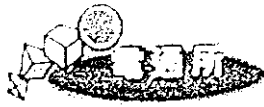


5. Enter the - Alt-F - command - you enter a key command by holding down the "Alt" key while you press the appropriate letter key, or use the mouse pointer to activate the pulldown menu bar and choose Install Utility item.

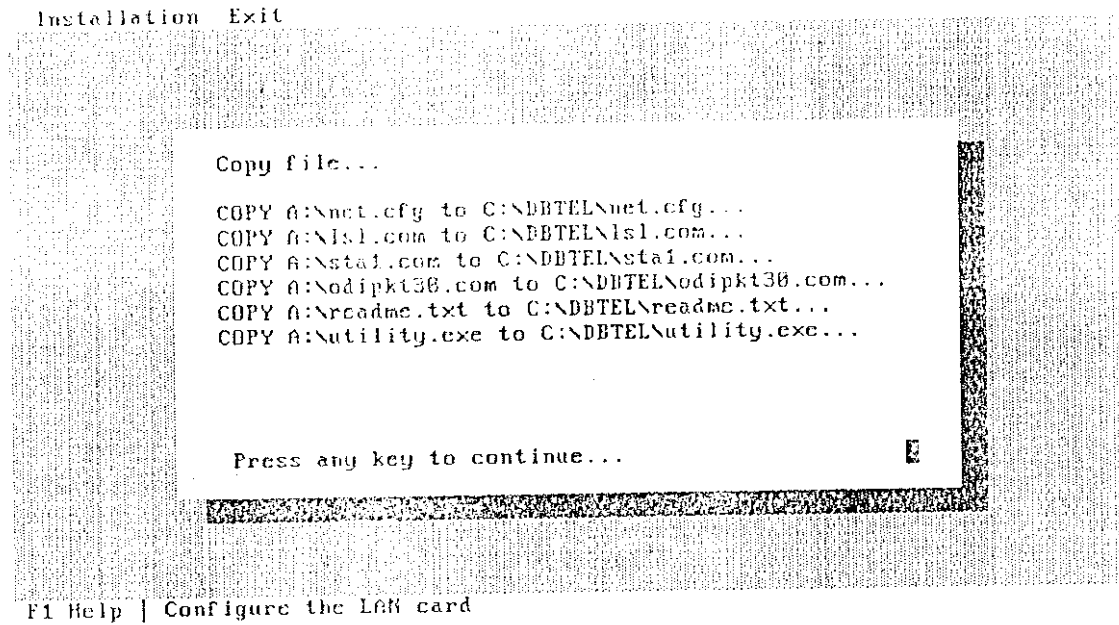
Installation Exit



6. Enter the source path and the destination path, and decide whether you want INSTALL to automatically update your AUTOEXEC.PAT file.
The source path is A: and the destination path is C:\DBTEL.
Press the OK button when you are ready.
7. Press the OK button to install the driver and the utility.



hard disk and will let you know when it finishes.



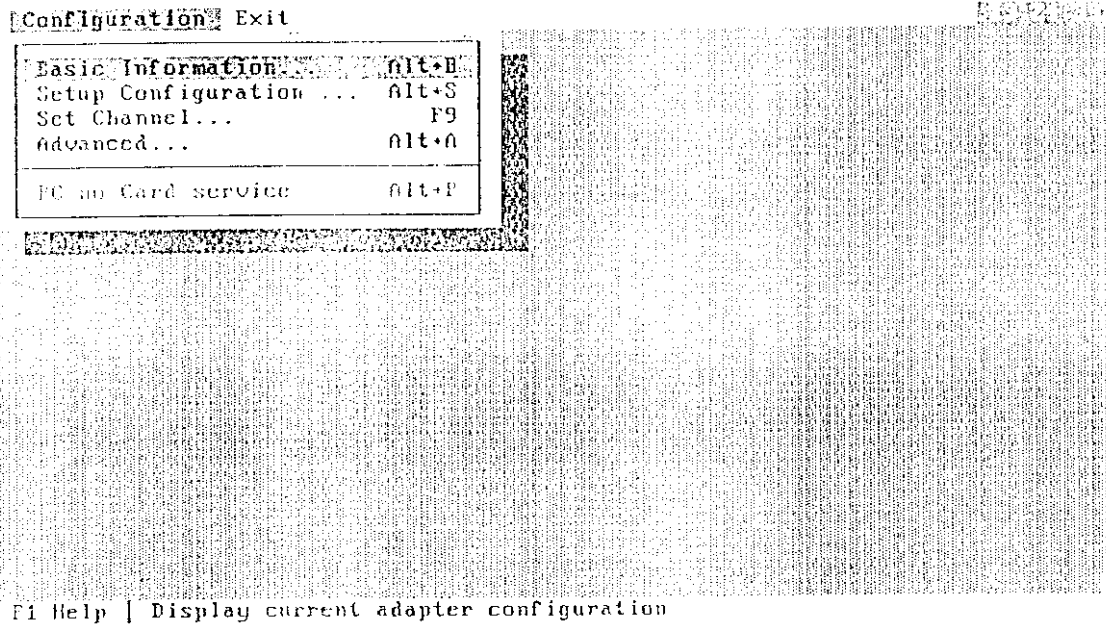
Configuring the LAN-TO-GO PC Card using UTILITY

After completing the installation procedure, you can now configure the LAN-TO-GO PC Card by consulting the following paragraph. To configure the LAN-TO-GO PC Card, follow these steps:

1. At the DOS prompt, type CD \DBTEL (or the directory where you installed the programs) and then press <Enter>.
2. Type at the prompt UTILITY and press <Enter>.

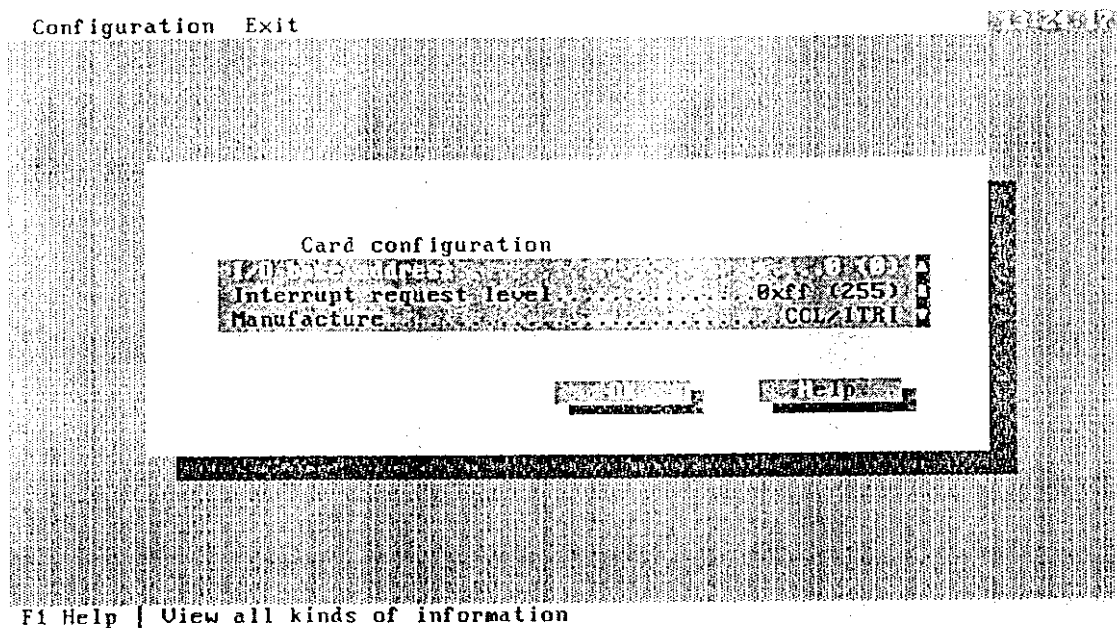
You tell UTILITY what you want to do by entering commands. The table below summarizes the commands available in UTILITY. As an alternative, you can use your mouse to navigate through the menu and activate the function you want. For details about each of these commands, see their respective explanations.

Function	Key
Basic Information	<Alt+B>
Setup Configuration	<Alt+S>
Advanced	<Alt+A>
Activate Configuration: pull down menu	<Alt>
Deactivate Configuration: pull down menu	<Alt>
Quit	<Alt>
Quit	<Alt>



Basic Information

This screen displays information about the LAN-TO-GO PC Card and its current configuration.



• I/O base address

The I/O base address designates the beginning of address space available for communication between the computer and the LAN-TO-GO PC Card. Each device must have a unique address (I/O).

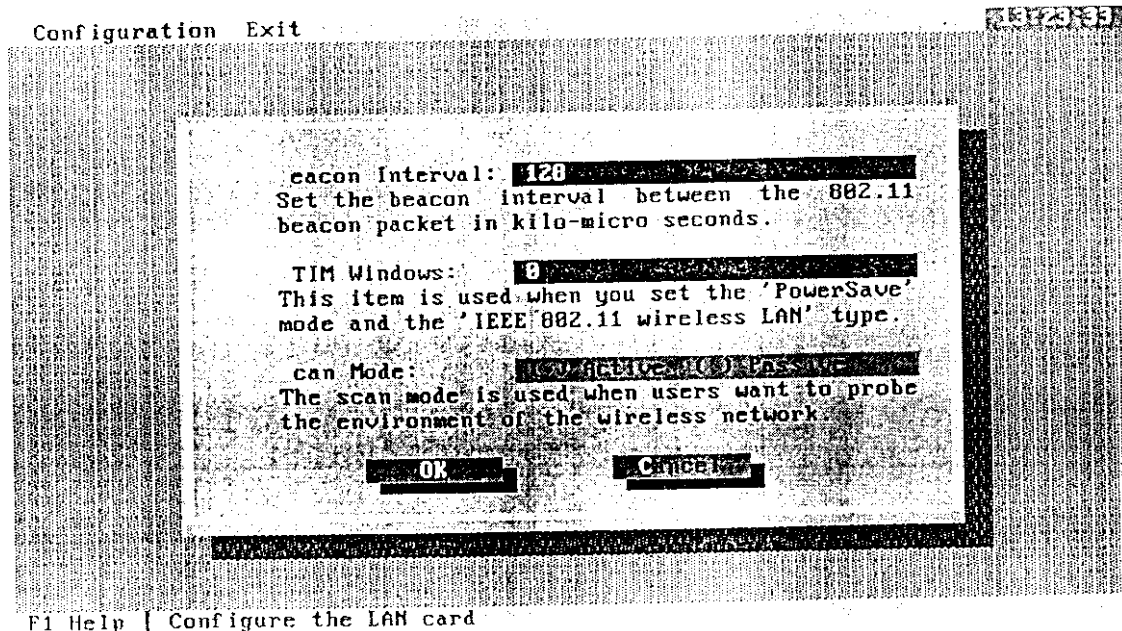
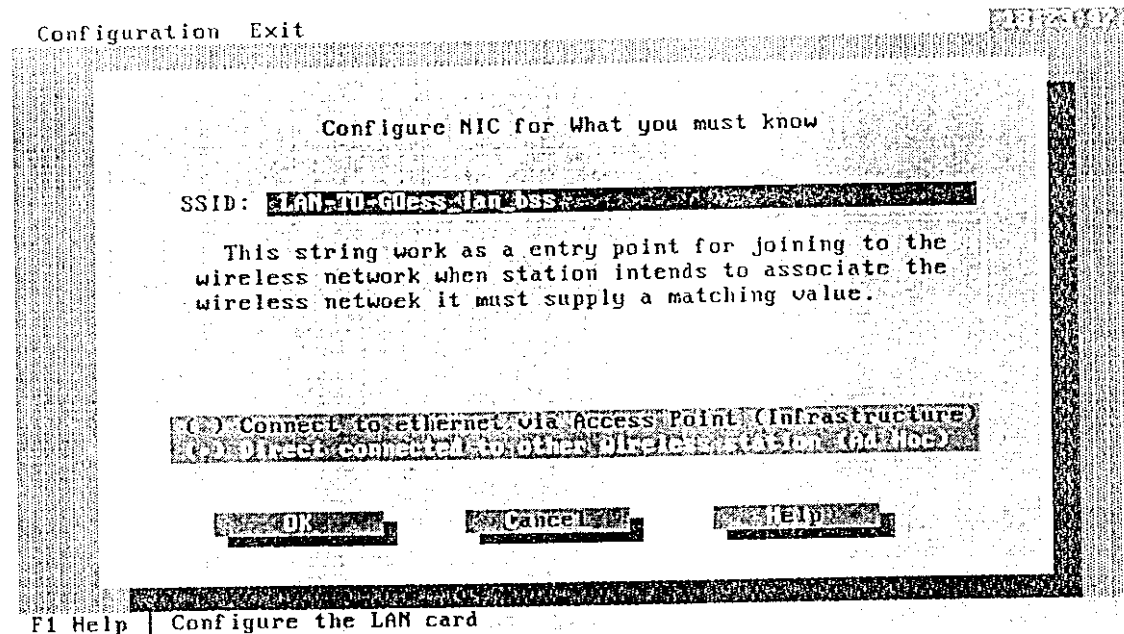


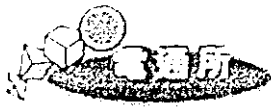
- Interrupt request level

An interrupt request (IRQ) signals the computer when a device needs attention. The LAN-TO-GO PC Card must have an IRQ assigned that is distinct from any other device installed in the computer.

- Manufacturer

Identify the maker of this LAN-TO-GO PC Card.





Configuration Exit

EXIT

Do you really want to exit?

YES

NO

F1 Help F10 Menu Alt+X Exit F5 Zoom F6 Next F7 Clock F8 Video mode



Installing Driver under Windows 95

At the very beginning, please be sure your computer is running Windows 95 and the following items are available and at hand:

1. A computer equipped with a free PCMCIA Type II or Type III slot
2. A 3.5" floppy disk drive
3. LAN-TO-GO PC Card
4. LAN-TO-GO Windows 95 Driver Disk
5. Windows 95 CD-ROM or installation disks
6. LAN-TO-GO User's Guide

Installing the LAN-TO-GO PC Card under Windows 95 is straightforward: simply insert the LAN-TO-GO PC Card in any PCMCIA Type II compatible slot, power-up your computer (typically a notepad or notebook computer) if it was switched off. The New Hardware Found window with the "CCL/ITRI-WDAS-PCMCIA" identification will popup indicating that the system has detected a new hardware device. Then Windows 95 will automatically start an installation procedure. Please follow the on-screen instructions and proceed with care from now on.

NOTE: *If you are unfamiliar with how to install PC Card hardware properly, turn to Chapter 2 for instructions.*

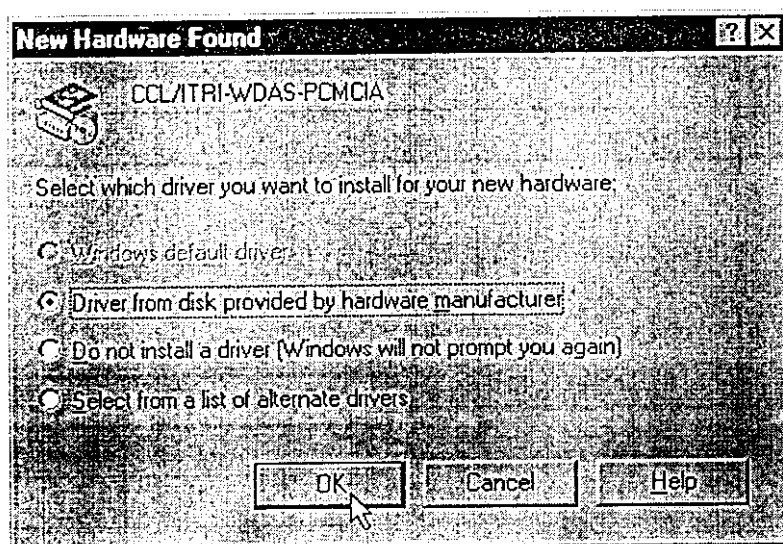
If Windows 95 recognizes the hardware, it will try loading the driver on behalf of you. If it can not identify the appropriate driver, then Windows 95 will prompt you to select which driver you want to install for your new hardware. Select "**Driver from disk provided by hardware manufacturer**" and click "OK". Next, Windows 95 will prompt you to specify the location containing the LAN-TO-GO driver. Insert the accompanying diskette titled "**LAN-TO-GO Windows 95 Driver Disk**" in drive A: (or B:). Click the "OK" button to continue. Then Windows 95 will start copying files (i.e., **Netlan2g.inf** and **Lan2go.sys**) from the LAN-TO-GO Windows 95 Driver Disk and the Windows 95 CD-ROM or installation disks. Again, the exact location containing the Windows 95 CD-ROM or installation disks may be varied such that you may need to identify correctly.

NOTE: *During driver installation, you may experience a conflict with the driver already loaded on your computer.*

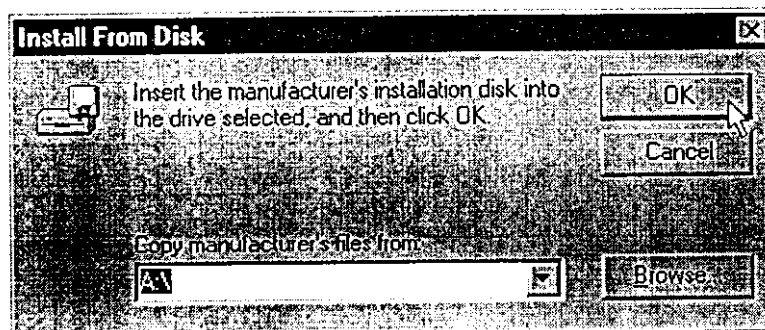


To put the matter in a nutshell, follow these steps:

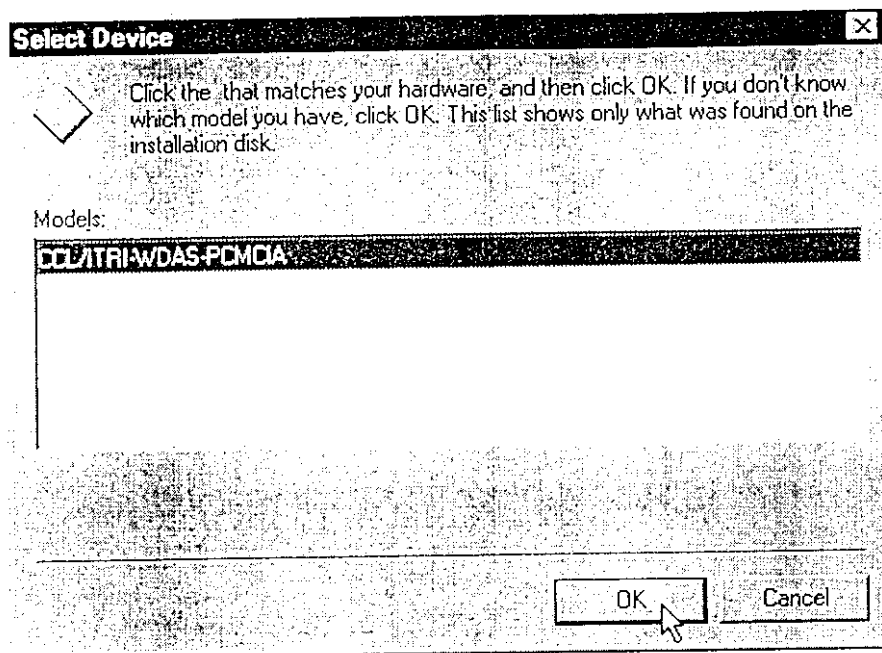
1. Insert the LAN-TO-GO PC Card in a PCMCIA Type II slot.
2. Power-up your computer if it was off and boot Windows 95.
3. A transient window will popup indicating that Windows 95 has found a new hardware and is installing the software for it. This window will last for only a few seconds and disappear by itself.
4. Then the New Hardware Found window will appear. Select "Driver from disk provided by hardware manufacturer" and click "OK" button.



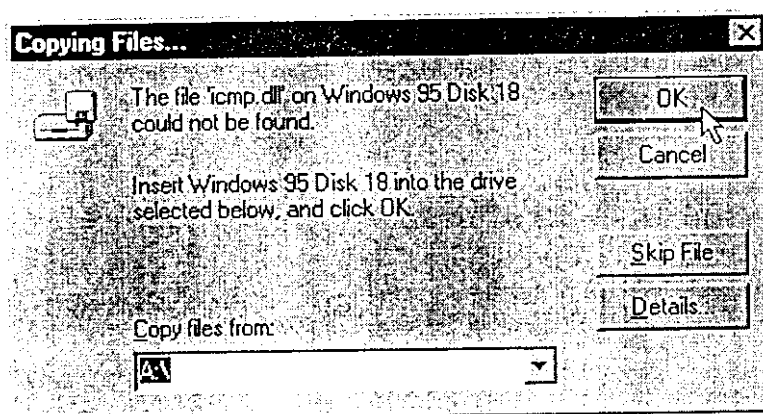
5. Insert LAN-TO-GO Windows 95 Driver Disk in drive A: (or B:) and click "OK". The Select Device window appears.



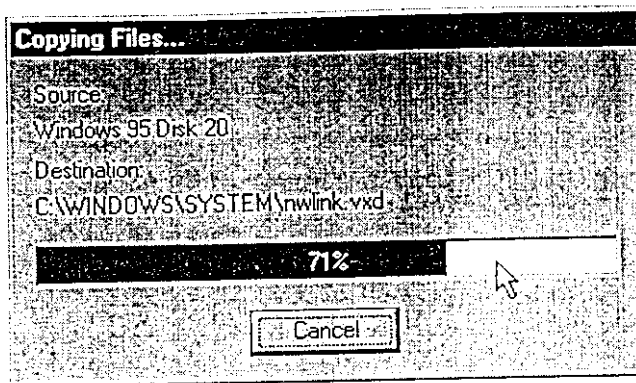
6. From the Select Device window, choose the "CCL/ITRI-WDAS-PCMCIA" from list and click the "OK" button.



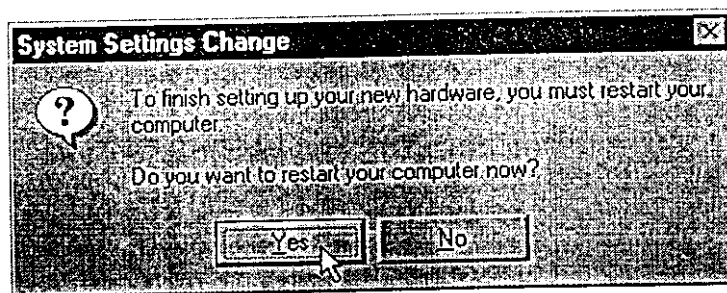
7. Insert Windows 95 CD-ROM or installation disks at request. Enter the correct drive and directory as needs when you are prompted.



8. Click the "OK" button to start copying files. Please be noted that your screen may look different from the one shown here.

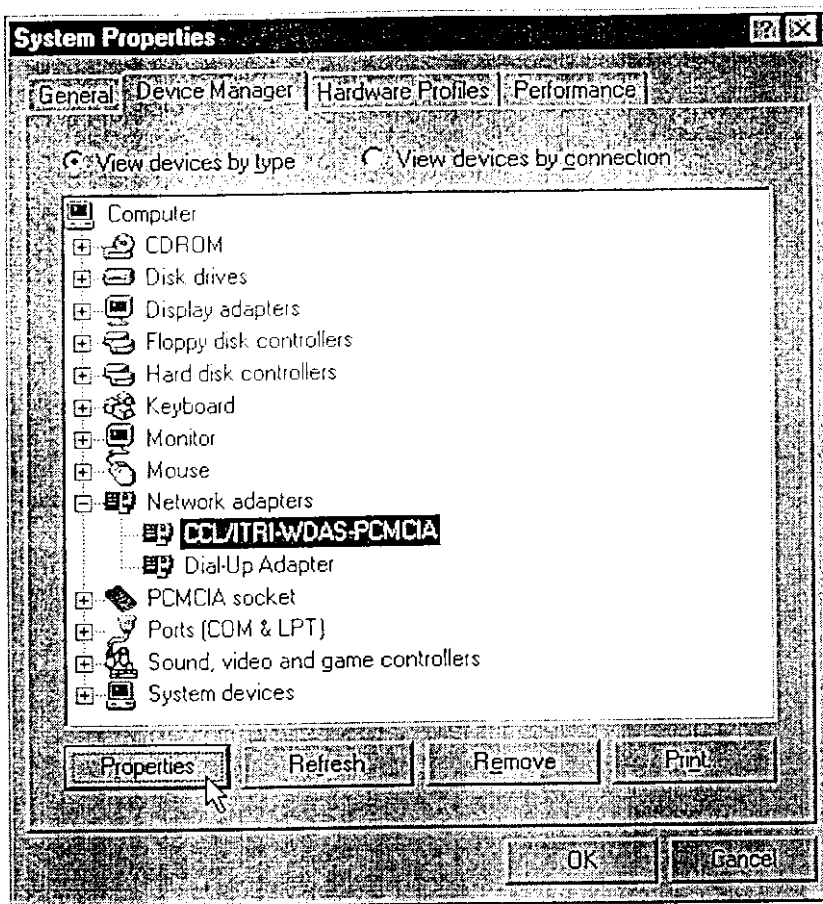


9. Upon finishing copying the files, you have the chance to shutdown and restart your system now by clicking the “Yes” button on the System Settings Change window. Otherwise, these changes will not take effect until next time you start your system.

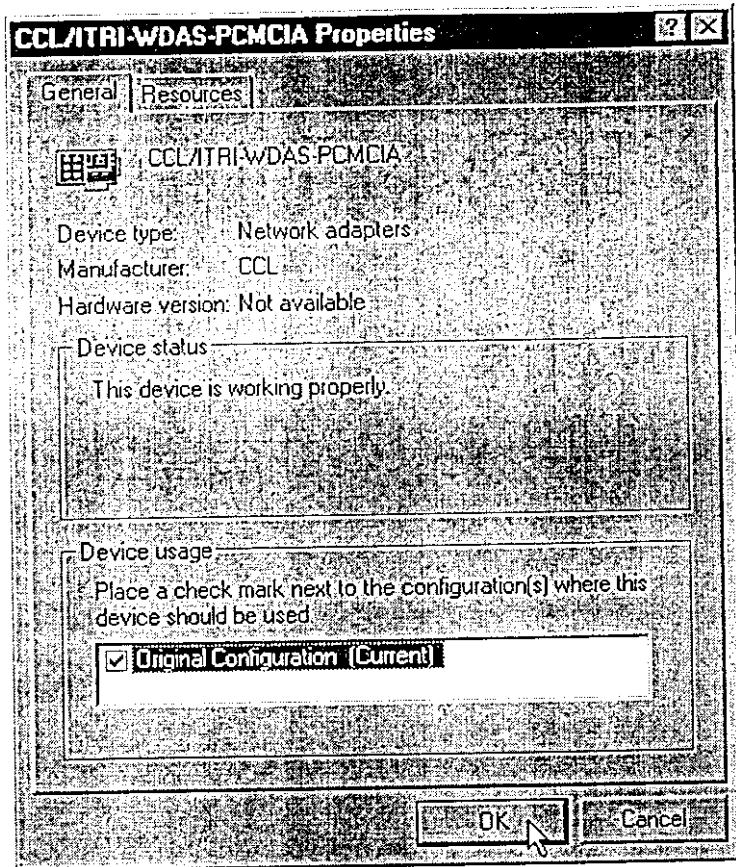


Check and change the current LAN-TO-GO PC Card's configuration

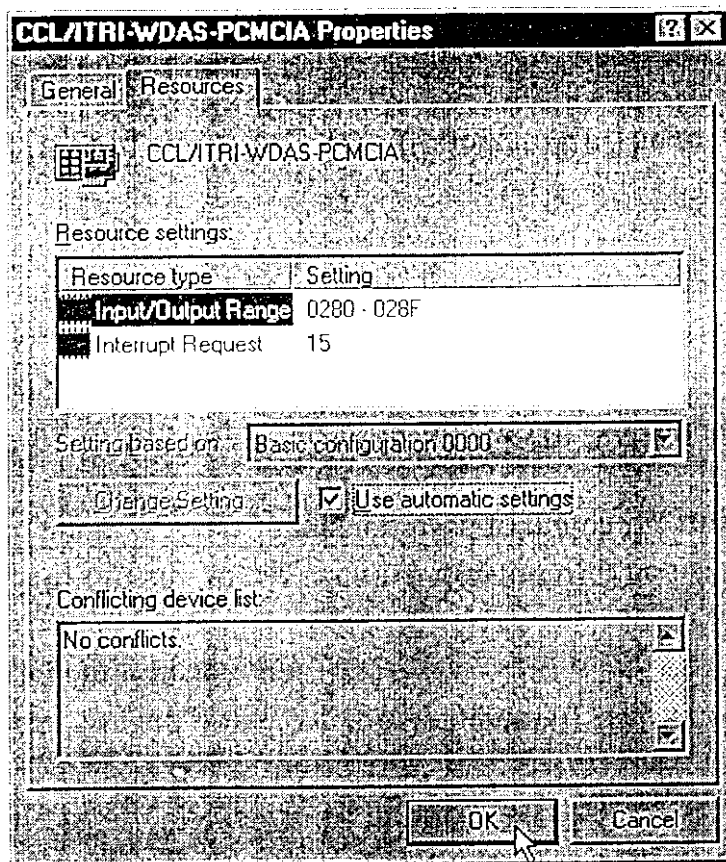
1. Double-click the “My Computer” icon on the Desktop. The My Computer window appears.
2. From the My Computer window, double-click the “Control Panel” icon. The Control Panel window appears.
3. From the Control Panel window, double-click the “System” icon. The “System Properties” folder appears.
4. Choose the “Device Manager” tab. Find and select the NIC with name “CCL/ITRI-WDAS-PCMCIA”.
5. Click the “Properties” button. The CCL/ITRI-WDAS-PCMCIA Properties folder appears.



6. Choose the "General" tab. If the Device status area is shown "This device is working properly.", your LAN-TO-GO PC Card was installed successfully. Otherwise, you may get an error message.



7. Choose the “Resources” tab to display the current configuration. If no devices conflict, then a “No conflicts.” Message should appear in the bottom Conflicting device list. If an error message appears, you need to find and solve the conflicts. To use different I/O port addresses and IRQ number, uncheck the “Use automatic settings” box, and click the scroll button “▼” to see what configurations are available.



8. Click the "OK" button to close the folder.

Remove the LAN-TO-GO PC Card from the computer

Although the PCMCIA software architecture supports automatic configuration and "hot insertion (referred to PC Cards to be inserted into a socket when power is on)" capability, it does not mean that you can definitely remove the PC Card without prior notice. The following procedure may save you a trouble whenever you want to remove the **LAN-TO-GO** PC Card from the computer whenever Windows 95 is still running. You are advised to take it for granted that thing should be done in that way. Ask Bill Gate to know how it is.

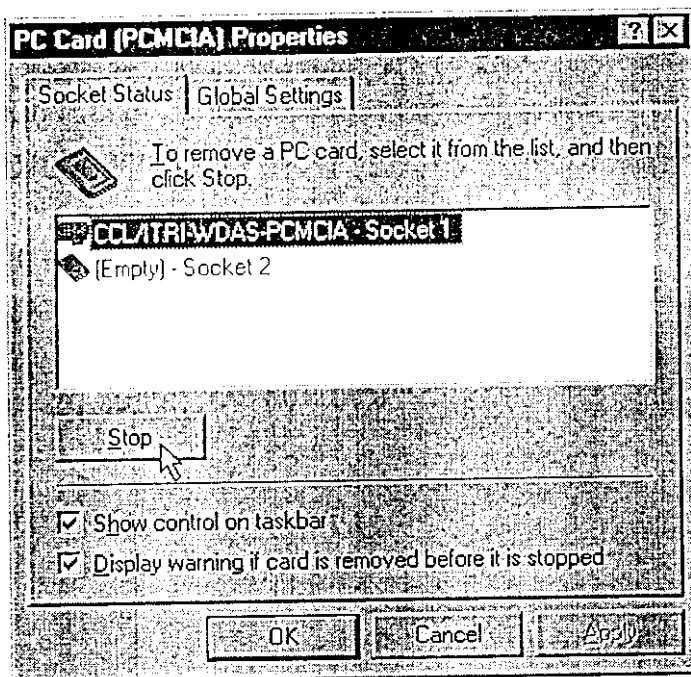
1. Double-click the small PC Card icon on the right-handed side of the Windows 95 Taskbar. Or double-click the "PC Card (PCMCIA)" icon from the Control Panel window.



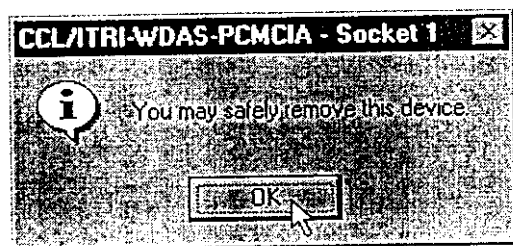
2. From the PC Card (PCMCIA) Properties holder, choose the "Socket Status" tab. A list of the PC Cards currently plugged into your system is



displayed.



3. To remove the **LAN-TO-GO** PC Card, select it from the list and then Click the “Stop” button.
4. You can be sure that the **LAN-TO-GO** PC Card can now be safely removed whenever you see the following popup window:



5. Click the “OK” button to close the window.

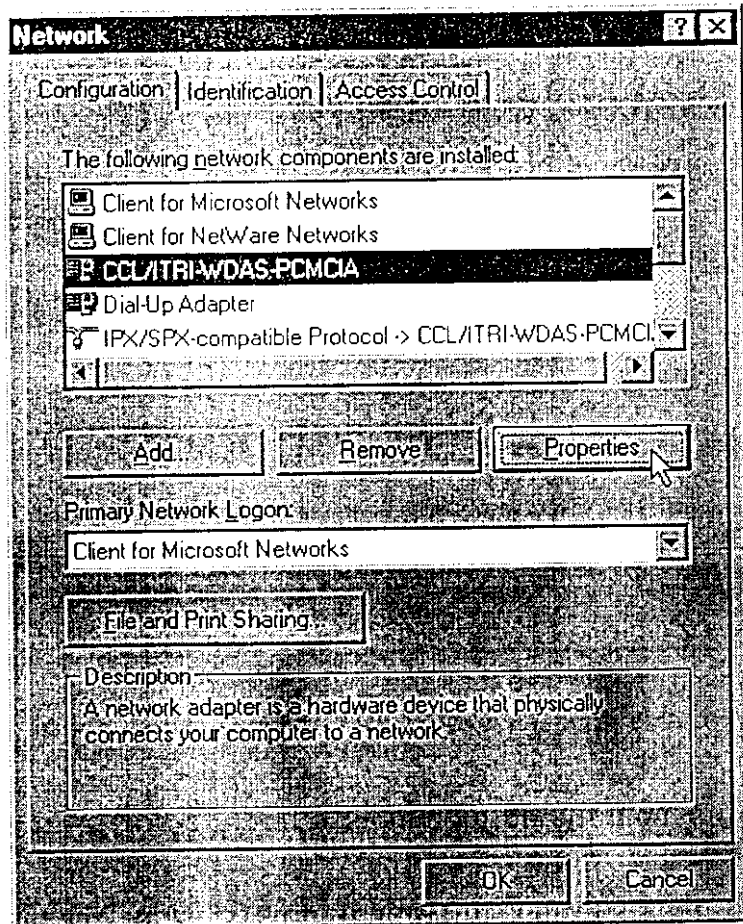
View or change the LAN-TO-GO WLAN parameters

You can verify whether the **LAN-TO-GO** PC Card was installed properly or not, and view and change its parameters by proceeding as follows:

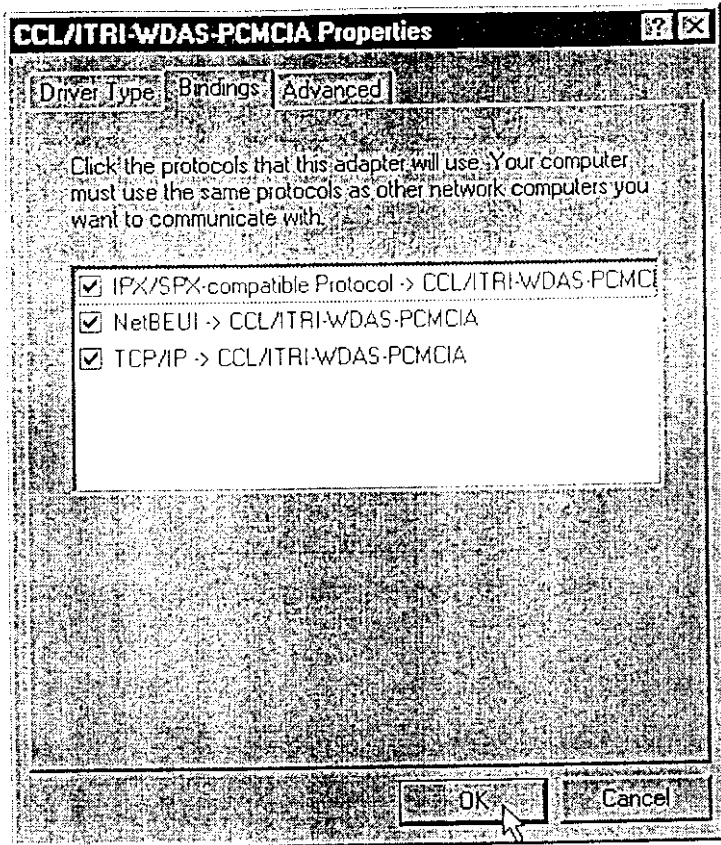
1. Click the “Start” button on the Windows 95 Taskbar. Move the pointer to Settings, and then click the Control Panel. The Control Panel window appears.
2. From the Control Panel window, double-click the “Network” icon. The Network folder will be displayed.



3. Choose the "Configuration" tab. All network components that have been added to your system will appear.
4. Find and select the NIC with name "CCL/ITRI-WDAS-PCMCIA". If it is not present, the prior installation was failed.
5. Click the "Properties" button. The CCL/ITRI-WDAS-PCMCIA Properties folder will appear.



6. To view the network protocol settings, choose the "Bindings" tab in the CCL/ITRI-WDAS-PCMCIA Properties folder.



7. Click the "OK" button to quit the CCL/ITRI-WDAS-PCMCIA Properties folder.

If you changed parameters in the CCL/ITRI-WDAS-PCMCIA Properties window, Windows 95 may prompt you to reboot your system.

LAN-TO-GO parameters

AP MAC Address

Any device that contains an IEEE 802.11 conformant MAC and PHY interface to the wireless medium is called the Station (STA). The Access Point (AP), considered to be synonymous with "*Portal*" as defined in the 802.11 Specifications, provides logical integration between the 802.11 WLAN and an integrated wired 802.x LAN. The AP MAC Address specifies the address of the AP with which the STA will try to be associated initially. At any given instant, a STA may be associated with no more than one AP. A STA learn the presence of an AP and then requests to establish an association by invoking the function of scanning. The Access Points establishes coverage areas or *cells* similar in concept to those of a cellular phone network.



Infrastructure/Ad Hoc Mode

An Ad Hoc network is often formed without pre-planning, for only as long as the LAN is needed. The principal characteristic of an Ad Hoc network is limited temporal and spatial extent. An Ad Hoc network is often supported by an Independent Basic Service Set (IBSS) network, where a STA communicates directly with one or more other STAs. In practice, an off-the-shell peer-to-peer network operating system (NOS) will provide the set of services required in an Ad Hoc network.

The 802.11 Specifications states that “the infrastructure includes the Distribution System Medium, Access Point and Portal entities, as well as being the logical location of Distribution and Integration service functions of an ESS”. It is possible to create an Extended Service Area (ESA) that provides wireless coverage for an entire building or area by connecting multiple Access Points to existing wired LANs. In such an environment, a mobile user can maintain a seamless connection to the network as he moves about.

Number of Operating Channels

The number of transmit and receive frequency channels is 79 for the US and Europe and 23 channels for Japan. This is fully defined in the below table.

Channel #	Value	Channel #	Value	Channel #	Value
2	2.402	28	2.428	54	2.454
3	2.403	29	2.429	55	2.455
4	2.404	30	2.430	56	2.456
5	2.405	31	2.431	57	2.457
6	2.406	32	2.432	58	2.458
7	2.407	33	2.433	59	2.459
8	2.408	34	2.434	60	2.460
9	2.409	35	2.435	61	2.461
10	2.410	36	2.436	62	2.462
11	2.411	37	2.437	63	2.463
12	2.412	38	2.438	64	2.464



13	2.413	39	2.439	65	2.465
14	2.414	40	2.440	66	2.466
15	2.415	41	2.441	67	2.467
16	2.416	42	2.442	68	2.468
17	2.417	43	2.443	69	2.469
18	2.418	44	2.444	70	2.470
19	2.419	45	2.445	71	2.471
20	2.420	46	2.446	72	2.472
21	2.421	47	2.447	73	2.473
22	2.422	48	2.448	74	2.474
23	2.423	49	2.449	75	2.475
24	2.424	50	2.450	76	2.476
25	2.425	51	2.451	77	2.477
26	2.426	52	2.452	78	2.478
27	2.427	53	2.453	79	2.479
				80	2.480

North American and European Requirements (Value specified in GHz)

Channel #	Value	Channel #	Value	Channel #	Value
73	2.473	81	2.481	89	2.489
74	2.474	82	2.482	90	2.490
75	2.475	83	2.483	91	2.491
76	2.476	84	2.484	92	2.492
77	2.477	85	2.485	93	2.493
78	2.478	86	2.486	94	2.494
79	2.479	87	2.487	95	2.495
80	2.480	88	2.488	-	-

Japan Requirements

SSID

The Service Set Identity (SSID), or called Domain ID by some vendors, has relation to the seamless “roaming” feature of the system. Its purpose is to render a homogeneous WLAN environment regardless of the physical location the Station would be. The rule of thumb is to use the same value as that used by the Access Point with which the Station will



be associated.



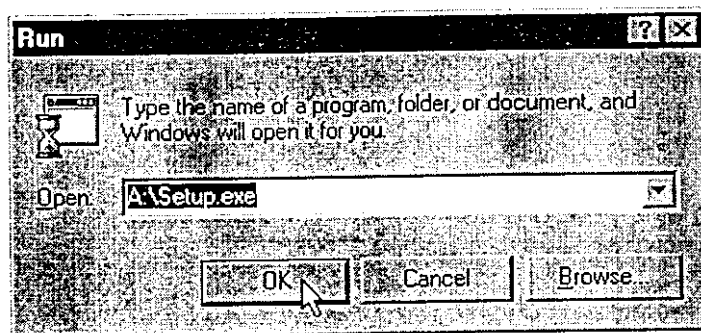
LAN-TO-GO Utilities

There are two utilities to help you easily configure and test the LAN-TO-GO PC Card. The smalicon program will continuously monitor the link quality, and the WDASusa program is a site survey and configuration tool. Both programs run in Windows 95 and should be installed into the fixed disk before they can be used. The Setup program located in the LAN-TO-GO Windows 95 Utilities Setup Disk 1 will copy most of the files into the default directory, C:\Program Files\DBTEL, or into the directory specified during the installation. To run this program, you will need a computer that:

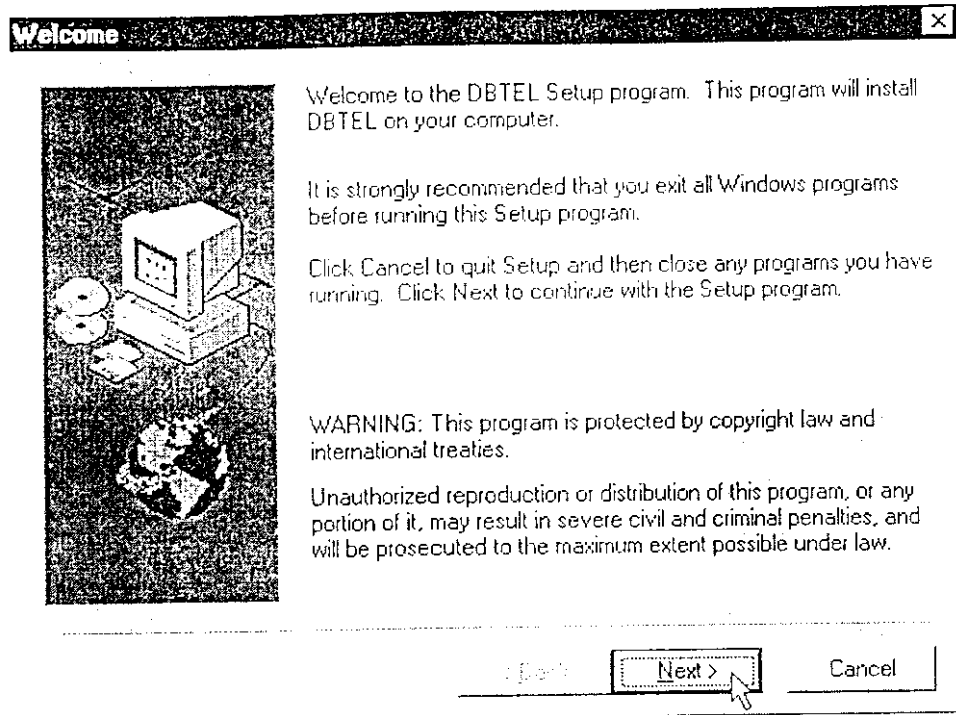
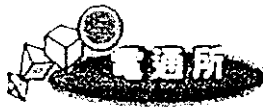
- Runs the Windows 95 operating system
- Has the LAN-TO-GO PC Card and its driver (miniport driver) properly installed.

Follow these steps:

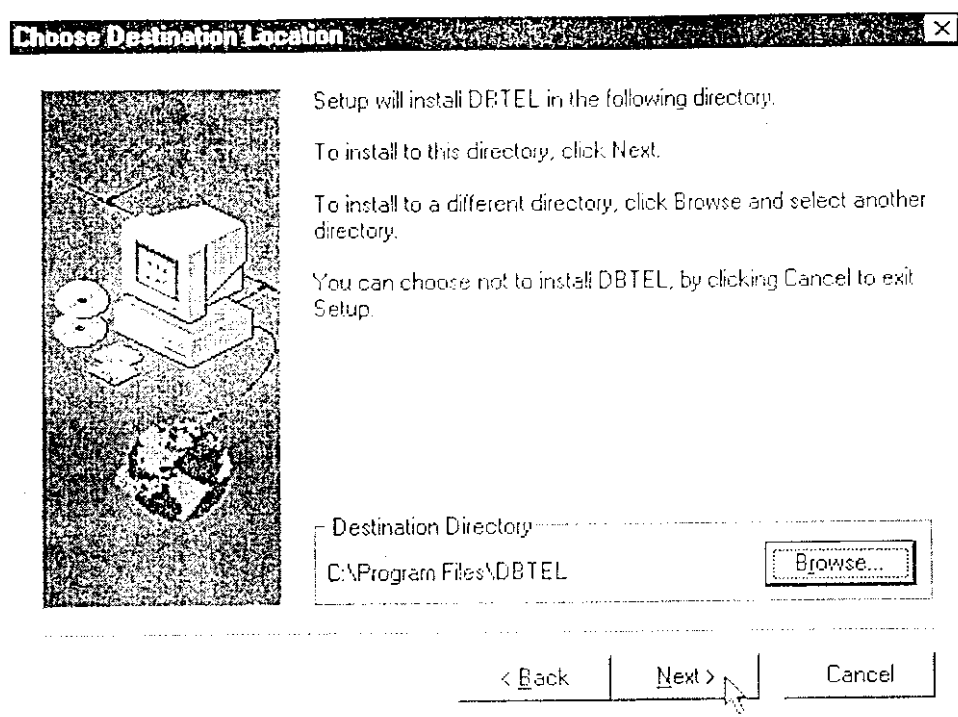
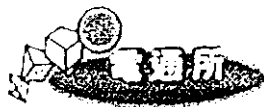
1. Insert the LAN-TO-GO Windows 95 Utilities Setup Disk 1 in drive A:.
2. Click the “Start” button on the Windows 95 Taskbar. Move the pointer to Run... and then click on it. The Run window appears.



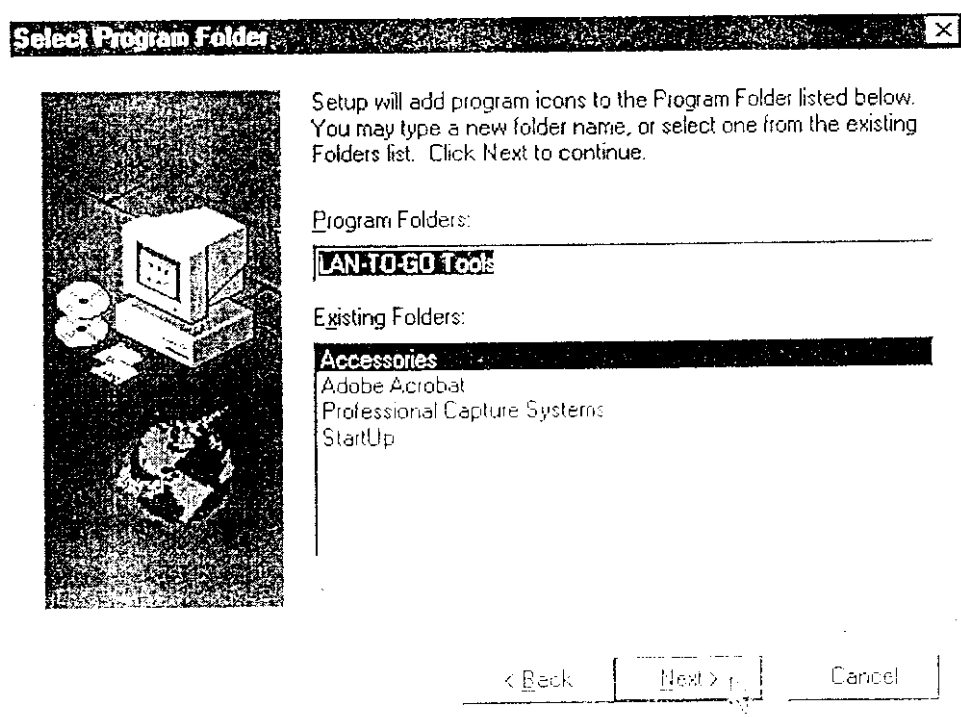
3. Type A:\Setup and click the “OK” button. The Setup program displays a Welcome message box with options to continue or exit. Click the “Next >” button to continue.



4. When the User Information window appears, simply fill in your name and the company you are working for (using the TAB key to change between fields). Click the "Next >" button when it is done. The Choose Destination Location window appears
5. Click the "Next >" button if you are satisfied with the default directory, C:\Program Files\DBTEL, or click the "Browse..." button to specify the directory you would like.

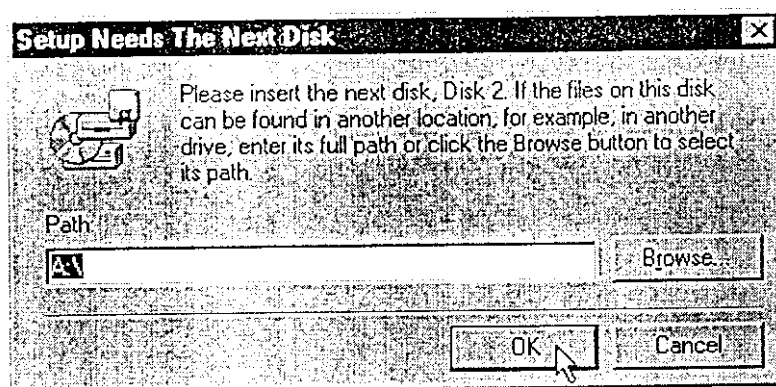


6. Next, in the Select Program Folder window, you are prompted to specify a folder name to place the utilities. You can either pick one from the "Existing Folders:" list or type in a new name if you wish. The default folder name is LAN-TO-GO Utilities. Click the "Next >" button to continue.





7. From Start Copying Files window, click the “Next >” button to start copying files, or click the “< Back” button to review or change any settings.
8. Insert the LAN-TO-GO Windows 95 Utilities Setup Disk 2 in drive A: at Setup request. Click the “Next >” button to continue.



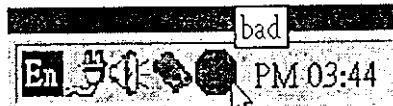
9. Click the “Finish” button when everything is done.
10. Review the README.TXT that opens automatically when the installation is complete.

When Setup is complete, the LAN-TO-GO Utilities Folder contains two icons: smalicon, and WDASusa.



Link Quality Monitoring

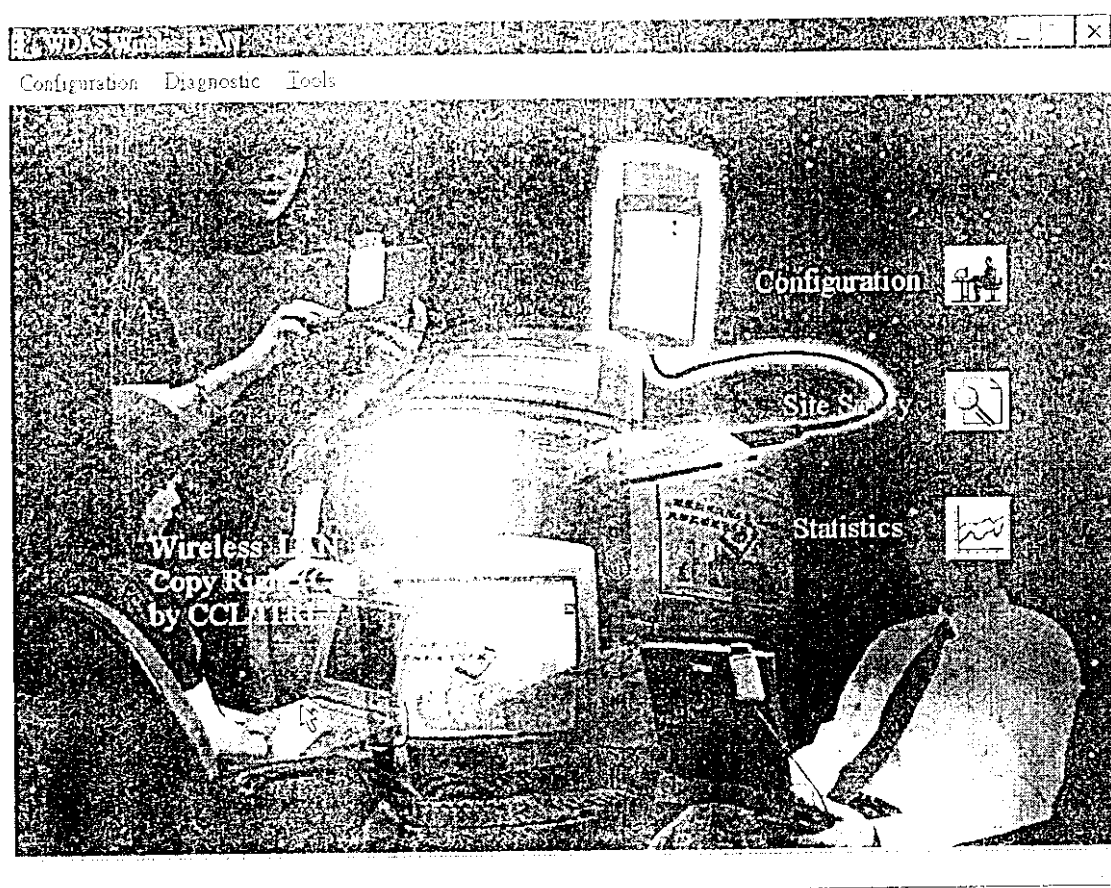
The smalicon program allows you to easily justify the link quality between two LAN-TO-GO stations, or between a LAN-TO-GO station and a LAN-TO-GO access point. To run the smalicon program, just click on its icon from the LAN-TO-GO Utilities folder. As long as the smalicon program is running, it will You can immediately tell how well the link quality is by looking up the facial expression appeared by the smalicon program. The better the link quality is, the farther the range can be. A link quality of good means that you can be sure that a reliable wireless connection is being maintained. On the contrary, a link quality of bad indicates that the station is no longer responding at all. Finally, a link quality of normal indicates that the connection is remained and usable, but signal is not strong. The link quality is the most important issue that you should keep an eye on it regularly.

Appearance	Link Quality
	Good. <i>Face is smiling, colored green.</i> Connection is reliable and dependable.
	Normal. <i>Mouth is closed, colored yellow.</i> Connection is maintained, but signal is not strong.
	Bad. <i>Face is crying, colored red.</i> No connection at all.



Configuration and Diagnosis

After the WIDAS program is loaded, the main menu similar to the following figure will appear.



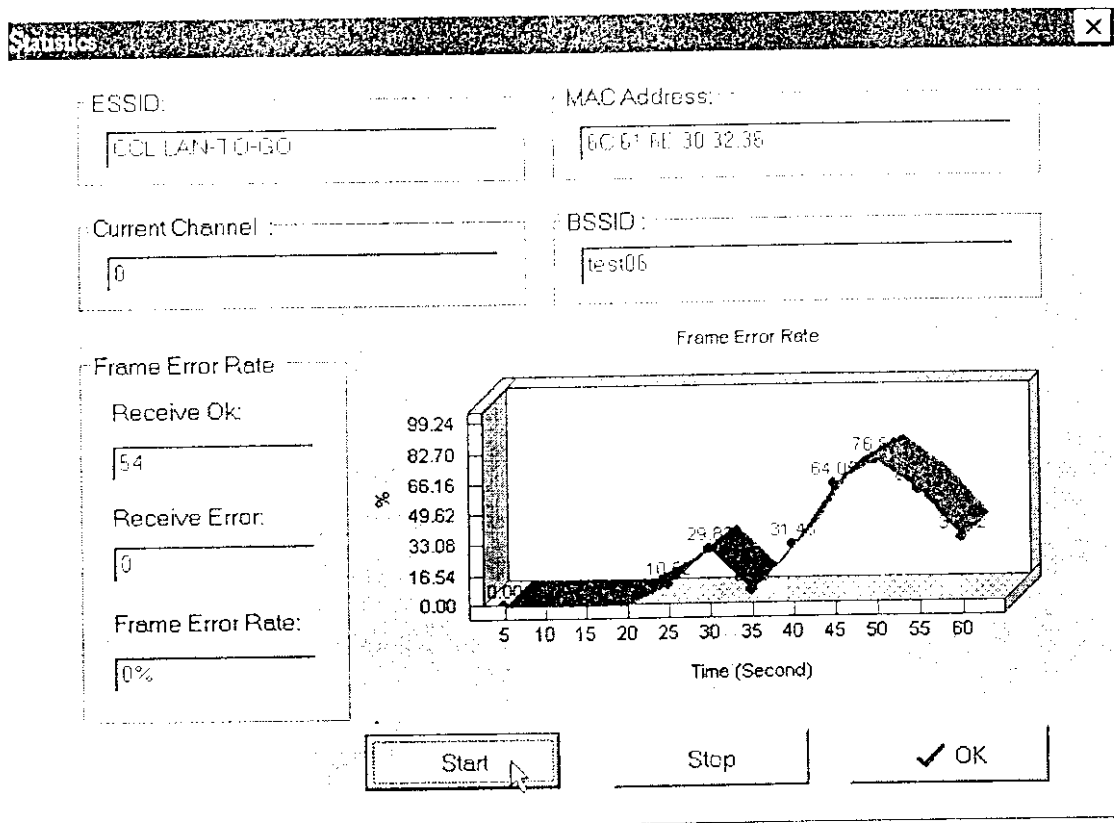
Statistics

This tool displays the network statistics maintained by the LAN-TO-GO PC Card. The use of statistics is a convenient way to judge how your LAN-TO-GO PC Card is. The Statistics window displays all the settings essential to the proper operation of the LAN-TO-GO PC Card at a glance. If you see any contradiction or invalid value from this Statistics window, the LAN-TO-GO PC Card may be in trouble or the surrounding environment is too hostile to its operation. The *Beacons* transmitted periodically from the access point will be utilized to calculate the receiving Frame Error Rate. The 32-bit *Cyclic Redundancy Check (CRC)* field of the Beacon frame is the criterion used to determine whether the frame is received successfully or not.



Follow these steps to use the statistics tool:

1. Click the Statistics option from the main menu of the WDA Sasa program. The Statistics window appears.
2. Click the "Start" button. The statistics of receiving Frame Error Rate will be calculated and depicted on the graph at an interval of five seconds.



3. Click the "OK" button when you are done.

Site Survey

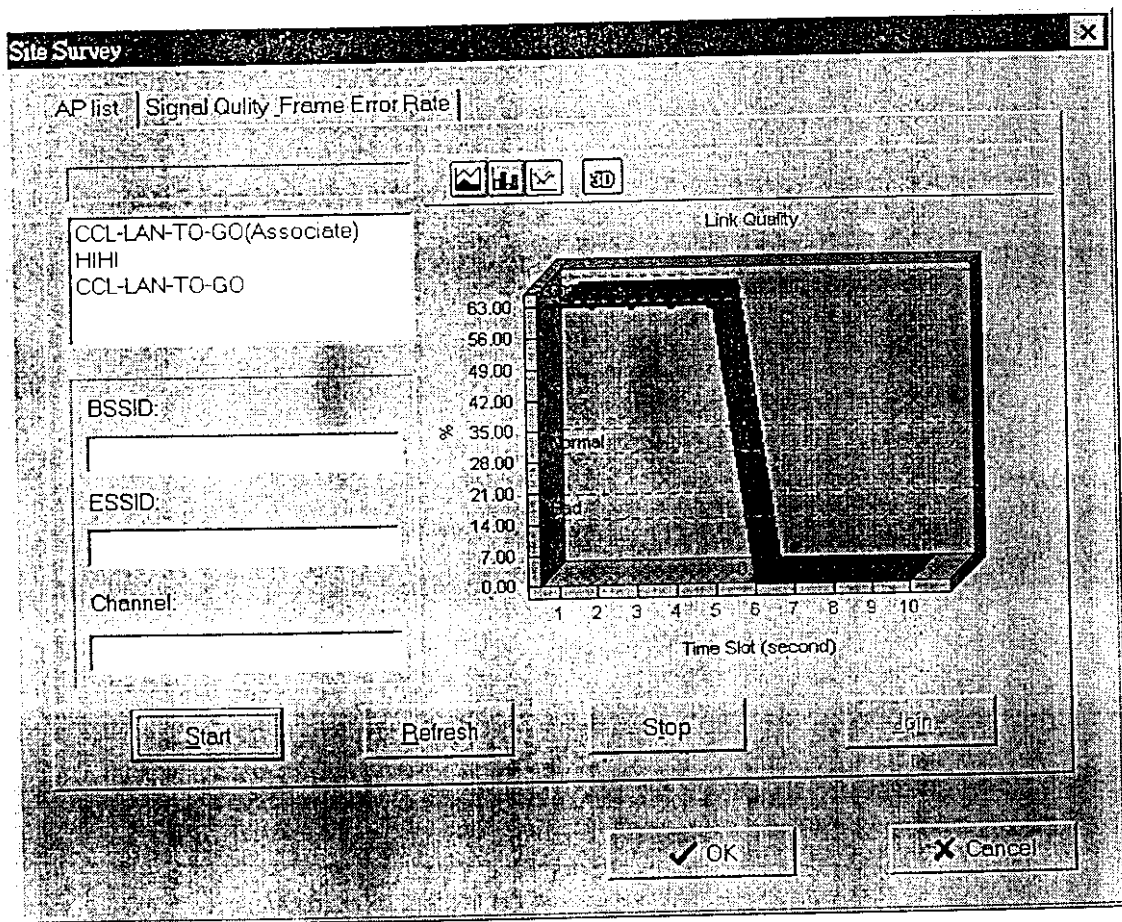
The purpose of the site survey tool is to provide you with a directory of access points in the vicinity of your current location. You learn what access points are within the range of access by referring to AP List shown on the Site Survey folder. If your computer is being associated with any access point, it will be specifically indicated in the AP List also. You are required to first become associated with an access point before you are allowed to make use of the services provided by the access point. If multiple access points are present simultaneously, you have the freedom to make your choice among them. But, you need to be sure that you have the privilege to establish an association with that access point. Ask your network administrator or MIS people to know exactly with which access points you are



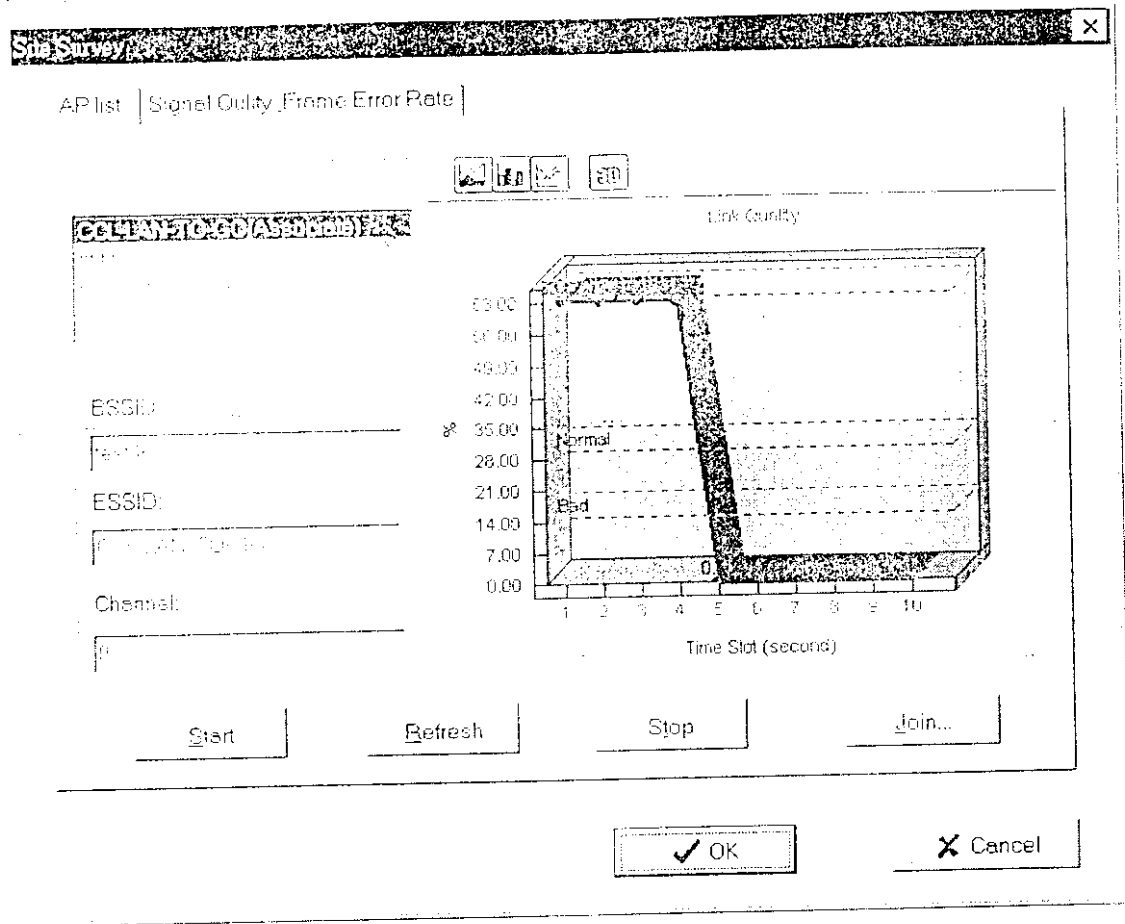
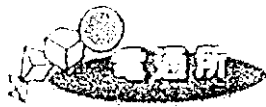
allowed to be associated. The presence of any particular access point does not automatically give you the right to be associated with. If you try to be associated with an access point which you are not authorized the privilege yet, then your request will be rejected. At any given instant, you can be associated with no more than one access point. This ensures that no chaos will occur in the network. On the contrary, an access point may be associated with many stations at one time.

Follow these steps to use the site survey tool:

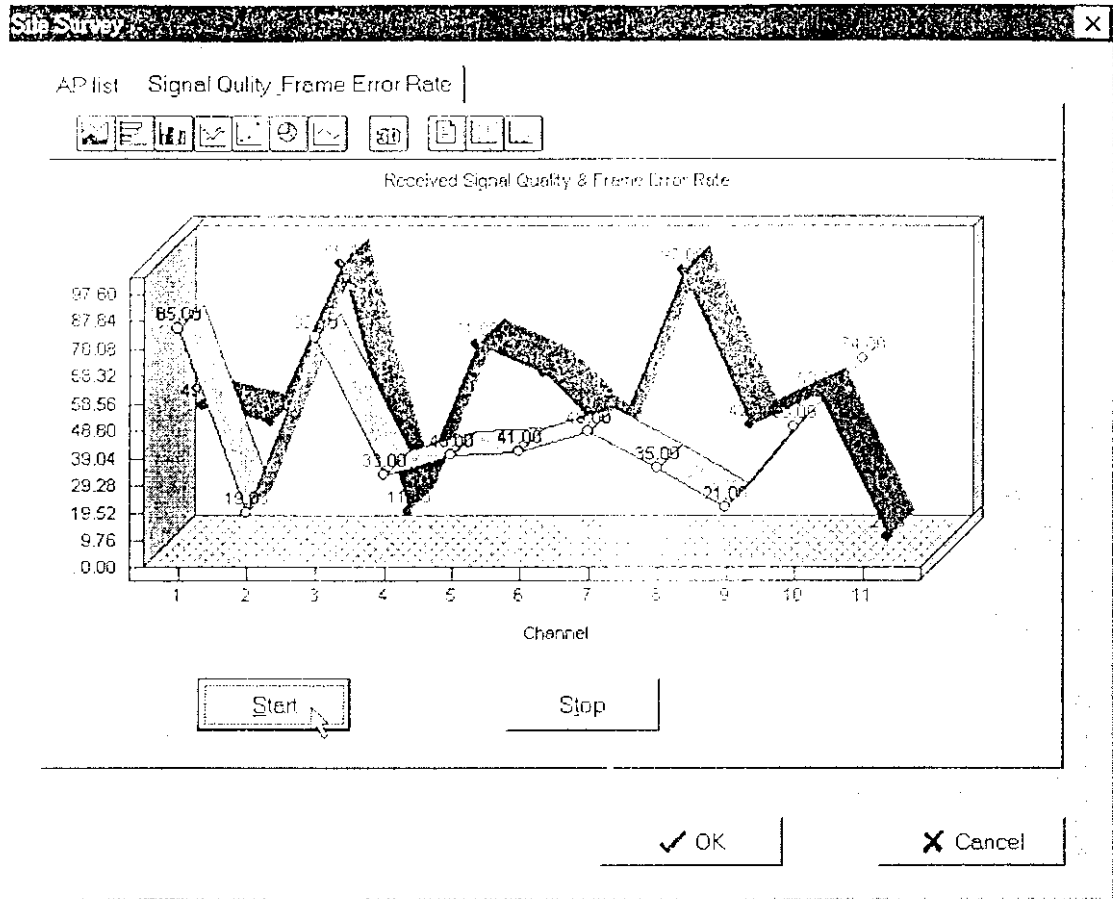
1. Click the Site Survey option from the main menu of the WDASusa program. The Site Survey folder appears.
2. Choose the "AP List" tab. The dialog box similar to the following one appears. All found access points, each identified with a unique host name (its ESSID), will be shown in the list.



3. Pick an access point from the list. The corresponding BSSID, ESSID, and Channel being used are shown immediately.



4. Click the "Start" button. The program will start monitoring the link quality between the station and the access point at a interval of time slot. The result will be logged and represented by the percentage diagram as shown in the figure.
5. Choose the "Signal Quality | Frame Error Rate" tab if you want to see the receiving Frame Error Rate precisely.
6. Click the "Start" button. Because this is a stochastic process, the resulting curve will be fluctuating with time.
7. Click the "OK" button when you are done.





Advanced Configuration

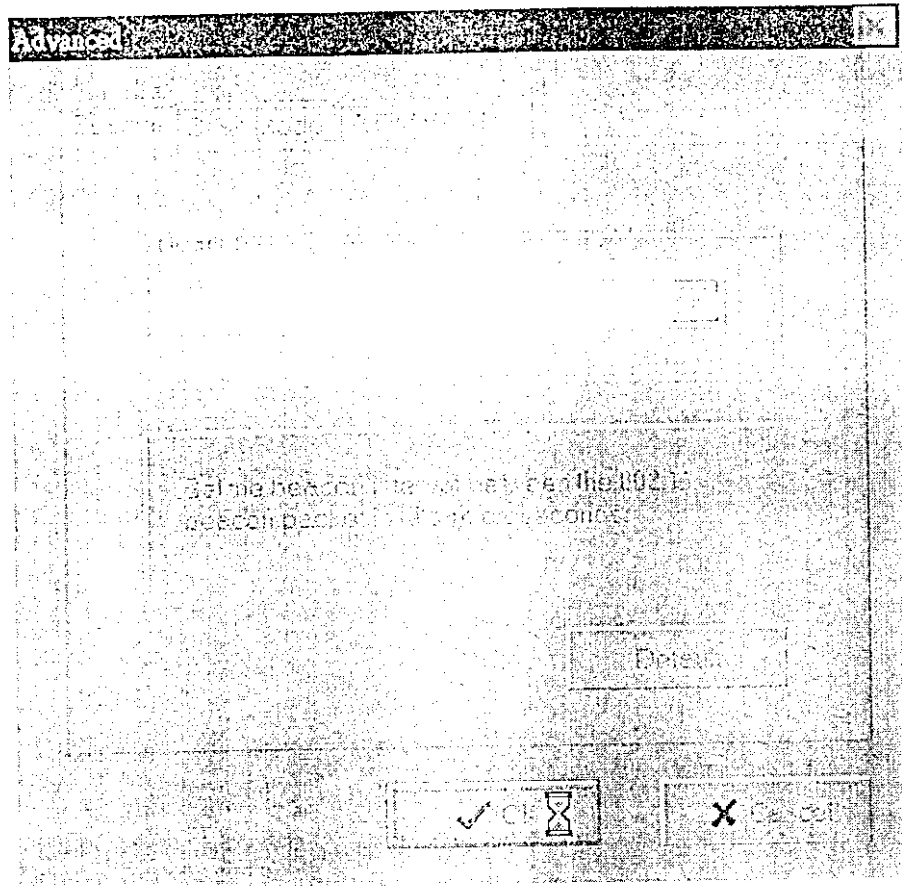
The following discussion deals with the subjects of synchronization, power management, roaming (scanning), etc., which are the essentials of wireless LAN. Generally speaking, you are not required to familiarize yourself with all the details explained below. As long as you follow the previous directions as to how to install the driver, you should be able to start using your wireless LAN without difficulty. Nevertheless, it will be to your advantage to become familiar with the topics covered below.

Beacon Interval

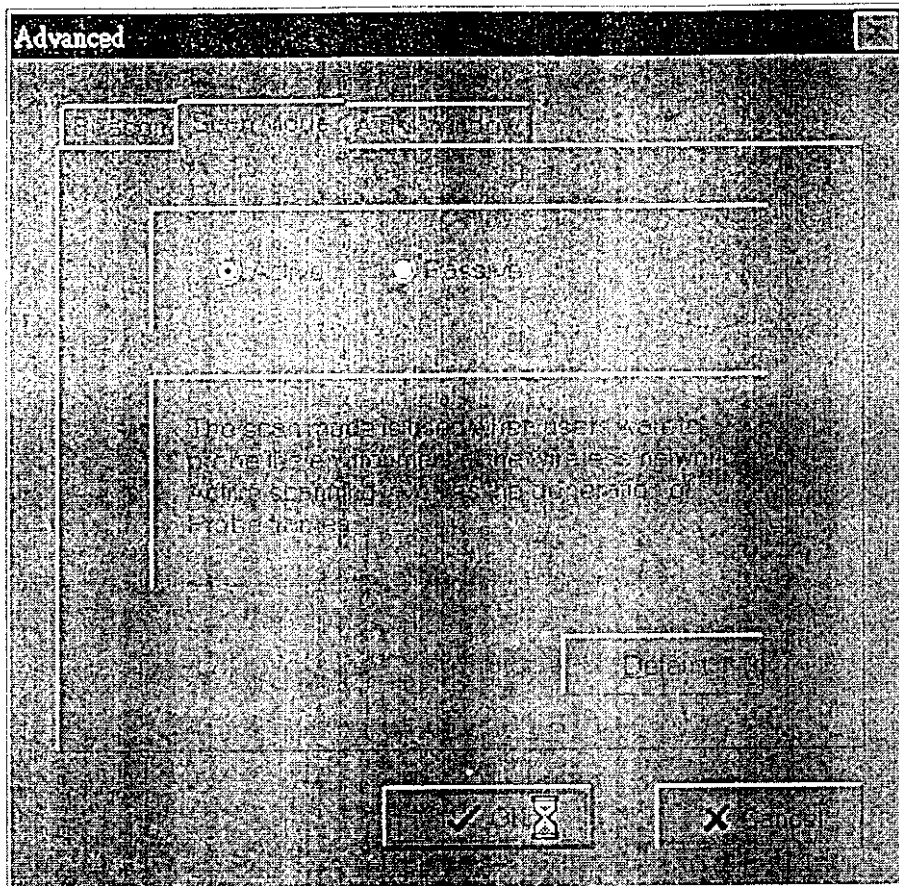
In an 802.11 wireless LAN, all stations within a single BSS shall be synchronized to a common clock using the *Timing Synchronization Function* (TSF). All stations shall maintain a local TSF timer. The TSF keeps the timers for all stations in the same BSS synchronized. In an infrastructure network, the AP shall be the timing master and shall perform the Timing Synchronization Function. The Timing Synchronization Function in an Independent BSS (Ad Hoc) shall be performed by all of the members of the BSS via a distributed algorithm. The AP shall initialize the TSF timer independently of any simultaneously started APs and the APs shall make their efforts to ensure they are not synchronized with each other. To synchronize the other stations in a BSS, the AP shall periodically transmit special frames called *Beacons* that contain a copy of its TSF timer. Receiving stations shall always accept the timestamp value in Beacons sent from the AP servicing their BSS. Beacons shall be generated for transmission by the AP once every Beacon Interval time units. Occasionally, you may have need to change the Beacon Interval attribute as required.

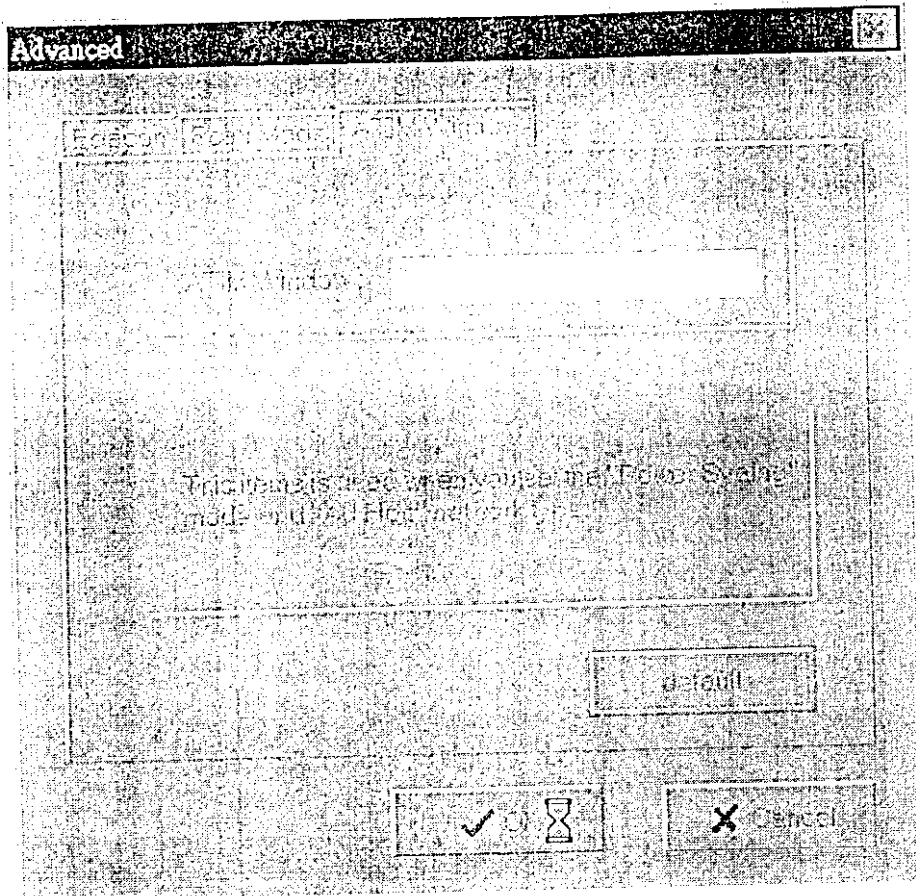
To change the Beacon Interval, follow these steps:

1. Click the Configuration option from the menu. The Advanced folder appears.
2. Choose the "Beacon" tab. Click the "▼" button, then a list of available values popups.
3. Choose a value from the list and click the "OK" button.
4. Click the "Default" button if you want the default value to be used.



Scan Mode







Specifications

Physical

Interface	PCMCIA Type II
PC Card Dimensions (include Antenna)	128 mm × 54 mm × 5 mm
Total Weight	110 g
Standard Compliance	IEEE 802.11
Media Access Protocol	Unicast: CSMA/CA + ACK, Broadcast: CSMA/CA
Frequency Band	2.4 - 2.4835 GHz ISM band
Modulation Technique	Frequency Hopping Spread Spectrum (FHSS)
Data Rate	1 Mb/s
Frame Error Rate	Less than 8×10^{-2}
Output Power	10 dBm
Receiver Sensitivity	-82 dBm

Regulations

USA	FCC Part 15
Europe	ETS 300-328

Environmental

Operating Temperature	0° - 40° C
-----------------------	------------

Range

Open Office	200 m
Semi-Open Office	50 m
Closed Office	25 m

Operating Voltage	5 Vdc
-------------------	-------

Power Consumption

Sleep Mode	30 mA
Receive Mode	317 mA
Transmit Mode	447 mA

□ **Developer's Guide to FHSS Debugger SUFHSS.EXE**

Sufhss.exe is a DOS application program designed to provide an integrated test environment for the FHSS Wireless Local Area Network of CCL/ITRI. The target to verify is the operation of the Medium Access Control Protocol residing in the WLAN PC card. This program is interface-specific and dedicatedly written for the FHSS Wireless Data Access System(WDAS) of CCL/ITRI. No further distribution is allowed without permission from CCL/ITRI.

Sufhss.exe simulates the interface operation between the driver(DOS device driver) and the embedded(WLAN card). Commands are provided to issue some proprietarily defined operation demands to trigger the embedded to operate. It should be emphasized that the Sufhss.exe is not a device driver, it is not able to offer all the capabilities that the WDAS device driver possesses.

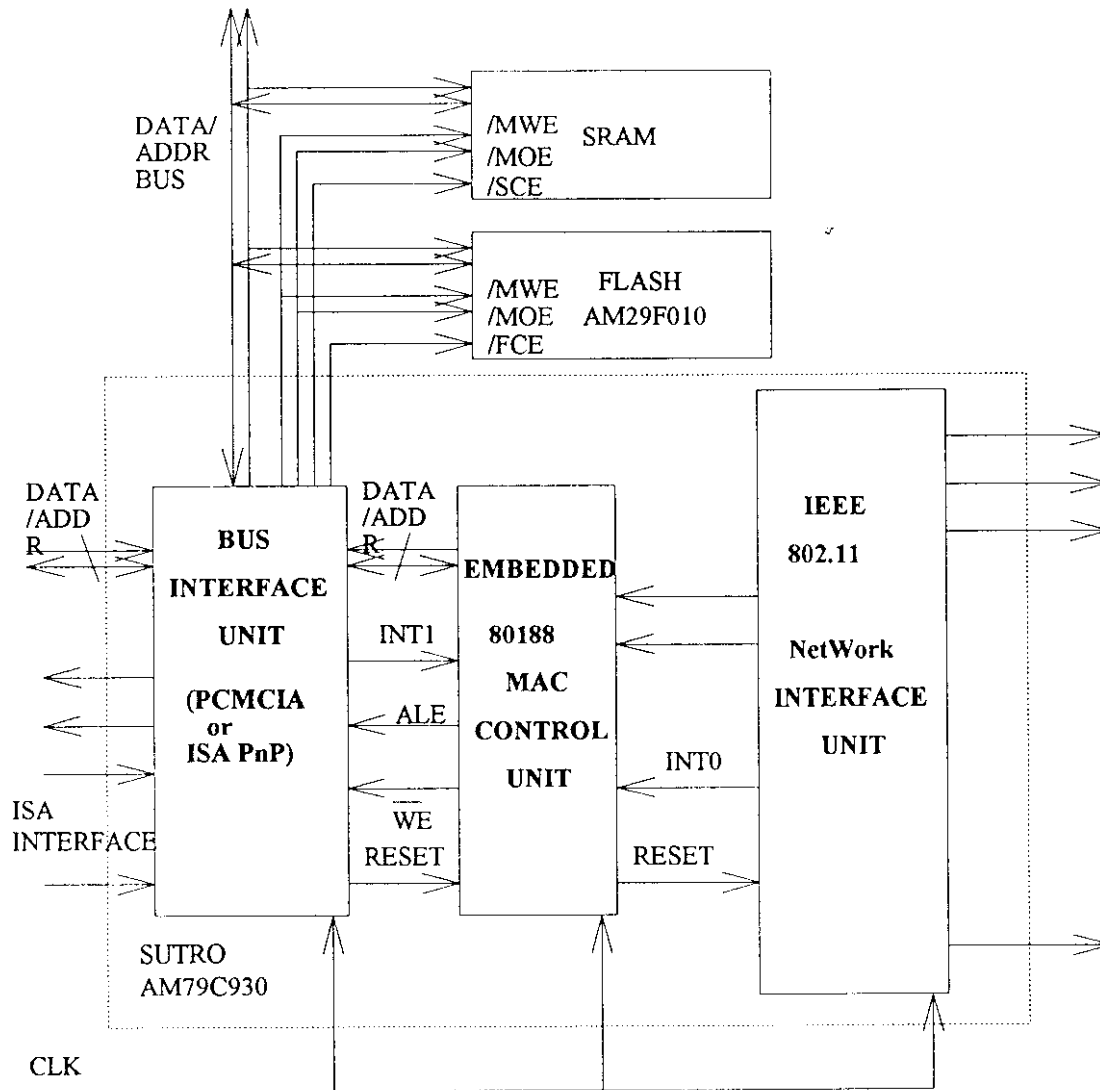
Sufhss.exe is suggested to be executed under single-tasking OS like DOS 6.22 or MS-Windows 3.1. Although it can also be executed under the MS-DOS command shell within the Microsoft Windows 95, some items are not guaranteed to work well due to the Operating System architecture, especially those relative to the IO and IRQ resources. The following section will briefly introduce how to use this tool under DOS environment.

□ Preliminary

In this section, we will briefly outline the WLAN system architecture. As the following figure shows, there are three major devices that shall be briefly explained here for clarity.

AM79C930, also called SUTRO, contains Bus Interface Unit(BIU), 80188 Embeded CPU, and a Network Interface Unit(NIU). NIU is in charge of control of physical interface, which can be either DS or FH RF module; BIU is responsible for arbitration of access to data bus from both 80188 and host side. The CPU 80188, without further emphasis, controls the whole operation of the embedded system. Inside SUTRO BIU, four sets of registers: SIRs(System Interface Registers), MIRs(MAC Interface Registers), TIRs(Transceiver Interface Registers) and TCRs(TAI Configuration Registers) are provided. Only the MIRs are not visible by the driver. We may

access desired data either from SRAM and FLASH(AM29F010) and control the TAI through the SIR, TIR and TCR register sets of the bus interface unit. Prior knowledge of the SIRs, TIRs and TCRs are necessary to skillfully manipulate the Sufhss.exe, which is beyond the scope of this manu and can be found in the AM79C930 data book.



□ Start Executing the Sufhss.exe

Under DOS environment, type

sufhss ↵

the program will be loaded and start executing. Upon its execution, the sufhss first calls some PCMCIA Card Service functions to get the hardware resource information like IO Base Address(IOBA) and IRQ number. If no hardware is

present, or the PC-card is not CCL/WDAS card, then the sufhs will prompt a Message dialog Window, requesting an IOBA input:

Invalid IRQ: 00/IOBA: 0000! Enter IOBA Value(ESC: 280): 300

Key in the IOBA you know(300 as example), or press ESC key to select the default value 0x0280. If a wrong IOBA is issued, then you will not be able to control the WLAN card at all.

If some proper PCMCIA CS and SS drivers are present, the sufhs will show the following message:

[SOCKET 0]: IOBA 0280, IRQ 0B.

Active Socket 0, IOBA: 0280, IRQ: 0B! Press Any Key...

This says that a CCL/ITRI card has been found, and the hardware resource IOBA is assigned to 0x0280, IRQ to 0x0b. The socket 0 is currently active.

If two CCL/ITRI card are inserted to the PCMCIA slot, the given message will be:

[SOCKET 0]: IOBA 0280, IRQ 0B. [Socket 1]: IOBA: 0300, IRQ: 05.

Active Socket 0, IOBA: 0280, IRQ: 0B! Press Any Key...

, indicating that two cards are detected.

After press any key, some menu is shown on screen:

Commands Packets CPU&MEM Registers Inspect FER Tests

Above this main manu inside the frame, the currently active socket is shown: *Socket[x]*. If the "x" within the [] is not 0 nor 1, then it means that the sufhs has not detected a valid card's presence after initialization process.

To have proper operation, user shall install some PCMCIA utility to provide the PCMCIA card service function calls. This is outside the scope of this document.

When manipulate the sufhs.exe, you may use the following keys to move the blue-emphasized cursor:

←: Move to the left

→: Move to the Right

↑: Move Up

↓: Move Down

↵: Enter to select

ESC: Cancel

PgUp: Go to the first item

PgDn: Go to the last item

Space: Change Active Socket

☐ The Commands Submenu

Commands submenu contains some driver-embedded interface defined

operation. Some of them are issued through the propriatorily defined interface commands; some operation will overwrite directly by the sufhss to target through the TIR registers. When the *Commands* is selected, you will see the sub-command list:

- *Start Embed FSM*: To start the finite state machine of the embedded system by the interface-specific START_EMBED_FSM command. The card will not accept any transmission and reception demand if the embedded finite state machine is not started.
- *Set Channel*: Set the hopping parameters: Dwell time, Hop Set, Hop Pattern and Hop Index, through the interface-specific SET_CHANNEL command. The Dwell time can be in 0, meaning that no hopping is required(*i.e.* infinitive dwell time); or 1 to 6, setting the dwell time to 64K μ s to 384 K μ s(6 $\times$ 64 K μ s). The remaining three parameters: Hop set(1~3), pattern(1~26) and index(1~80) can be set following exactly the definition in the IEEE 802.11 standard. The random hop sequence is built in the embedded, which is followed when the hop mechanism is enaled.
- *Stop Embed FSM*: To stop the finite state machine of the embedded system through interface-specific STOP_EMBED_FSM command.
- *Ping Pong Hop*: The Sufhss will program the frequency synthesiser directly (through TIRs) to hop between two specified channels periodically.
- *Hop To Channel*: The Sufhss will program the frequency synthesizer directly to change to the desired channel, numbering from 1 to 80. The corresponding frequencies to the channel number is exactly the same as defined in IEEE 802.11.
- *Sequential Hops*: The Sufhss will directly program the frequency synthesizer to hop sequentially from channel 1 to channel 80, cyclically. The dwell time within a channel can be set up by the user.
- *Set 1020 OLPOLA*: The Sufhss will directly program the frequency synthesizer directly to force the UMA1020 go into the test mode.

- *Best Modidx Tst*: The Sufhss will issue an interface-specific BEST_MODIDX_TEST command, forcing the embedded to send out 01010101... unscrambled data to the RF transmitter module.
- *Worst Modidx Tst*: The Sufhss will issue an interface-specific WORST_MODIDX_TEST command, forcing the embedded to send out the 00000000111111110000000011111111... unscrambled data to the RF transmitter module.
- *Tog Modem OnOff*: The Sufhss will turn on and off the Power Amplifier directly through the TIR resigsters in toggling manners. For example, if current PA is off, this command will turn the PA on, and vice versa.
- *Reset Freq Syn*: The Sufhss will program both frequency synthesizers directly through the TIR registers and reset the RF to channel 6.

□ The Packets Submenu

The Packets submenu collects all the frame generation setting bullets related to IEEE 802.11. As you chose *Packets*, you will see a submenu list as follows:

- *Set DA*: set your Destination Address.
- *Load Payload*: input any file as your payload. The file size shall not be larger than 1500 bytes.
- *Show Tx Packets*: Show the packet content and some information you are going to transmit.
- *Tx Curr Packet*: transmit the current packet.
- *Reload Dummy Pkt*: load the default packet content as your current transmission packet. The result can be viewed by “Show Tx Packets”
- *Set BSSID*: Set the Basic Service Set ID(Address3).
- *Set To/From DS: 00*: Change the TO_DS and FROM_DS subfields of the Frame Control Word. Once modified, the Address1(DA), Address2(SA) and Address3(BSSID) fields of a frame will be rearranged according to the IEEE 802.11 standard.
- *Set Original Src*: To set the Address4 field of a frame. This will

be present only when the TO_DS and FROM_DS are both set to 1.

- *Set Type: Data:* This sets the TYPE field of a frame. It can be either Data frame or Mgmt frame.
- *Set RTS Thrshld:* Set the desired threshold to enable the RTS-CTS frame exchange before DATA-ACK sequence. RTS-CTS+DATA-ACK will be a formal transmission sequence if the frame length is larger than this threshold, otherwise only the DATA+ACK sequence is necessary to accomplish the transmission.
- *Set Frag Thrshld:* Set the desired Fragmentation threshold. The MAC Service Data Unit(MSDU) larger than this limit will be fragmented into smaller frames.

The above address settings all require 6-character input. If less than 6 characters, the setting will be rejected. Note that the Source address (Address2) is automatically read from the flash.

□ The CPU&MEM Submenu

The *CPU & MEM* submenu consists of some Code Execution and CPU related functions. Moreover, basic operations to SRAM and Flash memory are included as well. This is especially important to provide the runtime inspection on the contents in the embedded for debugging.

- *Read SRAM:* Read contents of SRAM into the temporary allocated buffer. The SRAM is partitioned into two sectors: 0 and 1, with each 16 Kbytes in size. All displayed in Hex.
- *80188 Core Reset:* Clear the SRAM contents to 0 and reset the embedded core.
- *Next Breakpoint:* Let the embedded free run to next predetermined "Break point".
- *Write 1 Byte to SRAM:* write one specified byte to the absolute address you specify directly to the SRAM(not temporary buffer!).
- *Read Flash:* Read the contents of the desired flash sector. The

flash is partitioned into 8 sectors: 0 to 7, each with size 16 Kbytes.

One of the most frequently used function could be *Reset 80188 Core*, which will first stop the embedded execution, clear SRAM and then reset 80188's program counter to its beginning value to restart.

As to *Next Breakpoint*, we have to make clear how it works a bit. In this environment, users are not able to set breakpoints anywhere they want after their codes are programmed into the flash. The breakpoints shall be set by modifying the source codes by adding the macro “Break()” or “Breakat(...)”. What these two macros do are to put the message into a defined buffer and to poll a “resume” command at a particular location. That is, these macros will first let users know where the embedded stays at this moment and the embedded will not break the infinite polling loop until the *Next Breakpoint* command is ordered. If there is no breakpoint added to your source code, then *Next Breakpoint* affects nothing.

□ The Registers Submenu

The functions under the *Registers* submenu deal with registers display and modification within SUTRO. They are the previously mentioned SIRs, MIRs, TIRs and TCRs, which can be inspected and written for experiment purpose through the commands in this submenu.

- *Show Registers*: Show the contents of all the visible registers within SUTRO and HSP3824. All displayed in Hex.
- *Modify SIR*: Modify the specified SIR register. Prior knowledge is necessary to have proper result. Please refer to the AM79C930 data sheet for more details.
- *Modify TIR*: Modify the specified TIR register. Prior knowledge is necessary to have proper result. Please refer to the AM79C930 data sheet for more details.
- *Modify TCR*: Modify the specified TCR register. Prior knowledge is necessary to have proper result. Please refer to the AM79C930 data sheet for more details.

□ The Inspect Submenu

The *Inspect* Submenu contains some message display on the global variables declared by the embedded. To do so, user shall first load the corresponding MP2(a map file generated after linking), and then the variable values will be displayed according to the alphabetic order.

- *Load MP2 File*: Used to load an MP2 file.
- *Inspect...*: Inspect the contents of the variables listed in the MP2 file loaded.

□ The *FER Tests* Submenu

The *FER Tests* submenu contains some assistant Frame Error Rate Tests setups. The FER is used during product development to make sure if the FSM runs smoothly without being stucked. It can also used as a guide to how the RF performs, given that the MAC protocol performance is guaranteed to some degree.

- *FER TX Site*: This will issues continuously the frame transmission requests whenever the sufhs can. The Users may requests to send specified frame length, the delay inbetween frames and the number of frames to be transmitted.
- *FERRx Test End*: This enables the sufhs to react upon the receive interrupt signalled by the embedded. The statistic counting will be refreshed after every 16 frames have been received. This will cause trouble under Windows 95.

□ Quitting the Sufhs.exe

Under the top-menu, press ESC.

□ Summary

As emphasized, sufhs.exe is designed for the purpose of making sure the MAC layer protocol according to the operation mode defined between DOS driver and embedded. It is not a universal but a specially designed debug tool. Moreover, it just simply simulates the operation of this driver-embedded interface, users shall not expect it to simulate the jobs that a driver should do. The behaviors you see under the environment sufhs provides could be different from what you observe with a real driver.

☐ **The Test Procedure for FHSS FCC Test**

This test procedure describes the necessary steps to be manipulated the assistant test software program for every FCC tests, including the Conductive, Spurious 1GHz below, Harmonics to the 10th and the intended transmission radiation bandwidth characteristics.

☐ Preliminary

A dedicate software SuFHSS.exe written by CCL/ITRI is used to control the necessary operation for each test item. In the following section, some instruction to use is guided for convenience. More usage can be referenced in the user's manual of the SuFHSS.exe.

☐ Initiating the test under DOS 6.22

Insert the card to the lower socket of the PCMCIA slot.

Under DOS environment C:\WDAS\FHSS>, type

Card_on.exe ↵

After that type

Sufhss.exe ↵

to start the execution of the test program. Upon execution, the following information will be shown due to the absence of the PCMCIA Card Services:

Invalid IRQ: 00/IOBA: 0000! Enter IOBA Value(ESC: 280):

Press *ESC* to get to the Top(Main) menu:

Commands Packets CPU&MEM Registers Inspect FER Tests

When manipulate the sufhss.exe, you may use the following key to move the cursor:

☐: Move to the left

☐: Move to the Right

☐: Move Up

☐: Move Down

↵: Enter to select

ESC: Cancel

PgUp: Go to the first item

PgDn: Go to the last item

Space: Change Active Socket

☐ Conductive Test

The following steps drives the DUT to transmit randomly generated data with hopping mechanism enabled. This simulates the normal operation situation and is usually the worst case.

1. Select top-menu: *CPU & MEM* ↵ and then select submenu: *80188 Core Reset* ↵.
2. Select top-menu: *Commands* ↵ and then submenu:

Reset Freq. Syn ↵.

3. Select top-menu: *Commands ↵* and then submenu: *Start Embed FSM ↵*. This enables the transceiver to transmit and receive.
4. Select submenu: *Set Channel ↵*
This sets up the hopping parameters: Dwell time, Hop Set, Pattern and Index. Hopping mechanism is enabled by this step.
 - 4.1 The program will pop a dialog box: *Dwell Time(0~6) 64K□s*, requesting for inputs. Type 1 and enter(↵) to enable 64Kμs dwell time(2 for 128, etc). Note that 0 dwell time disables the hopping mechanism.
 - 4.2 The program will next pop another dialog box: *Hop Set(1~3)*, requesting for inputs. Type 1(or any number) and enter(↵).
 - 4.3 The program will pop next dialog box: *Hop Pattern(1~26)*, requesting for inputs. Type 1(or any number) and enter(↵).
 - 4.4 The program will pop the last dialog box: *Hop Index(1~80)*, requesting for inputs. Type 1(or any number) end enter(↵).
5. Select top-menu *FER Tests ↵* and submenu *FER TX Site ↵*. The following steps will send out frames with random contents in burst mode.
 - 5.1 The program then pops a dialog box: *Test Frame Length(Enter for 1024)*, requesting for an input. Press Enter(↵) directly.
 - 5.2 The program next pops out another dialog box: *Max Random Delay(1~65535)(Enter for Fixed)*, requesting for an input. Key in 10 and press Enter(↵).
 - 5.3 The program next pops out the third dialog: *Frame Counts(Enter for Continuous)*, requesting for an input. Press Enter(↵) directly to send frames infinitely.
 - 5.4 When Done, press *q* to stop.

☐ Note 1: The followings are steps taken to replace the above corresponding ones when the DUT is to be driven to radiate continuous wave with hopping mechanism enabled(for test purpose only).

5. Select top-menu: *Commands ↵* and then submenu *Tog Modem OnOff ↵*. This enables the WDAS to operate in continuous mode transmission. When finished, select top-menu *Commands* and submenu *Tog Modem OnOff* again.

☐ Note 2: The followings are steps taken to replace the above corresponding steps when the DUT is to be driven to transmit in continuous mode with hopping mechanism disabled, i.e. fixed channel(for test purpose only).

3. Step 3 can be neglected.
4. Select top-menu: *Commands ↵* and then submenu *Hop to Channel ↵*. Input the desired channel number and press enter(↵).

5. Select top-menu: *Commands* ↵ and then submenu *Tog Modem OnOff* ↵. This enables the WDAS to operate in continuous mode transmission. When finished, select top-menu *Commands* and submenu *Tog Modem OnOff* again.

Repeat the above for the channels 1(2.401GHz), 40 and 80.

- ☐ Note 3: The followings are steps taken to replace the above corresponding steps when the DUT is to be driven to transmit random contents in burst mode with hopping mechanism disabled, i.e. fixed channel(for test purpose only).
- 3. Select top-menu: *Commands* ↵ and then submenu *Hop to Channel* ↵. Input the desired channel number and press enter(↵).

Repeat the above for the channels 1(2.401GHz), 40 and 80.

☐ Spurious Below 1GHz

The harmonics are tested under the condition that the DUT is driven to transmit randomly generated data with hopping mechanism enabled. This simulates the normal operation situation, which is usually the worst case.

The steps are identical to that in the section: Conductive Test.

☐ Harmonics to the 10th

The harmonics are tested under the condition that the DUT is driven to transmit randomly generated data with hopping mechanism enabled. This simulates the normal operation situation in some fixed channel, which is usually the worst case.

The steps are identical to that in the section: Conductive Test.

☐ Transmission Radiation Bandwidth Characteristics

The following steps drives the DUT to transmit randomly generated data with hopping mechanism disabled. The hopping mechanism is disabled simply for the bandwidth measurement purpose. This simulates the normal operation bandwidth characteristics and is usually the worst case.

1. Select top-menu: *CPU & MEM* ↵, and then the submenu: *80188 Core Reset* ↵.
2. Select top-menu: *Commands* ↵, and then submenu: *Reset Freq Syn* ↵.
3. Select top-menu: *Commands* ↵ and then submenu: *Start Embed FSM* ↵. This enables the transceiver to transmit and receive.
4. Select top-menu: *Commands* ↵ and then submenu *Hop to Channel* ↵.

Input the desired channel number and press enter(↵).

5. Select top-menu *FER Tests*↵ and submenu *FER TX Site*↵. The following steps will send out frames with random contents in burst mode.
 - 5.1 The program then pops a dialog box: *Test Frame Length*(Enter for 1024), requesting for an input. Press Enter(↵) directly.
 - 5.2 The program next pops out another dialog box: *Max Random Delay*(1~65535)(Enter for Fixed), requesting for an input. Key in 10 and press Enter(↵).
 - 5.3 The program next pops out the third dialog: *Frame Counts*(Enter for Continuous), requesting for an input. Press Enter(↵) directly to send frames infinitively.
 - 5.4 When Done, press *q* to stop.
- Note 1: The followings are steps taken to replace the above corresponding ones when the DUT is to be driven to radiate continuous wave with hopping mechanism disabled(for test purpose only).
5. Select top-menu: *Commands* ↵ and then submenu *Tog Modem OnOff* ↵. This enables the WDAS to operate in continuous mode transmission. When finished, select top-menu *Commands* and submenu *Tog Modem OnOff* again.

B. Annex - Hopping Sequences (informative)

The following tables pertain to the hopping sequences for North America and ETSI.

Table B-1, Hopping Sequence Set 1

index	0	3	6	9	12	15	18	21	24	27	30	33	36
1	2	5	8	11	14	17	20	23	26	29	32	35	38
2	25	28	31	34	37	40	43	46	49	52	55	58	61
3	64	67	70	73	76	79	3	6	9	12	15	18	21
4	10	13	16	19	22	25	28	31	34	37	40	43	46
5	45	48	51	54	57	60	63	66	69	72	75	78	2
6	18	21	24	27	30	33	36	39	42	45	48	51	54
7	73	76	79	3	6	9	12	15	18	21	24	27	30
8	49	52	55	58	61	64	67	70	73	76	79	3	6
9	21	24	27	30	33	36	39	42	45	48	51	54	57
10	63	66	69	72	75	78	2	5	8	11	14	17	20
11	78	2	5	8	11	14	17	20	23	26	29	32	35
12	31	34	37	40	43	46	49	52	55	58	61	64	67
13	61	64	67	70	73	76	79	3	6	9	12	15	18
14	24	27	30	33	36	39	42	45	48	51	54	57	60
15	54	57	60	63	66	69	72	75	78	2	5	8	11
16	65	68	71	74	77	80	4	7	10	13	16	19	22
17	28	31	34	37	40	43	46	49	52	55	58	61	64
18	79	3	6	9	12	15	18	21	24	27	30	33	36
19	33	36	39	42	45	48	51	54	57	60	63	66	69
20	4	7	10	13	16	19	22	25	28	31	34	37	40
21	20	23	26	29	32	35	38	41	44	47	50	53	56
22	13	16	19	22	25	28	31	34	37	40	43	46	49
23	38	41	44	47	50	53	56	59	62	65	68	71	74
24	74	77	80	4	7	10	13	16	19	22	25	28	31
25	56	59	62	65	68	71	74	77	80	4	7	10	13
26	71	74	77	80	4	7	10	13	16	19	22	25	28
27	23	26	29	32	35	38	41	44	47	50	53	56	59
28	5	8	11	14	17	20	23	26	29	32	35	38	41
29	39	42	45	48	51	54	57	60	63	66	69	72	75
30	12	15	18	21	24	27	30	33	36	39	42	45	48
31	36	39	42	45	48	51	54	57	60	63	66	69	72
32	68	71	74	77	80	4	7	10	13	16	19	22	25
33	9	12	15	18	21	24	27	30	33	36	39	42	45
34	70	73	76	79	3	6	9	12	15	18	21	24	27
35	77	80	4	7	10	13	16	19	22	25	28	31	34
36	6	9	12	15	18	21	24	27	30	33	36	39	42
37	62	65	68	71	74	77	80	4	7	10	13	16	19
38	29	32	35	38	41	44	47	50	53	56	59	62	65
39	14	17	20	23	26	29	32	35	38	41	44	47	50

index	0	3	6	9	12	15	18	21	24	27	30	33	36
40	27	30	33	36	39	42	45	48	51	54	57	60	63
41	16	19	22	25	28	31	34	37	40	43	46	49	52
42	59	62	65	68	71	74	77	80	4	7	10	13	16
43	43	46	49	52	55	58	61	64	67	70	73	76	79
44	76	79	3	6	9	12	15	18	21	24	27	30	33
45	34	37	40	43	46	49	52	55	58	61	64	67	70
46	72	75	78	2	5	8	11	14	17	20	23	26	29
47	11	14	17	20	23	26	29	32	35	38	41	44	47
48	60	63	66	69	72	75	78	2	5	8	11	14	17
49	80	4	7	10	13	16	19	22	25	28	31	34	37
50	47	50	53	56	59	62	65	68	71	74	77	80	4
51	22	25	28	31	34	37	40	43	46	49	52	55	58
52	75	78	2	5	8	11	14	17	20	23	26	29	32
53	66	69	72	75	78	2	5	8	11	14	17	20	23
54	41	44	47	50	53	56	59	62	65	68	71	74	77
55	15	18	21	24	27	30	33	36	39	42	45	48	51
56	35	38	41	44	47	50	53	56	59	62	65	68	71
57	67	70	73	76	79	3	6	9	12	15	18	21	24
58	52	55	58	61	64	67	70	73	76	79	3	6	9
59	58	61	64	67	70	73	76	79	3	6	9	12	15
60	44	47	50	53	56	59	62	65	68	71	74	77	80
61	50	53	56	59	62	65	68	71	74	77	80	4	7
62	17	20	23	26	29	32	35	38	41	44	47	50	53
63	7	10	13	16	19	22	25	28	31	34	37	40	43
64	19	22	25	28	31	34	37	40	43	46	49	52	55
65	8	11	14	17	20	23	26	29	32	35	38	41	44
66	69	72	75	78	2	5	8	11	14	17	20	23	26
67	51	54	57	60	63	66	69	72	75	78	2	5	8
68	42	45	48	51	54	57	60	63	66	69	72	75	78
69	3	6	9	12	15	18	21	24	27	30	33	36	39
70	30	33	36	39	42	45	48	51	54	57	60	63	66
71	57	60	63	66	69	72	75	78	2	5	8	11	14
72	37	40	43	46	49	52	55	58	61	64	67	70	73
73	55	58	61	64	67	70	73	76	79	3	6	9	12
74	26	29	32	35	38	41	44	47	50	53	56	59	62
75	46	49	52	55	58	61	64	67	70	73	76	79	3
76	53	56	59	62	65	68	71	74	77	80	4	7	10
77	40	43	46	49	52	55	58	61	64	67	70	73	76
78	32	35	38	41	44	47	50	53	56	59	62	65	68
79	48	51	54	57	60	63	66	69	72	75	78	2	5

index	39	42	45	48	51	54	57	60	63	66	69	72	75
1	41	44	47	50	53	56	59	62	65	68	71	74	77
2	64	67	70	73	76	79	3	6	9	12	15	18	21
3	24	27	30	33	36	39	42	45	48	51	54	57	60
4	49	52	55	58	61	64	67	70	73	76	79	3	6
5	5	8	11	14	17	20	23	26	29	32	35	38	41
6	57	60	63	66	69	72	75	78	2	5	8	11	14
7	33	36	39	42	45	48	51	54	57	60	63	66	69
8	9	12	15	18	21	24	27	30	33	36	39	42	45
9	60	63	66	69	72	75	78	2	5	8	11	14	17
10	23	26	29	32	35	38	41	44	47	50	53	56	59
11	38	41	44	47	50	53	56	59	62	65	68	71	74
12	70	73	76	79	3	6	9	12	15	18	21	24	27
13	21	24	27	30	33	36	39	42	45	48	51	54	57
14	63	66	69	72	75	78	2	5	8	11	14	17	20
15	14	17	20	23	26	29	32	35	38	41	44	47	50
16	25	28	31	34	37	40	43	46	49	52	55	58	61
17	67	70	73	76	79	3	6	9	12	15	18	21	24
18	39	42	45	48	51	54	57	60	63	66	69	72	75
19	72	75	78	2	5	8	11	14	17	20	23	26	29
20	43	46	49	52	55	58	61	64	67	70	73	76	79
21	59	62	65	68	71	74	77	80	4	7	10	13	16
22	52	55	58	61	64	67	70	73	76	79	3	6	9
23	77	80	4	7	10	13	16	19	22	25	28	31	34
24	34	37	40	43	46	49	52	55	58	61	64	67	70
25	16	19	22	25	28	31	34	37	40	43	46	49	52
26	31	34	37	40	43	46	49	52	55	58	61	64	67
27	62	65	68	71	74	77	80	4	7	10	13	16	19
28	44	47	50	53	56	59	62	65	68	71	74	77	80
29	78	2	5	8	11	14	17	20	23	26	29	32	35
30	51	54	57	60	63	66	69	72	75	78	2	5	8
31	75	78	2	5	8	11	14	17	20	23	26	29	32
32	28	31	34	37	40	43	46	49	52	55	58	61	64
33	48	51	54	57	60	63	66	69	72	75	78	2	5
34	30	33	36	39	42	45	48	51	54	57	60	63	66
35	37	40	43	46	49	52	55	58	61	64	67	70	73
36	45	48	51	54	57	60	63	66	69	72	75	78	2
37	22	25	28	31	34	37	40	43	46	49	52	55	58
38	68	71	74	77	80	4	7	10	13	16	19	22	25
39	53	56	59	62	65	68	71	74	77	80	4	7	10

index	39	42	45	48	51	54	57	60	63	66	69	72	75
40	66	69	72	75	78	2	5	8	11	14	17	20	23
41	55	58	61	64	67	70	73	76	79	3	6	9	12
42	19	22	25	28	31	34	37	40	43	46	49	52	55
43	3	6	9	12	15	18	21	24	27	30	33	36	39
44	36	39	42	45	48	51	54	57	60	63	66	69	72
45	73	76	79	3	6	9	12	15	18	21	24	27	30
46	32	35	38	41	44	47	50	53	56	59	62	65	68
47	50	53	56	59	62	65	68	71	74	77	80	4	7
48	20	23	26	29	32	35	38	41	44	47	50	53	56
49	40	43	46	49	52	55	58	61	64	67	70	73	76
50	7	10	13	16	19	22	25	28	31	34	37	40	43
51	61	64	67	70	73	76	79	3	6	9	12	15	18
52	35	38	41	44	47	50	53	56	59	62	65	68	71
53	26	29	32	35	38	41	44	47	50	53	56	59	62
54	80	4	7	10	13	16	19	22	25	28	31	34	37
55	54	57	60	63	66	69	72	75	78	2	5	8	11
56	74	77	80	4	7	10	13	16	19	22	25	28	31
57	27	30	33	36	39	42	45	48	51	54	57	60	63
58	12	15	18	21	24	27	30	33	36	39	42	45	48
59	18	21	24	27	30	33	36	39	42	45	48	51	54
60	4	7	10	13	16	19	22	25	28	31	34	37	40
61	10	13	16	19	22	25	28	31	34	37	40	43	46
62	56	59	62	65	68	71	74	77	80	4	7	10	13
63	46	49	52	55	58	61	64	67	70	73	76	79	3
64	58	61	64	67	70	73	76	79	3	6	9	12	15
65	47	50	53	56	59	62	65	68	71	74	77	80	4
66	29	32	35	38	41	44	47	50	53	56	59	62	65
67	11	14	17	20	23	26	29	32	35	38	41	44	47
68	2	5	8	11	14	17	20	23	26	29	32	35	38
69	42	45	48	51	54	57	60	63	66	69	72	75	78
70	69	72	75	78	2	5	8	11	14	17	20	23	26
71	17	20	23	26	29	32	35	38	41	44	47	50	53
72	76	79	3	6	9	12	15	18	21	24	27	30	33
73	15	18	21	24	27	30	33	36	39	42	45	48	51
74	65	68	71	74	77	80	4	7	10	13	16	19	22
75	6	9	12	15	18	21	24	27	30	33	36	39	42
76	13	16	19	22	25	28	31	34	37	40	43	46	49
77	79	3	6	9	12	15	18	21	24	27	30	33	36
78	71	74	77	80	4	7	10	13	16	19	22	25	28
79	8	11	14	17	20	23	26	29	32	35	38	41	44

Table B-2, Hopping Sequence Set 2

index	1	4	7	10	13	16	19	22	25	28	31	34	37
1	3	6	9	12	15	18	21	24	27	30	33	36	39
2	26	29	32	35	38	41	44	47	50	53	56	59	62
3	65	68	71	74	77	80	4	7	10	13	16	19	22
4	11	14	17	20	23	26	29	32	35	38	41	44	47
5	46	49	52	55	58	61	64	67	70	73	76	79	3
6	19	22	25	28	31	34	37	40	43	46	49	52	55
7	74	77	80	4	7	10	13	16	19	22	25	28	31
8	50	53	56	59	62	65	68	71	74	77	80	4	7
9	22	25	28	31	34	37	40	43	46	49	52	55	58
10	64	67	70	73	76	79	3	6	9	12	15	18	21
11	79	3	6	9	12	15	18	21	24	27	30	33	36
12	32	35	38	41	44	47	50	53	56	59	62	65	68
13	62	65	68	71	74	77	80	4	7	10	13	16	19
14	25	28	31	34	37	40	43	46	49	52	55	58	61
15	55	58	61	64	67	70	73	76	79	3	6	9	12
16	66	69	72	75	78	2	5	8	11	14	17	20	23
17	29	32	35	38	41	44	47	50	53	56	59	62	65
18	80	4	7	10	13	16	19	22	25	28	31	34	37
19	34	37	40	43	46	49	52	55	58	61	64	67	70
20	5	8	11	14	17	20	23	26	29	32	35	38	41
21	21	24	27	30	33	36	39	42	45	48	51	54	57
22	14	17	20	23	26	29	32	35	38	41	44	47	50
23	39	42	45	48	51	54	57	60	63	66	69	72	75
24	75	78	2	5	8	11	14	17	20	23	26	29	32
25	57	60	63	66	69	72	75	78	2	5	8	11	14
26	72	75	78	2	5	8	11	14	17	20	23	26	29
27	24	27	30	33	36	39	42	45	48	51	54	57	60
28	6	9	12	15	18	21	24	27	30	33	36	39	42
29	40	43	46	49	52	55	58	61	64	67	70	73	76
30	13	16	19	22	25	28	31	34	37	40	43	46	49
31	37	40	43	46	49	52	55	58	61	64	67	70	73
32	69	72	75	78	2	5	8	11	14	17	20	23	26
33	10	13	16	19	22	25	28	31	34	37	40	43	46
34	71	74	77	80	4	7	10	13	16	19	22	25	28
35	78	2	5	8	11	14	17	20	23	26	29	32	35
36	7	10	13	16	19	22	25	28	31	34	37	40	43
37	63	66	69	72	75	78	2	5	8	11	14	17	20
38	30	33	36	39	42	45	48	51	54	57	60	63	66
39	15	18	21	24	27	30	33	36	39	42	45	48	51

index	1	4	7	10	13	16	19	22	25	28	31	34	37
40	28	31	34	37	40	43	46	49	52	55	58	61	64
41	17	20	23	26	29	32	35	38	41	44	47	50	53
42	60	63	66	69	72	75	78	2	5	8	11	14	17
43	44	47	50	53	56	59	62	65	68	71	74	77	80
44	77	80	4	7	10	13	16	19	22	25	28	31	34
45	35	38	41	44	47	50	53	56	59	62	65	68	71
46	73	76	79	3	6	9	12	15	18	21	24	27	30
47	12	15	18	21	24	27	30	33	36	39	42	45	48
48	61	64	67	70	73	76	79	3	6	9	12	15	18
49	2	5	8	11	14	17	20	23	26	29	32	35	38
50	48	51	54	57	60	63	66	69	72	75	78	2	5
51	23	26	29	32	35	38	41	44	47	50	53	56	59
52	76	79	3	6	9	12	15	18	21	24	27	30	33
53	67	70	73	76	79	3	6	9	12	15	18	21	24
54	42	45	48	51	54	57	60	63	66	69	72	75	78
55	16	19	22	25	28	31	34	37	40	43	46	49	52
56	36	39	42	45	48	51	54	57	60	63	66	69	72
57	68	71	74	77	80	4	7	10	13	16	19	22	25
58	53	56	59	62	65	68	71	74	77	80	4	7	10
59	59	62	65	68	71	74	77	80	4	7	10	13	16
60	45	48	51	54	57	60	63	66	69	72	75	78	2
61	51	54	57	60	63	66	69	72	75	78	2	5	8
62	18	21	24	27	30	33	36	39	42	45	48	51	54
63	8	11	14	17	20	23	26	29	32	35	38	41	44
64	20	23	26	29	32	35	38	41	44	47	50	53	56
65	9	12	15	18	21	24	27	30	33	36	39	42	45
66	70	73	76	79	3	6	9	12	15	18	21	24	27
67	52	55	58	61	64	67	70	73	76	79	3	6	9
68	43	46	49	52	55	58	61	64	67	70	73	76	79
69	4	7	10	13	16	19	22	25	28	31	34	37	40
70	31	34	37	40	43	46	49	52	55	58	61	64	67
71	58	61	64	67	70	73	76	79	3	6	9	12	15
72	38	41	44	47	50	53	56	59	62	65	68	71	74
73	56	59	62	65	68	71	74	77	80	4	7	10	13
74	27	30	33	36	39	42	45	48	51	54	57	60	63
75	47	50	53	56	59	62	65	68	71	74	77	80	4
76	54	57	60	63	66	69	72	75	78	2	5	8	11
77	41	44	47	50	53	56	59	62	65	68	71	74	77
78	33	36	39	42	45	48	51	54	57	60	63	66	69
79	49	52	55	58	61	64	67	70	73	76	79	3	6

index	40	43	46	49	52	55	58	61	64	67	70	73	76
1	42	45	48	51	54	57	60	63	66	69	72	75	78
2	65	68	71	74	77	80	4	7	10	13	16	19	22
3	25	28	31	34	37	40	43	46	49	52	55	58	61
4	50	53	56	59	62	65	68	71	74	77	80	4	7
5	6	9	12	15	18	21	24	27	30	33	36	39	42
6	58	61	64	67	70	73	76	79	3	6	9	12	15
7	34	37	40	43	46	49	52	55	58	61	64	67	70
8	10	13	16	19	22	25	28	31	34	37	40	43	46
9	61	64	67	70	73	76	79	3	6	9	12	15	18
10	24	27	30	33	36	39	42	45	48	51	54	57	60
11	39	42	45	48	51	54	57	60	63	66	69	72	75
12	71	74	77	80	4	7	10	13	16	19	22	25	28
13	22	25	28	31	34	37	40	43	46	49	52	55	58
14	64	67	70	73	76	79	3	6	9	12	15	18	21
15	15	18	21	24	27	30	33	36	39	42	45	48	51
16	26	29	32	35	38	41	44	47	50	53	56	59	62
17	68	71	74	77	80	4	7	10	13	16	19	22	25
18	40	43	46	49	52	55	58	61	64	67	70	73	76
19	73	76	79	3	6	9	12	15	18	21	24	27	30
20	44	47	50	53	56	59	62	65	68	71	74	77	80
21	60	63	66	69	72	75	78	2	5	8	11	14	17
22	53	56	59	62	65	68	71	74	77	80	4	7	10
23	78	2	5	8	11	14	17	20	23	26	29	32	35
24	35	38	41	44	47	50	53	56	59	62	65	68	71
25	17	20	23	26	29	32	35	38	41	44	47	50	53
26	32	35	38	41	44	47	50	53	56	59	62	65	68
27	63	66	69	72	75	78	2	5	8	11	14	17	20
28	45	48	51	54	57	60	63	66	69	72	75	78	2
29	79	3	6	9	12	15	18	21	24	27	30	33	36
30	52	55	58	61	64	67	70	73	76	79	3	6	9
31	76	79	3	6	9	12	15	18	21	24	27	30	33
32	29	32	35	38	41	44	47	50	53	56	59	62	65
33	49	52	55	58	61	64	67	70	73	76	79	3	6
34	31	34	37	40	43	46	49	52	55	58	61	64	67
35	38	41	44	47	50	53	56	59	62	65	68	71	74
36	46	49	52	55	58	61	64	67	70	73	76	79	3
37	23	26	29	32	35	38	41	44	47	50	53	56	59
38	69	72	75	78	2	5	8	11	14	17	20	23	26
39	54	57	60	63	66	69	72	75	78	2	5	8	11

index	40	43	46	49	52	55	58	61	64	67	70	73	76
40	67	70	73	76	79	3	6	9	12	15	18	21	24
41	56	59	62	65	68	71	74	77	80	4	7	10	13
42	20	23	26	29	32	35	38	41	44	47	50	53	56
43	4	7	10	13	16	19	22	25	28	31	34	37	40
44	37	40	43	46	49	52	55	58	61	64	67	70	73
45	74	77	80	4	7	10	13	16	19	22	25	28	31
46	33	36	39	42	45	48	51	54	57	60	63	66	69
47	51	54	57	60	63	66	69	72	75	78	2	5	8
48	21	24	27	30	33	36	39	42	45	48	51	54	57
49	41	44	47	50	53	56	59	62	65	68	71	74	77
50	8	11	14	17	20	23	26	29	32	35	38	41	44
51	62	65	68	71	74	77	80	4	7	10	13	16	19
52	36	39	42	45	48	51	54	57	60	63	66	69	72
53	27	30	33	36	39	42	45	48	51	54	57	60	63
54	2	5	8	11	14	17	20	23	26	29	32	35	38
55	55	58	61	64	67	70	73	76	79	3	6	9	12
56	75	78	2	5	8	11	14	17	20	23	26	29	32
57	28	31	34	37	40	43	46	49	52	55	58	61	64
58	13	16	19	22	25	28	31	34	37	40	43	46	49
59	19	22	25	28	31	34	37	40	43	46	49	52	55
60	5	8	11	14	17	20	23	26	29	32	35	38	41
61	11	14	17	20	23	26	29	32	35	38	41	44	47
62	57	60	63	66	69	72	75	78	2	5	8	11	14
63	47	50	53	56	59	62	65	68	71	74	77	80	4
64	59	62	65	68	71	74	77	80	4	7	10	13	16
65	48	51	54	57	60	63	66	69	72	75	78	2	5
66	30	33	36	39	42	45	48	51	54	57	60	63	66
67	12	15	18	21	24	27	30	33	36	39	42	45	48
68	3	6	9	12	15	18	21	24	27	30	33	36	39
69	43	46	49	52	55	58	61	64	67	70	73	76	79
70	70	73	76	79	3	6	9	12	15	18	21	24	27
71	18	21	24	27	30	33	36	39	42	45	48	51	54
72	77	80	4	7	10	13	16	19	22	25	28	31	34
73	16	19	22	25	28	31	34	37	40	43	46	49	52
74	66	69	72	75	78	2	5	8	11	14	17	20	23
75	7	10	13	16	19	22	25	28	31	34	37	40	43
76	14	17	20	23	26	29	32	35	38	41	44	47	50
77	80	4	7	10	13	16	19	22	25	28	31	34	37
78	72	75	78	2	5	8	11	14	17	20	23	26	29
79	9	12	15	18	21	24	27	30	33	36	39	42	45

Table B-3, Hopping Sequence Set 3

index	2	5	8	11	14	17	20	23	26	29	32	35	38
1	4	7	10	13	16	19	22	25	28	31	34	37	40
2	27	30	33	36	39	42	45	48	51	54	57	60	63
3	66	69	72	75	78	2	5	8	11	14	17	20	23
4	12	15	18	21	24	27	30	33	36	39	42	45	48
5	47	50	53	56	59	62	65	68	71	74	77	80	4
6	20	23	26	29	32	35	38	41	44	47	50	53	56
7	75	78	2	5	8	11	14	17	20	23	26	29	32
8	51	54	57	60	63	66	69	72	75	78	2	5	8
9	23	26	29	32	35	38	41	44	47	50	53	56	59
10	65	68	71	74	77	80	4	7	10	13	16	19	22
11	80	4	7	10	13	16	19	22	25	28	31	34	37
12	33	36	39	42	45	48	51	54	57	60	63	66	69
13	63	66	69	72	75	78	2	5	8	11	14	17	20
14	26	29	32	35	38	41	44	47	50	53	56	59	62
15	56	59	62	65	68	71	74	77	80	4	7	10	13
16	67	70	73	76	79	3	6	9	12	15	18	21	24
17	30	33	36	39	42	45	48	51	54	57	60	63	66
18	2	5	8	11	14	17	20	23	26	29	32	35	38
19	35	38	41	44	47	50	53	56	59	62	65	68	71
20	6	9	12	15	18	21	24	27	30	33	36	39	42
21	22	25	28	31	34	37	40	43	46	49	52	55	58
22	15	18	21	24	27	30	33	36	39	42	45	48	51
23	40	43	46	49	52	55	58	61	64	67	70	73	76
24	76	79	3	6	9	12	15	18	21	24	27	30	33
25	58	61	64	67	70	73	76	79	3	6	9	12	15
26	73	76	79	3	6	9	12	15	18	21	24	27	30
27	25	28	31	34	37	40	43	46	49	52	55	58	61
28	7	10	13	16	19	22	25	28	31	34	37	40	43
29	41	44	47	50	53	56	59	62	65	68	71	74	77
30	14	17	20	23	26	29	32	35	38	41	44	47	50
31	38	41	44	47	50	53	56	59	62	65	68	71	74
32	70	73	76	79	3	6	9	12	15	18	21	24	27
33	11	14	17	20	23	26	29	32	35	38	41	44	47
34	72	75	78	2	5	8	11	14	17	20	23	26	29
35	79	3	6	9	12	15	18	21	24	27	30	33	36
36	8	11	14	17	20	23	26	29	32	35	38	41	44
37	64	67	70	73	76	79	3	6	9	12	15	18	21
38	31	34	37	40	43	46	49	52	55	58	61	64	67
39	16	19	22	25	28	31	34	37	40	43	46	49	52

index	2	5	8	11	14	17	20	23	26	29	32	35	38
40	29	32	35	38	41	44	47	50	53	56	59	62	65
41	18	21	24	27	30	33	36	39	42	45	48	51	54
42	61	64	67	70	73	76	79	3	6	9	12	15	18
43	45	48	51	54	57	60	63	66	69	72	75	78	2
44	78	2	5	8	11	14	17	20	23	26	29	32	35
45	36	39	42	45	48	51	54	57	60	63	66	69	72
46	74	77	80	4	7	10	13	16	19	22	25	28	31
47	13	16	19	22	25	28	31	34	37	40	43	46	49
48	62	65	68	71	74	77	80	4	7	10	13	16	19
49	3	6	9	12	15	18	21	24	27	30	33	36	39
50	49	52	55	58	61	64	67	70	73	76	79	3	6
51	24	27	30	33	36	39	42	45	48	51	54	57	60
52	77	80	4	7	10	13	16	19	22	25	28	31	34
53	68	71	74	77	80	4	7	10	13	16	19	22	25
54	43	46	49	52	55	58	61	64	67	70	73	76	79
55	17	20	23	26	29	32	35	38	41	44	47	50	53
56	37	40	43	46	49	52	55	58	61	64	67	70	73
57	69	72	75	78	2	5	8	11	14	17	20	23	26
58	54	57	60	63	66	69	72	75	78	2	5	8	11
59	60	63	66	69	72	75	78	2	5	8	11	14	17
60	46	49	52	55	58	61	64	67	70	73	76	79	3
61	52	55	58	61	64	67	70	73	76	79	3	6	9
62	19	22	25	28	31	34	37	40	43	46	49	52	55
63	9	12	15	18	21	24	27	30	33	36	39	42	45
64	21	24	27	30	33	36	39	42	45	48	51	54	57
65	10	13	16	19	22	25	28	31	34	37	40	43	46
66	71	74	77	80	4	7	10	13	16	19	22	25	28
67	53	56	59	62	65	68	71	74	77	80	4	7	10
68	44	47	50	53	56	59	62	65	68	71	74	77	80
69	5	8	11	14	17	20	23	26	29	32	35	38	41
70	32	35	38	41	44	47	50	53	56	59	62	65	68
71	59	62	65	68	71	74	77	80	4	7	10	13	16
72	39	42	45	48	51	54	57	60	63	66	69	72	75
73	57	60	63	66	69	72	75	78	2	5	8	11	14
74	28	31	34	37	40	43	46	49	52	55	58	61	64
75	48	51	54	57	60	63	66	69	72	75	78	2	5
76	55	58	61	64	67	70	73	76	79	3	6	9	12
77	42	45	48	51	54	57	60	63	66	69	72	75	78
78	34	37	40	43	46	49	52	55	58	61	64	67	70
79	50	53	56	59	62	65	68	71	74	77	80	4	7

index	41	44	47	50	53	56	59	62	65	68	71	74	77
1	43	46	49	52	55	58	61	64	67	70	73	76	79
2	66	69	72	75	78	2	5	8	11	14	17	20	23
3	26	29	32	35	38	41	44	47	50	53	56	59	62
4	51	54	57	60	63	66	69	72	75	78	2	5	8
5	7	10	13	16	19	22	25	28	31	34	37	40	43
6	59	62	65	68	71	74	77	80	4	7	10	13	16
7	35	38	41	44	47	50	53	56	59	62	65	68	71
8	11	14	17	20	23	26	29	32	35	38	41	44	47
9	62	65	68	71	74	77	80	4	7	10	13	16	19
10	25	28	31	34	37	40	43	46	49	52	55	58	61
11	40	43	46	49	52	55	58	61	64	67	70	73	76
12	72	75	78	2	5	8	11	14	17	20	23	26	29
13	23	26	29	32	35	38	41	44	47	50	53	56	59
14	65	68	71	74	77	80	4	7	10	13	16	19	22
15	16	19	22	25	28	31	34	37	40	43	46	49	52
16	27	30	33	36	39	42	45	48	51	54	57	60	63
17	69	72	75	78	2	5	8	11	14	17	20	23	26
18	41	44	47	50	53	56	59	62	65	68	71	74	77
19	74	77	80	4	7	10	13	16	19	22	25	28	31
20	45	48	51	54	57	60	63	66	69	72	75	78	2
21	61	64	67	70	73	76	79	3	6	9	12	15	18
22	54	57	60	63	66	69	72	75	78	2	5	8	11
23	79	3	6	9	12	15	18	21	24	27	30	33	36
24	36	39	42	45	48	51	54	57	60	63	66	69	72
25	18	21	24	27	30	33	36	39	42	45	48	51	54
26	33	36	39	42	45	48	51	54	57	60	63	66	69
27	64	67	70	73	76	79	3	6	9	12	15	18	21
28	46	49	52	55	58	61	64	67	70	73	76	79	3
29	80	4	7	10	13	16	19	22	25	28	31	34	37
30	53	56	59	62	65	68	71	74	77	80	4	7	10
31	77	80	4	7	10	13	16	19	22	25	28	31	34
32	30	33	36	39	42	45	48	51	54	57	60	63	66
33	50	53	56	59	62	65	68	71	74	77	80	4	7
34	32	35	38	41	44	47	50	53	56	59	62	65	68
35	39	42	45	48	51	54	57	60	63	66	69	72	75
36	47	50	53	56	59	62	65	68	71	74	77	80	4
37	24	27	30	33	36	39	42	45	48	51	54	57	60
38	70	73	76	79	3	6	9	12	15	18	21	24	27
39	55	58	61	64	67	70	73	76	79	3	6	9	12

index	41	44	47	50	53	56	59	62	65	68	71	74	77
40	68	71	74	77	80	4	7	10	13	16	19	22	25
41	57	60	63	66	69	72	75	78	2	5	8	11	14
42	21	24	27	30	33	36	39	42	45	48	51	54	57
43	5	8	11	14	17	20	23	26	29	32	35	38	41
44	38	41	44	47	50	53	56	59	62	65	68	71	74
45	75	78	2	5	8	11	14	17	20	23	26	29	32
46	34	37	40	43	46	49	52	55	58	61	64	67	70
47	52	55	58	61	64	67	70	73	76	79	3	6	9
48	22	25	28	31	34	37	40	43	46	49	52	55	58
49	42	45	48	51	54	57	60	63	66	69	72	75	78
50	9	12	15	18	21	24	27	30	33	36	39	42	45
51	63	66	69	72	75	78	2	5	8	11	14	17	20
52	37	40	43	46	49	52	55	58	61	64	67	70	73
53	28	31	34	37	40	43	46	49	52	55	58	61	64
54	3	6	9	12	15	18	21	24	27	30	33	36	39
55	56	59	62	65	68	71	74	77	80	4	7	10	13
56	76	79	3	6	9	12	15	18	21	24	27	30	33
57	29	32	35	38	41	44	47	50	53	56	59	62	65
58	14	17	20	23	26	29	32	35	38	41	44	47	50
59	20	23	26	29	32	35	38	41	44	47	50	53	56
60	6	9	12	15	18	21	24	27	30	33	36	39	42
61	12	15	18	21	24	27	30	33	36	39	42	45	48
62	58	61	64	67	70	73	76	79	3	6	9	12	15
63	48	51	54	57	60	63	66	69	72	75	78	2	5
64	60	63	66	69	72	75	78	2	5	8	11	14	17
65	49	52	55	58	61	64	67	70	73	76	79	3	6
66	31	34	37	40	43	46	49	52	55	58	61	64	67
67	13	16	19	22	25	28	31	34	37	40	43	46	49
68	4	7	10	13	16	19	22	25	28	31	34	37	40
69	44	47	50	53	56	59	62	65	68	71	74	77	80
70	71	74	77	80	4	7	10	13	16	19	22	25	28
71	19	22	25	28	31	34	37	40	43	46	49	52	55
72	78	2	5	8	11	14	17	20	23	26	29	32	35
73	17	20	23	26	29	32	35	38	41	44	47	50	53
74	67	70	73	76	79	3	6	9	12	15	18	21	24
75	8	11	14	17	20	23	26	29	32	35	38	41	44
76	15	18	21	24	27	30	33	36	39	42	45	48	51
77	2	5	8	11	14	17	20	23	26	29	32	35	38
78	73	76	79	3	6	9	12	15	18	21	24	27	30
79	10	13	16	19	22	25	28	31	34	37	40	43	46