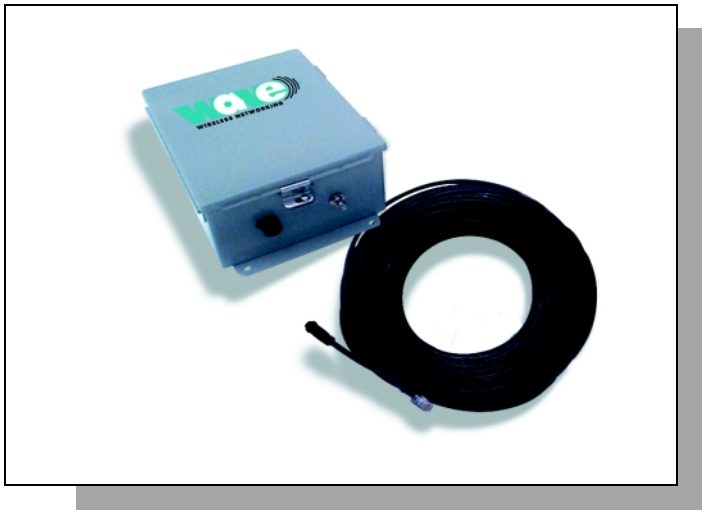
SPEEDLAN 4100 & 4200



Installation and Operation User Guide

Version 1.0 / Last Revised September, 2000

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Chapter 1
Introduction

Features and Benefits

SPEEDLAN 4100 and 4200 are wireless Ethernet brouters. Similar in function to other SPEEDLAN products, the 4100 and 4200 differ in how they are installed. Using a unique pole mount design, the 4100 and 4200 allow up to 300 feet of cable to be run from the connection point to the network up to the RF device, without introducing loss of any radio signal. This increases the effective wireless link distance and reduces or even eliminates the need for an amplifier in the system.

The outdoor mounted 4100 and 4200 are connected to the network using an indoor junction box. This small box combines the Ethernet signal and DC power which is then run over a single Teflon jacketed Ethernet cable up to the RF device.

These radios operate in the 2400MHz to 2483.5MHz ISM band, contain 11 user selectable RF channels. The radios use direct sequence spread spectrum with a QPSK modulation, and employ 11 dB of processing gain.

The SPEEDLAN 4100 & 4200 brouters also contain transparent Ethernet bridging and IP routing as described below.

Transparent Ethernet Bridging with Advanced Filtering for Security and Network Reliability

SPEEDLAN 4100 & 4200 brouters support what is known as Transparent Ethernet Bridging with no Spanning Tree or Source Routing support. Since the SPEEDLAN 4100 & 4200 provide network security between a local LAN and a campus or enterprise wide network, and since using multiple bridges in a Spanning Tree could compromise this security, the Spanning Tree scenario is not supported. In addition, the SPEEDLAN 4100 & 4200 can filter packets based on protocol type or MAC address pairings. These features can add a significant measure of security and network reliability to a network interconnection.

IP Routing with Advanced Filtering for Security

The SPEEDLAN 4100 & 4200 support IP Routing in addition to bridging. It can be used to add routing capability when an IP router may be a more appropriate choice.

SNMP Management

SNMP wireless and wired link management may be administered from any Ethernet network or remotely from the Internet. The SNMP MIB II, Bridge MIB, and Ethernet-Interface MIB come with the brouters, so you can use SNMP to monitor a number of SPEEDLAN parameters, including RF-signal quality and noise level.

SNMP Features

- IP "ping" Support
- IP SNMP Support (MIB II, Ethernet, Interface, SNMP, and Bridge MIB)
- IP SNMP WaveLAN
- IP SNMP Trap Support
- SNMP Access Lists

SNMP Management

SNMP wireless and wired link management may be administered from any Ethernet network or remotely from the Internet. The SNMP MIB II, Bridge MIB, and Ethernet-Interface MIB come with the bridges, so you can use SNMP to monitor a number of SPEEDLAN 4100 & 4200 parameters, including RF-signal quality and noise level.

IP-Router Features

- IP Static Routing with Direct and Static Routes
- ICMP Messages, Default Router, and Subnet Support
- SNMP Support for All Router-Related MIB Variables
- RIP Support

Encryption Features (Add-on Option)

- Data Encryption of Wireless Packets

Wireless Multipoint Protocol

Campus Cell PRC features provide multipoint networking, improved performance, and increased reliability. In multipoint networks, a SPEEDLAN 4100 acts as a central base station with responsibility to manage the flow of data within the radio cell. When necessary, packets are repeated or retransmitted by this brouter, allowing communications between multiple remote networks by using SPEEDLAN 4200.

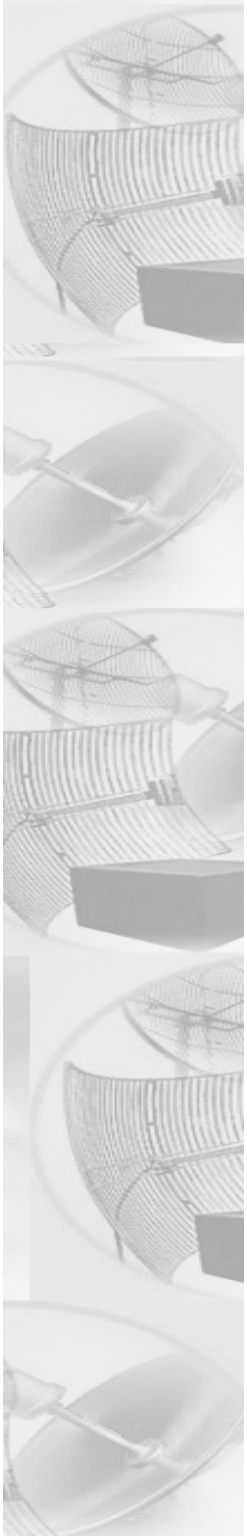
Additional Functionality for SPEEDLAN 4100 & 4200

- RF cable loss is negligible
- Brouters can be mounted in more remote locations because Ethernet cable is connected to the brouters
- Increased RF power to the antenna will mean longer links are possible without using an amplifier

Features

- 10BASE-T Ethernet interface
- SPEEDLAN 11 Mb Wireless Radio
- Bridging Features
- Protocol Transparent Bridging
- IP Routing
- Filtering by Ethernet Multicast, Broadcast and Bad Packets
- Filtering by Protocol
- Filtering by Ethernet Address Pair
- Generic Ethernet Tunneling through IP Networks
- Learned Table Lockdown
- Expanded IP ARP Support
- Automatic Broadcast Storm Protection and Notification

Chapter 2
Quick Start



System Description

The SPEEDLAN 4100 & 4200 are high speed, long range wireless LAN brouters that provide connectivity to remote Ethernet networks. For single point-to-point links, a SPEEDLAN 4200 can be used in each building to create a wireless communication link. For multipoint links, a SPEEDLAN 4100 acts as the central base station, which controls the communication between multiple SPEEDLAN 4200 brouters acting as CPE. The local brouter communicates with a remote brouter on another LAN. This effectively creates an extended wireless network, spanning sites situated up to 25 miles apart. This enables a central Ethernet LAN to be connected with one or more branch office LANs. A single brouter with an omnidirectional antenna, may communicate with multiple brouters to create multipoint wireless site-to-site connectivity.

Rooftop and Tower Installations Warning

Rooftop, tower and mounted equipment (brouters) installations are extremely dangerous and incorrect installation can result in death, injury, or property damage. These installations must be performed by professional antenna installers only.

Package Contents

Note: Certain items are only available when purchased with the SPEEDLAN Installation Kit.

- 4100 or 4200 SPEEDLAN brouter
- SPEEDLAN 4100 or 4200 mounting hardware
- Product registration card
- SPEEDLAN CD containing:
  - Product manual
  - Configuration management software
- *Electrical tape
- *Cable sealant putty
- *Lightning arrestor
- *Specialized CAT5 cable
- 10’ RF cable

- 24" proprietary pigtail cable
- *Grounding clamps
- *Ethernet surge protector
- *Wire zip ties
- *Antenna (specialized upon request)

* Note: Items can be purchased separately or as part of an Installation Kit.

Installation Steps

Some installation instructions are specific to customers who purchased Installation Kits from Wave Wireless. To view a diagram of the installation listed below, see *Installation Diagram, page 2-8*.

The directions below contain installation procedures for the items included in the SPEEDLAN 4100 & 4200 antenna (and amplifier) kit. If you do not have an item included in the instructions below, contact Wave Wireless.

If you are having trouble and need a full site installation, contact Wave Wireless Networking for services and fees.

To install the SPEEDLAN 4100 & 4200, do the following:

Step 1.Verifying Line-of-Sight

Before installing the antennas and brouters, make sure a clear line-of-sight exists. Line-of-sight can be defined as each antenna clearly seeing the other antenna, and seeing the remote locations when viewing from the central base location. Be sure to look level with the center of origin of the transmission (i.e., the middle of the antenna). Repeat this procedure from the remote location. Any disruption of the signal path due to trees, building, or any other obstructions may cause the link to function incorrectly. If you see any obstructions between two antennas, move one or both antennas to another location.

Step 2. Mounting the Antenna

Follow the instructions below to mount the antenna.

Note: You can use a 24db grid antenna to achieve a link as long as the remote brouter can hear it.

a) On a side-building mount, position the bracket so there will be at least three feet (one meter) above the roof line where the pole is attached. This enables room for the antenna and reduces signal loss from building reflection.

Note: It is not recommended to mount the antenna onto any unstable object. For more information on antennas, see *Polarizations on a Grid Antenna, page 2-9*.

b) Allow for as much space between the wall brackets as possible while maintaining the appropriate antenna height. For extended poles, additional wall brackets may be necessary.

c) Assemble the antenna and mount it to the pole using the included U-bolt antenna mounting hardware. For a semi-parabolic grid type antenna, align the grid to run parallel with the grid on the tip of the antenna horn. Preferably, the grid should be horizontal (or parallel to the ground). Make sure all bolts and screws are fastened tightly.

d) Fasten the pole to the brackets. Position the antenna, point it in the appropriate direction, and tighten the screws. Then, aim the antenna so it is pointed toward the receiving antenna on the other building. The radio signal radiates from the end of antenna like a wide-beamed flashlight. For optimal performance, you may need to test your link using both polarities. This configuration option varies with each location, as well as RF signals that may be present in the area.

Step 3. Mounting the SPEEDLAN 4100 or 4200 Brouter

Select one of two options below:

- Option A: Pole Mount
  On a pole mount, position the brouter 5 to 10 feet below the antenna. Then, attach the brouter to the mounting pole using two included U-bolt clamps, one on the top of the brouter and the other on the bottom of brouter. Make sure you tighten the screws on the back of the pole mount.

OR

- Option B: Wall or Concrete Mount
  On a side building mount, position the brouter 5 to 10 feet below the antenna. Then, attach the brouter to the wall or concrete by using the concrete or wood mounting screws. Make sure the brouter is secured.

Step 4. Running and Securing All Cable

The installation kit includes two cables with ready-made connectors to fit your particular installation needs such as:

- Pigtail (12" adapter from brouter)
- (1) 5-10' antenna cable (attaches to antenna one end and to lightning arrestor other end)
- Lighting arrestor (attaches to pigtail and to antenna cable)

a) Attach the 24" pigtail to the SPEEDLAN brouter to the appropriate port.

b) Attach the 10' length of cable to the antenna. Next, attach the lightning arrestor to the lower end of the antenna cable.

c) Attach the other end of lightning arrestor to 24" pigtail.

d) Run the main length of the specialized Ethernet cable from the SPEEDLAN brouter to the indoor junction box located inside the building).

e) Secure the cable with zip ties or cable clamps during this procedure.

TIP

When running the cable through walls or obstructions, make sure that there is ample room for the connector to pass through without being damaged. Also, do not create extra pressure that would cause the cable to kink or be stretched or cut (i.e., pulling cable through tight locations).

f) Create a proper weatherproofing seal on all outdoor connections by wrapping it with electrical tape and sealing it with putty. This is the most crucial step of the installation. If this procedure is not completed, long-term and complex problems could occur. For more information on implementing this procedure, see *Weatherproofing Connectors, page 2-6*.

g) Next, ground the lighting arrestor. For more information, see *Grounding the Lightning Arrestor, page 2-6*.

Step 5. Grounding the Lightning Arrestor

a) Mount the lightning arrestor to a solid surface.

b) Run the grounding wire from the lightning arrestor to a proper ground source such as a grounding rod or roof ground wire. The lightning arrestor is NOT waterproof.

Step 6. Weatherproofing Connectors

a) Seal the entire lightning arrestor with the black waterproof sealant insulation putty that is included in the installation kit.

b) Apply two layers of electrical tape to the connector, and leave approximately 3 inches of cable exposed on either side of the connector. An alternative is to begin at the lowest point, so the tape overlaps from bottom to top creating a shingled effect. (This creates an effective barrier against water runoff). Apply this "shingle effect" to each layer of the sealing process.

c) Apply one layer of insulation putty over the top of the electrical tape, and leave at least one inch of the cable jacket to ensure a good seal. Do not stretch the putty, as this causes thinning and reduces the effectiveness of a good seal.

d) Apply five layers of electrical tape over the insulation putty and extend at least one (1) inch past the putty. This is the most important step in creating a watertight seal. Make sure that there are no wrinkles in the tape and the final wrap must be completed from bottom to top.

Step 7. Connect the Wireless SPEEDLAN Brouter to the Power Supply

a) Connect power cord of AC-DC 18 Vdc adapter to 110 or 220 Vac power outlet (the input voltage of this universal adapter can vary from 100 to 240 Vac).

b) Connect the DC output of the adapter (18 Vdc) to DC jack on the indoor junction box.

Step 8. Connect the Wireless SPEEDLAN Brouter to Customer's Ethernet LAN

a) Connect the RJ-45 connector on a standard Ethernet CAT5 cable to the RJ-45 port (color of port is white) on indoor junction box.

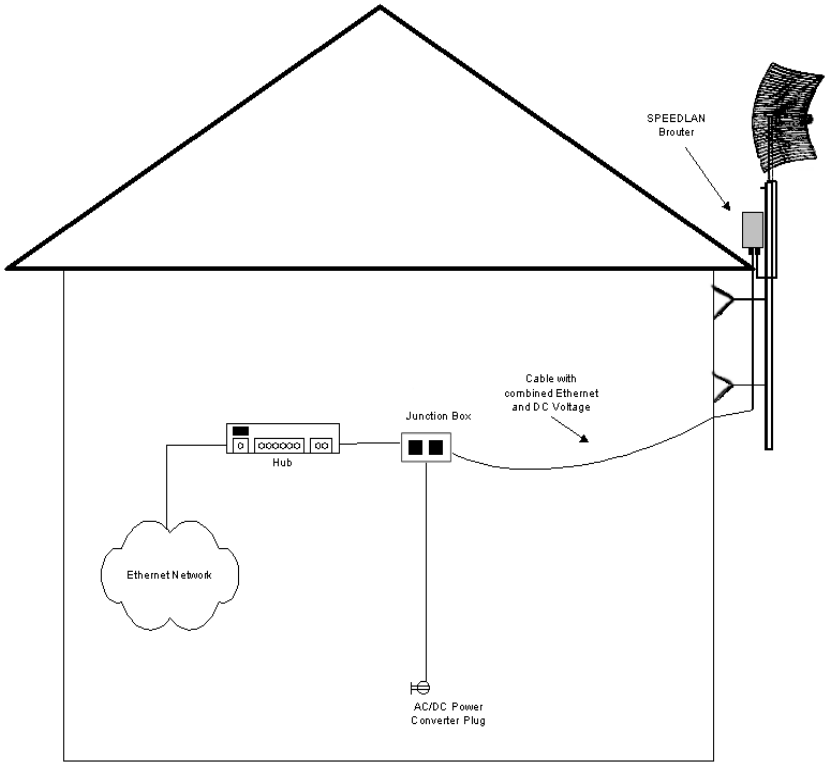
b) Connect the other end of the Ethernet CAT5 cable to your Ethernet hub, switch or router.

Step 9. Adding Additional Brouters

Repeat the steps above for all of The SPEEDLAN 4100 & 4200 brouters that will be communicating with this one.

Installation Diagram

The diagram below displays where the main components are located.

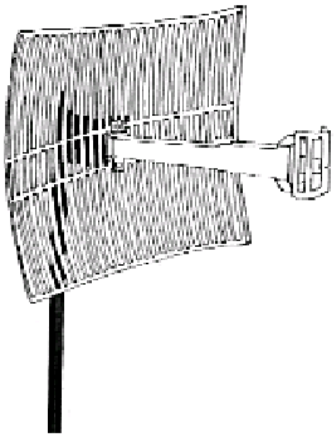


All outdoor cable connections and lightning arrestors must be insulated with waterproof electrical putty.

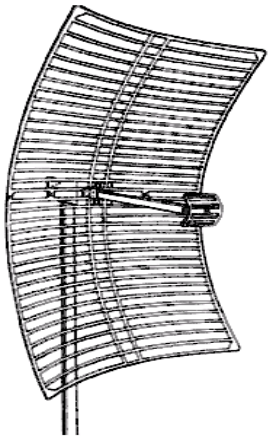
Polarizations on a Grid Antenna

The antenna must be aimed so that when you look out from the center of the antenna it is pointing toward the receiving antenna on the other building. The radio signal radiates from the end of the antenna like a wide-beamed flashlight.

Vertical Polarity



Horizontal Polarity



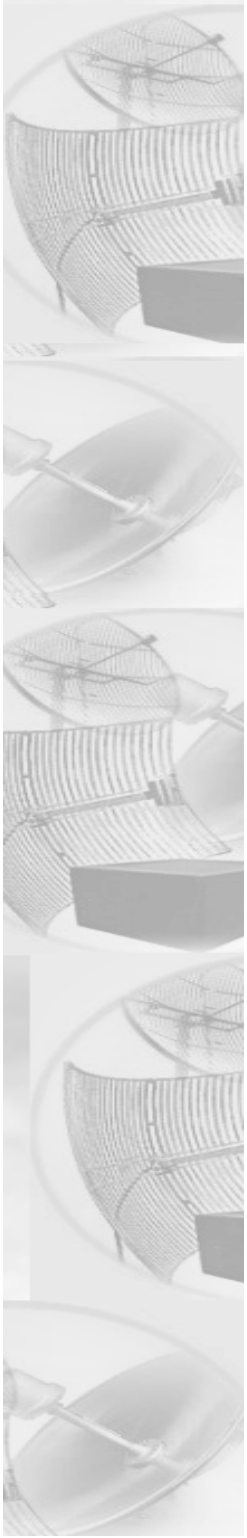
TIP

In order for the antennas to operate correctly, the polarities must match!

For most applications we have found that horizontally polarized antennas work best. This is because most other signals that may cause interference are vertically polarized. If you use horizontal polarization, you can reduce the interference caused by those other signals.

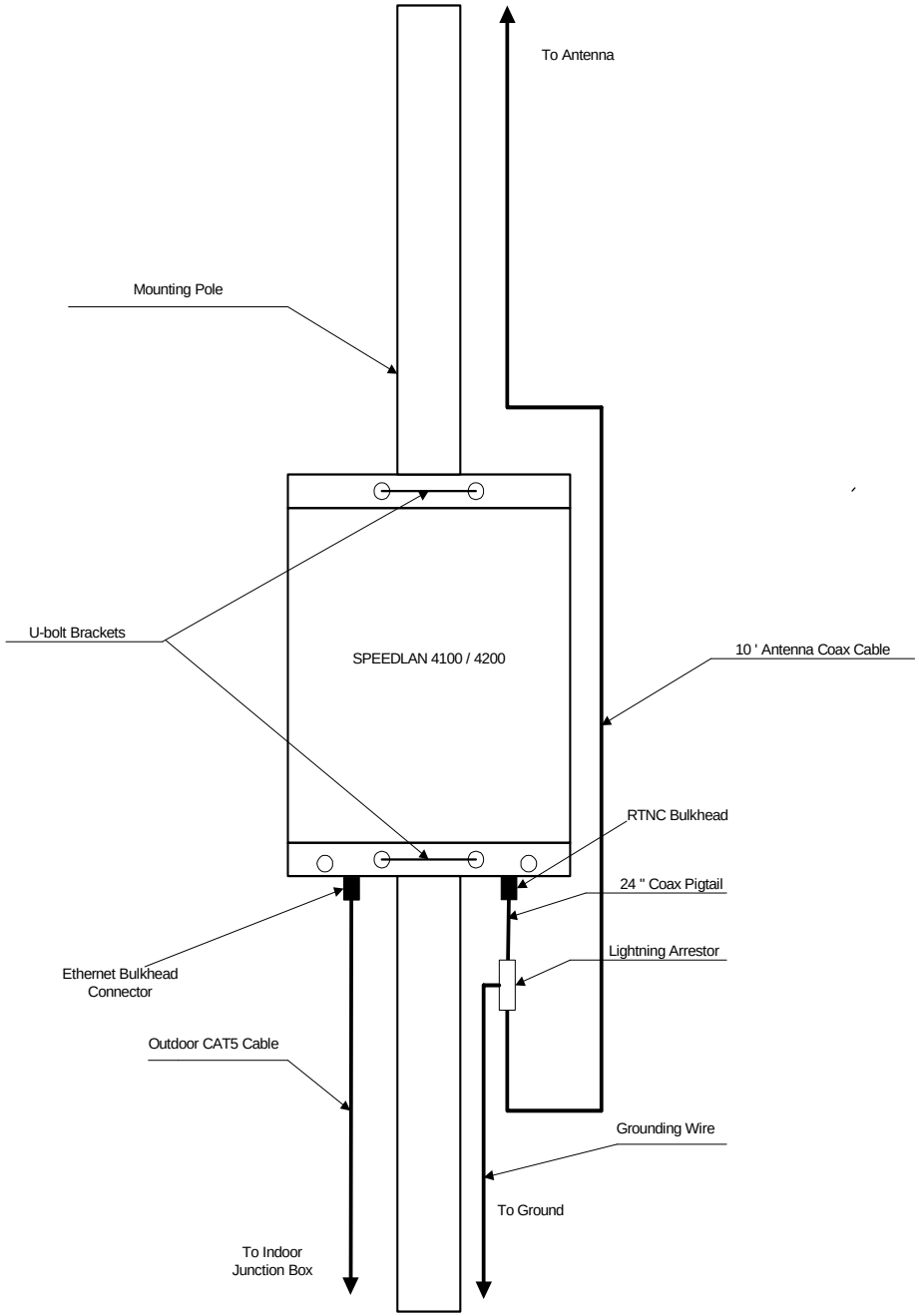
Notes:

Chapter 3
Hardware

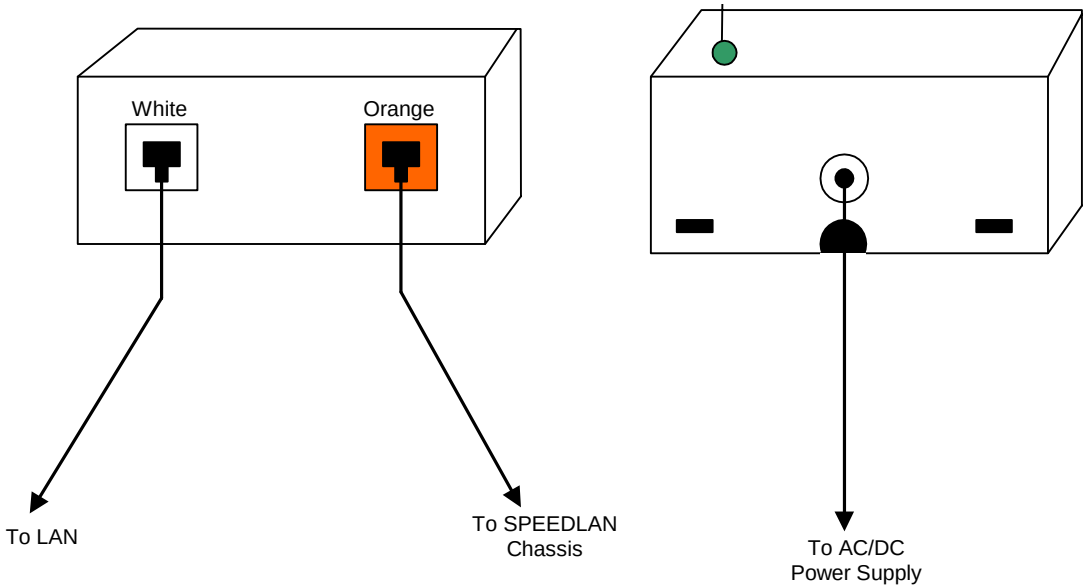


Drawings of Components

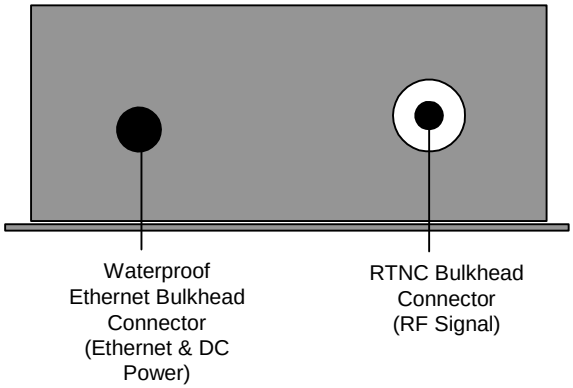
Overview of SPEEDLAN 4100 & 4200 (Tower Mount)



Front and Back of Indoor Junction Box



Bottom View of SPEEDLAN 4100/4200

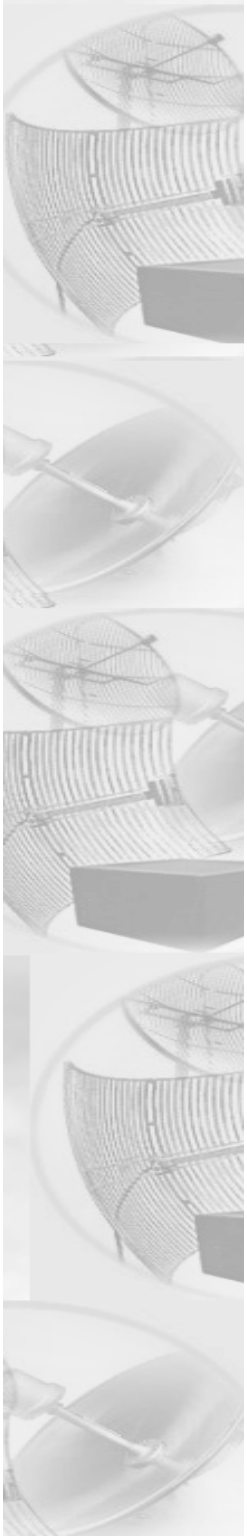


Upgrading the Firmware

You will need to update your firmware if the old one is damaged or additional functionality has been added. To upgrade the firmware, do the following:

1. Turn the SPEEDLAN unit off.
2. Connect the PC to the brouter using a crossover Ethernet cable, or using 2 Straight-through cables and a hub.
3. Under the Network Neighborhood on your PC, change the IP address to 198.17.74.195 and assign a Subnet Mask of 255.255.255.0. You will also need to remove any gateways that were defined in your TCP/IP properties.
4. You will be asked if you want to re-boot your PC. Click Yes.
5. On your PC, start the SPEEDLAN Configurator.
6. From the File menu, select Open Config. Then, select the appropriate .Bin file.
7. Then from the File menu, choose Upload Software. A dialog box will appear with an IP address in it. Click Scan; this will bring up another dialog box with the IP Address of the SPEEDLAN. This IP Address will be 198.17.74.254. At this point click OK, and confirm the IP Address in the first dialog box is 198.17.74.254. Then, click OK again.
8. Next a menu will appear requesting a MAC Address, as well as a Passkey. You can only receive these from Wave Wireless. You will enter these two variables and click the OK button. There will be a sequence of dialog boxes, which will warn you that you are about to reload the Flash ROM with a new .Bin file. Click OK for all of them. This will cause the brouter to reboot.
9. Allow the brouter to reboot normally.
10. The brouter has now been updated with a new .Bin file. You may now configure the brouter to operate on your network.

Chapter 4
Overview of Configurator



Installation and Setup

Windows 95/98/NT 4.0 SPEEDLAN 4100 & 4200 Configurator

To install the SPEEDLAN Configurator, do the following:

1 Shut down all programs and applications.

Note: The SPEEDLAN Configurator uses library files, which reside on your Windows 95/98/NT 4.0 PC. If a program or application is open, the Setup will not install correctly. If the Configurator is not installed correctly, the brouter could be rendered and inoperable after saving a configuration.

2 Insert the CD into your floppy drive (i.e., Drive E, F, etc.).

3 If the setup.exe program does not execute automatically, click Start + Run. The Run dialog box appears. Click Browse and locate the setup.exe where your CD-ROM drive is located. Then, click Open and OK.

4 Follow the installation prompts.

5 After the installation is complete, restart your computer.

Toolbar and Menus

File Menu

The Windows 95/98/NT 4.0 Configurator will configure either a remote Flash ROM in the brouters or configure a SPEEDLAN file saved on your computer. You can configure a SPEEDLAN file on your computer and download it to the brouters later after you have verified that all settings are correct. This can make reconfiguring your brouter a quick operation if you have the completed configuration already saved to your computer.

Configuring a SPEEDLAN Brouter

To configure a remote (network attached) brouter, you can use the Open Remote Config and Save functions. You must have a brouter configuration opened with the Configuration Utility before any configuration functions are performed. After you have opened the remote device and configured it, you can then save your configuration back to the open device. When you `Save' back to the remote device, its Flash ROM will be erased and reprogrammed with the new configuration. After you save the configuration, wait the required 15-second period. This allows the Flash ROM to be fully programmed and enables the brouter to reboot with the new configuration.

Turning off the brouter, or otherwise interrupting the reprogramming of the Flash ROM, will damage the programming of the brouter, and render it inoperable.

Note: Anytime you make changes in Frequency, IP Routing, or Network ID, start with the brouter furthest away from your current location. This will allow you to complete your changes without having to physically go to each location.

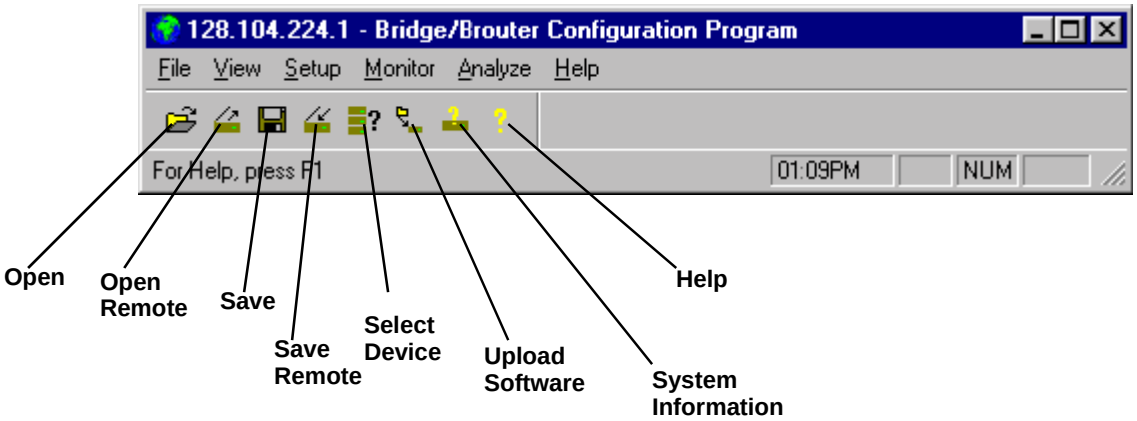
Configuring a Saved Configuration File

To configure a saved CNF file (configuration file), open it from the File menu by using the Open function. Then, configure the file just as if you were configuring a remote brouter. When you are finished configuring the file, save it to disk from the File menu using the "Save Config File As..." function. The "Open Remote Config..." and "Save Config" functions are used for accessing and saving directly to the brouter without using a file saved on diskette. Be careful when you save the configuration file that you do not save the configuration directly to the SPEEDLAN; otherwise, you will be configuring the brouter and may not be able to re-access it after uploading the incorrect configuration to it.

Exporting and Importing a Configuration

Once you have opened a remote brouter, you can take a "snapshot" of the current configuration with the "Save Config File As..." function. This function will result in creating a CNF file. The extension .CNF is used to denote the special exported binary configuration file. The CNF file created with the "Save Config File As..." function can later be imported into another brouter by using the "Import Config File..." function, then saving the configuration to the brouter using the "Save Config" function.

The Toolbar



Note: The functions on the toolbar can also be accessed from the menus on the Configurator (i.e., Save can be accessed from the File menu).

The Menu Bar

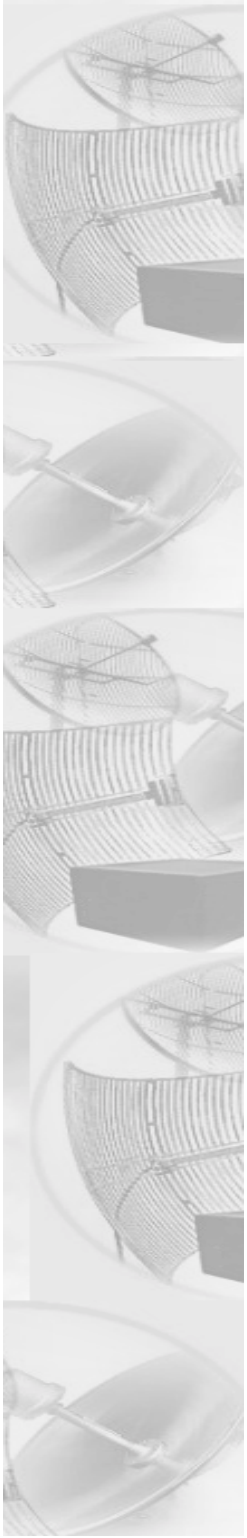
- The File Menu - This is the most common menu and is used to perform the following functions:
- Open Config File - This opens a configuration file from disk.
- Open Remote Config - This opens the configuration file directly from a remote device.
- Save Config - This saves the configuration you are working on to the place where you opened it.
- Save Config File as - This saves the current configuration into a file on disk. This file will have the extension .CNF.
- Import Config File - This opens a configuration file from disk. This function is used when you are going to save the configuration from disk to a remote brouter.
- Upload Software - This enables you to load a raw and unconfigured binary file to the brouter. This is done only in the event that the brouter's firmware has been damaged.
- Reboot Remote - This is used to reboot a brouter from a remote location.
- Exit - This closes the SPEEDLAN Configurator.

Quick Overview of Other Menus

- View Menu - This menu is used to change the display of the Configurator's various items.
- Setup Menu - This menu is used to modify all aspects of the brouter.
- Monitor Menu - This menu is used to monitor the brouter's performance and monitor another brouter.
- Analyze Menu - This menu is used to select another brouter and perform various tests (i.e., interval test, wireless link test, or antenna alignment test)
- Help Menu - This menu is used to troubleshoot questions pertaining to the SPEEDLAN Configurator.

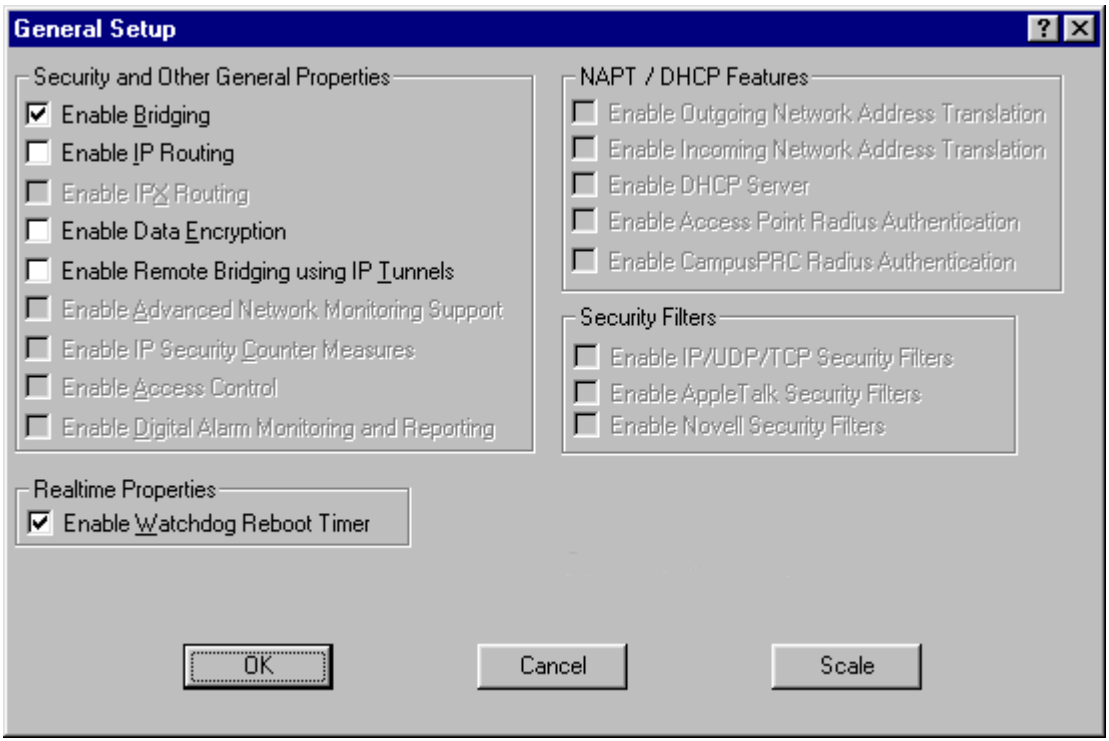
Notes:

Chapter 5
Configuring SPEEDLAN 4100 & 4200



General Setup

This dialog box activates the features to configure your brouters. To select this dialog box, choose General Setup from the Setup menu of the SPEEDLAN Configurator. Select the appropriate check boxes as described below:



- Enable Bridging
  The transparent bridging function will be enabled when this is item is selected. If you want the brouters to perform the bridging function, you must select this check box. When bridging is enabled, the Bridge Setup dialog box will be accessible. Bridging should be enabled for nearly all applications of the brouter. The default is ON.
- Enable IP Routing
  The transparent routing function will be enabled when this is item is selected. IP Routing will work properly only if the routes are set up in the IP Route dialog box. If the routes are not set up properly before you save the configuration, the router will become inoperable. The default is OFF.

- Enable Data Encryption
  This optional feature allows you to encrypt wireless data transmissions on top of the encryption provided by the radio. It provides 56-bit DES encryption. It is not shipped standard as part of the brouter. If you did not purchase it when you originally bought the brouter, it can be purchased later as a software upgrade. Data encryption is disabled by default. Select the box labeled Enable Encryption to enable the encryption features. You will still need to define at least one encryption key before your wireless traffic will be transmitted using wireless data encryption. To do this, return to the drop-down menu presented when you click on Setup. Now you will see a Data Encryption Setup item added to the menu list. Select Data Encryption Setup. Click the DES Encryption button and enter an 8 digit alhpanumeric string in the range of "a-z", "A-Z", and "0-9".

Examples:
Alphanumeric: a5F2z4wK

Warning: This setting must be set to the same value for the brouters that will be communicating together. Failure to set them to the same value will prevent any communications from taking place. For example, in order to use a multipoint link, you must use the same Encryption setting on the base station (SPEEDLAN 4100) and on the CPE brouter (SPEEDLAN 4200).

- Enable Remote Bridging using IP Tunnels
  SPEEDLAN brouters support a special feature which will enable Ethernet packets of any protocol type to be encapsulated in IP packets and sent to other brouters (purchased from Wave Wireless) for de-encapsulation. This method can be used to setup virtual Ethernet LANs between several points using an IP network as the transport layer.
- Enable Advanced Network Monitoring Support
  This option is not available at this time.
- Enable IP Security Counter Measures
  This option is not available at this time.
- Enable Access Control
  This option is not available at this time.
- Enable Digital Alarm Monitoring and Reporting
  This option is not available at this time.
- *Enable Outgoing Network Address Translation
  This option is only available for the SPEEDLAN 8000 series.
- *Enable Incoming Network Address Translation
  This option is only available for the SPEEDLAN 8000 series.
- *Enable DHCP Server
  This option is only available for the SPEEDLAN 8000 series.

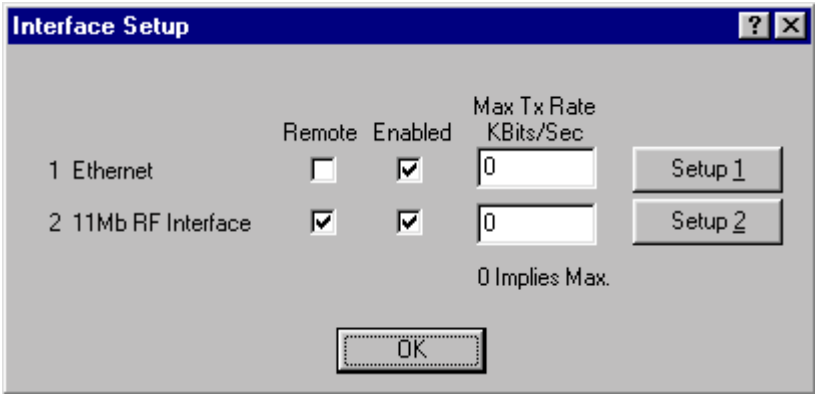
- Enable Access Point Radius Authentication
  This option is not available at this time
- Enable CampusPRC Radius Authentication
  This option is not available at this time.
- Enable IP/UDP/TCP Security Filters
  This option is not available at this time.
- Enable AppleTalk Security Filters
  This option is not available at this time.
- Enable Novell Security Filters
  This option is not available at this time.
- Enable Watchdog Reboot Timer
  This feature instructs the brouter to reboot in the event that the brouter fails to receive any incoming packets, from any port, for a period of 10 minutes. The brouter will assume an error has occurred and will reboot. If, after the brouter reboots, it does not receive an incoming hello signal, the bridge will listen for the hello signal until the user reboots the brouter manually. The Watchdog will recognize when a signal has been re-established and will reset the timer accordingly.

*Note: These check boxes are only active for customers that purchased the SPEEDLAN 8000 series which include the DHCP server, Outgoing NAT, and Incoming NAT.

Interface & Advanced Interface Setup

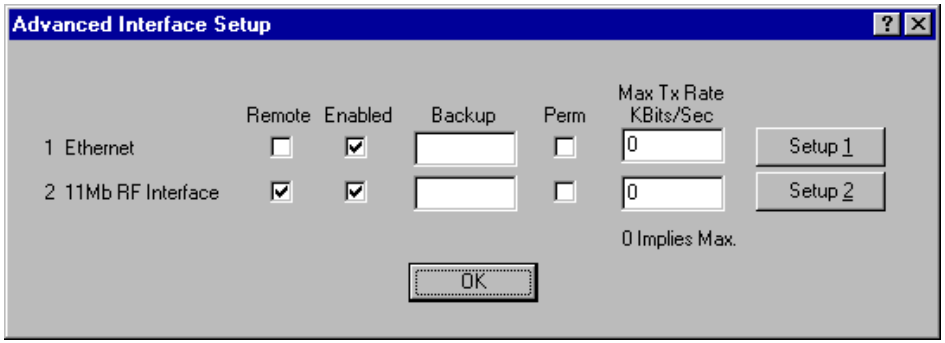
Interface Setup

To set up the basic interface, choose Interface Setup from the Setup menu on the SPEEDLAN Configurator. The interfaces that are installed in your brouter will be represented on this dialog box. The Remote check box is used to designate which interfaces will be considered local and remote. The local interface is considered to be the interface that connects directly to the local LAN with respect to the brouter. The remote interface is considered to be the interface that connects with the remote LAN. The set up buttons are used to access the portion of the configuration which controls how the individual interfaces are configured.



Advanced Interface Setup

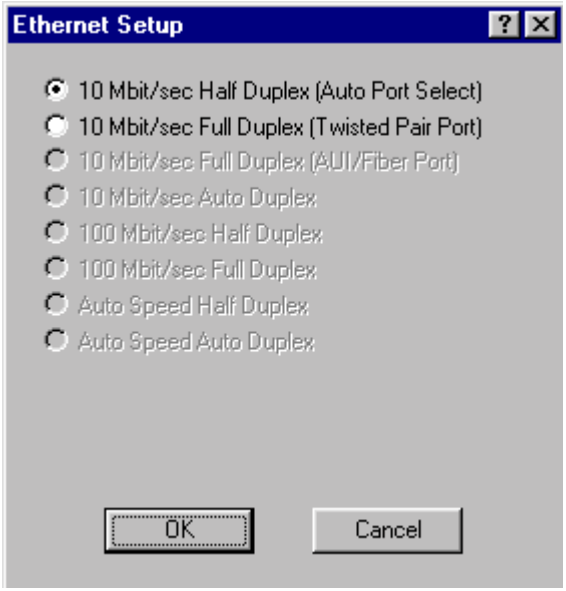
To set up the advanced interface, choose Advanced Interface Setup from the Setup menu on the SPEEDLAN Configurator. The Advanced Interface Setup contains a few more advanced settings, but they are set up in the same manner. Note that the Max Tx rate is available on both the Interface Setup and Advanced Interface Setup. Max Tx Rate is useful to ISPs that want to regulate the maximum bandwidth provided to each customer. These settings should not be changed without the assistance of a Wave Wireless Networking Technical Support Engineer. Backup and Perm are not used with the SPEEDLAN 4100 & 4200 products. These fields must remain empty.



The Setup Buttons

Setup 1 Button - Ethernet Setup

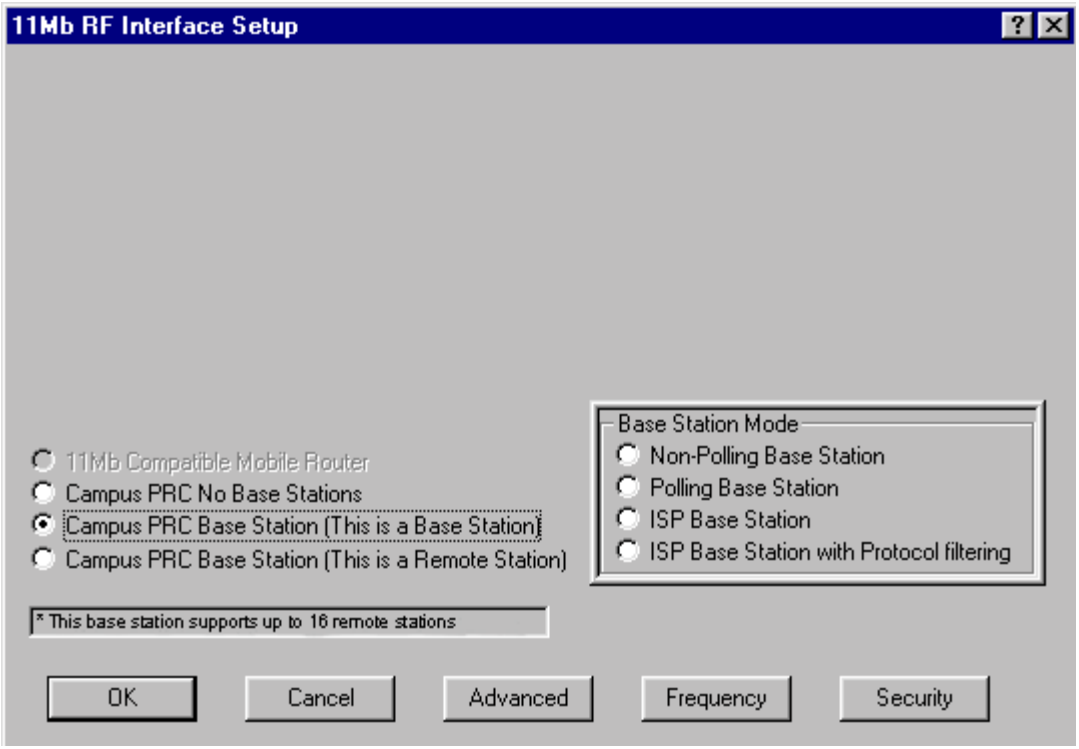
To modify the Ethernet Setup, click the Setup 1 button on the Interface Setup or Advanced Interface Setup dialog box. SPEEDLAN 4100/4200 brouters come standard with a 10 Base-T interface to connect to your wired network.



Clicking the Setup buttons (1 and 2) on the Interface & Advanced Interface Setup dialog box will open the Setup dialog box (for the interface selected).

Setup 2 Button - 11 Mb RF Interface Setup

To modify the 11 Mb RF Interface Setup, click the Setup 2 button on the Interface Setup or Advanced Interface Setup dialog box. This dialog box displays the configuration settings that control the individual interfaces and how they communicate with each other. On the next page, you will find a description of the settings, as well as how they affect the brouter's performance of the interfaces.



Transport Methods

The industry compatible method of transmitting and receiving data over wireless networks will cause data packets to frequently be lost. This is due to the fact that a wireless network does not have the ability to detect collisions like a wired Ethernet network. On an Ethernet network, collisions can be detected by the hardware and are automatically retransmitted. Ethernet is referred to as CSMA/CD (Carrier Sense Multiple Access with Collision Detection). Wireless networks are CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance). Collisions cannot be detected because wireless cannot receive and transmit at the same time. This means brouters are not able to listen for collisions. A brouter that is operating properly in a point-to-point network will loose, due to collisions, less than 1% of the transmitted packets. This packet loss is not normally a problem with protocols such as Novell IPX (without the Burst Mode NLM), but may cause networks using most

other protocols to experience poor performance. Campus Cell PRC helps to alleviate this problem by placing multiple packets into one larger packet, which saves bandwidth by eliminating the extra overhead. The transport methods are described below:

- Campus Cell PRC Mode (No Base Station/Brouter)
  This method of transportation is used only for point-to-point links. If any of the brouters are unable to see each other, a base station must be used to repeat traffic from one brouter to next brouter in line. This point-to-point mode utilizes Campus Cell PRC packet bundling, which reduces the amount of overhead caused by sending smaller individual packets across the wireless network. This greatly improves the performance of the connection.
- Campus PRC Mode (This is a Non-Polling Base Station/Brouter)
  This setting should be used if this is the only base station in the wireless network cell. SPEEDLAN has a special mode where one wireless brouter can be configured as a base station (a SPEEDLAN 4100) and each additional wireless node is setup as a CPE brouter (a SPEEDLAN 4200). In this configuration the only requirement is that each SPEEDLAN 4200 be able to communicate directly with the SPEEDLAN 4100. The SPEEDLAN 4100 is responsible for repeating packets that need to travel between the SPEEDLAN 4200. The Non-Polling Base does not dynamically allocate bandwidth to each remote brouter.

The performance of this approach is greatly improved if the SPEEDLAN 4100 is connected to the heaviest network or network server.

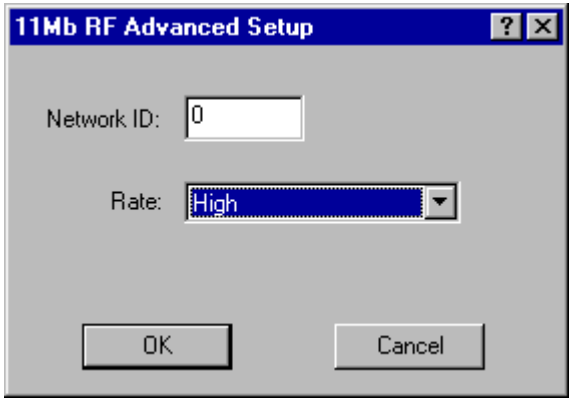
- Campus PRC Mode (This is a Polling Base Station/Brouter)
  This is the recommended mode of operation for a wireless base station. When the number of CPE exceed 3 or 4, the non-polling base station may not be able to keep up with the wireless traffic that needs to be forwarded. The polling base station alleviates this problem by continuously communicating with every SPEEDLAN 4200 in its cell. It is also responsible for dynamically assigning how much bandwidth is allocated to each remote site based on the network traffic load.

This greatly improves the performance of a SPEEDLAN 4100 wireless network cell. As the number of SPEEDLAN 4200 brouters increase, the importance of a polling base station increases and efficiency is proportionately improved.

- Campus PRC (This is a Remote Station/Brouter)
  This is the configuration required for remote brouters that will be installed as CPE into a multipoint wireless network (e.g., a SPEEDLAN 4400). In this mode, a SPEEDLAN 4200 will only communicate with a base station. This cannot be used for point-to-point links.

Advanced Button - 11 Mb RF Interface Setup

The Advanced button is located to the left of the Frequency button. Clicking this button will open a new dialog box that allows you to change the Network ID and rate of the interface.



- Network ID
  The Network ID is a security setting that allows the brouter to reject packets from other wireless brouters in the area. Although the bridging or routing table would reject the packet once it was processed, the Network ID allows the brouter to reject the packet with less processing. This improves the performance of the brouters in installations where many wireless brouters are co-located in the same area or where other organizations may be running wireless bridges of their own. The default setting is 0 and the valid range is 0 to 15.

This setting must be set to the same value for the brouters that will be communicating together. Failure to set them to the same value will prevent any communications from taking place. For example, in order to use a multipoint link, you must use the same Network ID setting on the base station (SPEEDLAN 4100) and on the CPE brouter (SPEEDLAN 4200).

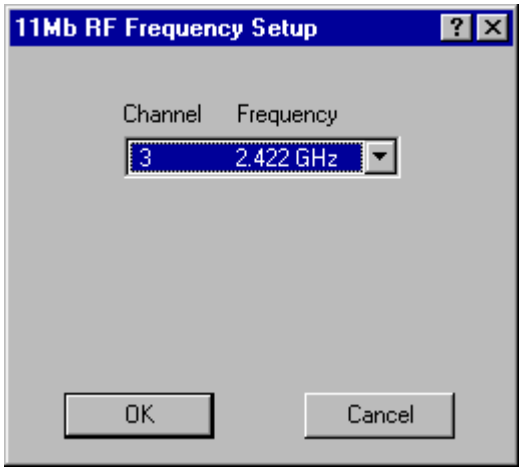
- Rate
  This setting refers to the RF data rate. The SPEEDLAN 11 Mbps radios have four data rates that can be used:
  - *High*
    This is the full 11 Mbps data rate. The interface default to this value and it is recommended that you operate using it for most installations. The receiver sensitivity of the radio with this setting is -82 dBm.
  - *Medium*
    This setting limits the card to providing 5.5 Mbps of bandwidth. The receiver sensitivity of the radio with this setting is -85 dBm.

- *Standard*
  This setting limits the card by providing 2 Mbps of bandwidth. The receiver sensitivity of the radio with this setting is -89 dBm.
- *Low*
  This setting limits the card by providing 1 Mbps of bandwidth. The receiver sensitivity of the radio with this setting is -92 dBm.

Warning: This setting must be set to the same value for the brouters that will be communicating together. Failure to set them to the same value will prevent any communications from taking place.

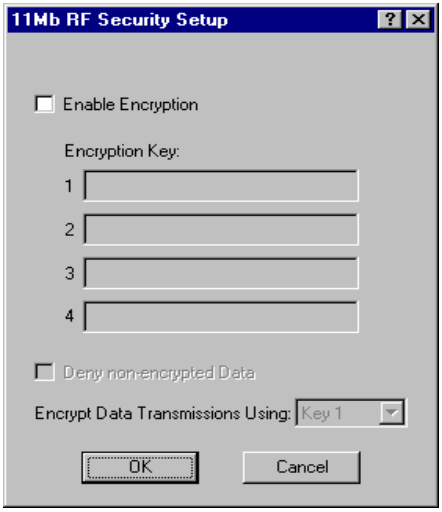
Frequency Button - 11 Mb Frequency Setup

The Frequency button is located to the right of the Advanced button. Clicking this button will open a new dialog box that allows you to change the operating frequency of the interface. All of the brouters expected to communicate with this device must be configured with the same frequency.



Security Button - 11 Mb RF Security Setup

The Security button is located to the right of the Frequency button. Clicking this button will open a new dialog box that allows you to change the security options of the interface. These settings are used to encrypt data that will be transmitted by the 11 Mb RF port and also to decrypt data that is received by 11 Mb RF port. You may define up to 4 encryption keys to be used for decrypting incoming data and one key for encrypting outgoing data.



Check the box labeled Enable Encryption to enable the encryption features. You will still need to define at least one encryption key before your wireless traffic will be transmitted using wireless data encryption.

The Encryption Key can be defined using either:

- 5 alphanumeric characters in the range of "a-z", "A-Z", and "0-9"
- A 10 digit hexadecimal value using the range "A-F" and "0-9". If you choose to use the hexadecimal method, use the prefix "0x" (zero, x) in defining the key

Examples:

- Alphanumeric: a5F2z
- Hexadecimal: 0xA95F2BR39K

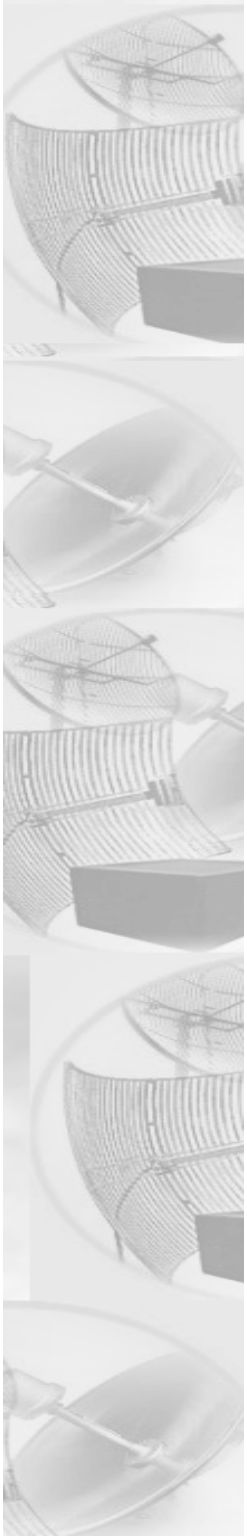
Write down the values you enter as Encryption Keys and store them in a secure place. The values you enter will only be visible when they are entered for the first time. Each time this option is displayed after the initial setup, the values will appear only as "xxxxxxxxxx"

Warning:

This setting must be set to the same value for the brouters that will be communicating together. Failure to set them to the same value will prevent any communications from taking place. For example, in order to use a multipoint link, you must use the same Encryption setting on the base station (SPEEDLAN 4100) and on the CPE brouter (SPEEDLAN 4200).

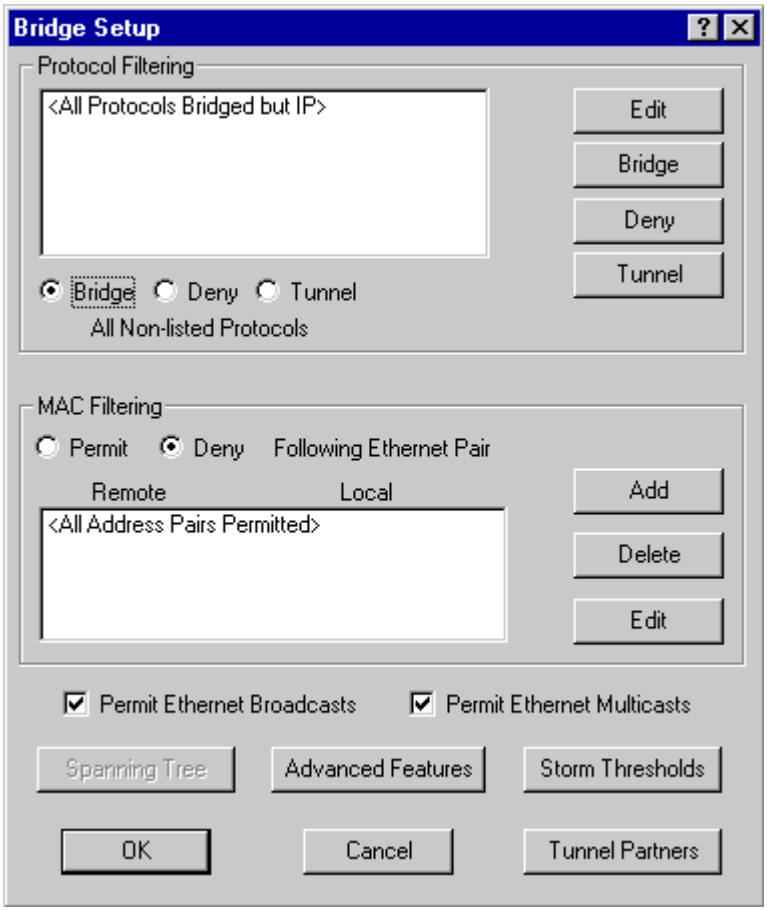
There is also an option to Deny non encrypted Data. This feature is disabled by default and is designed primarily for multipoint SPEEDLAN installations where it may not be necessary to run using data encryption at all locations. If you enable this option, any data received by this brouter will not be passed to the wired network interface.

Chapter 6
Bridging Setup



Bridge Setup

Each SPEEDLAN brouter contains an IEEE 802.3 MAC-layer bridging engine. The bridge can be configured to filter or pass any 802.3 frame type protocols, including Novell IPX, TCP/IP, AppleTalk, etc. The brouter can also be configured to filter packets by their destination and origin. This is done using the unique MAC (Media Access Control) addresses that all network interface devices have assigned to them at the factory. Bridge Setup is accessed from the main Setup menu of the SPEEDLAN Configurator.

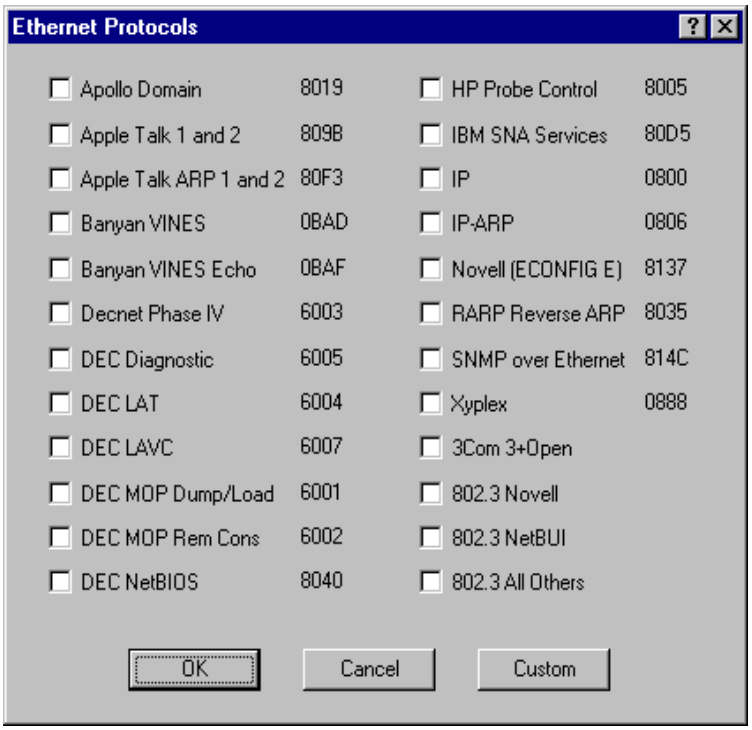


Protocol Filtering

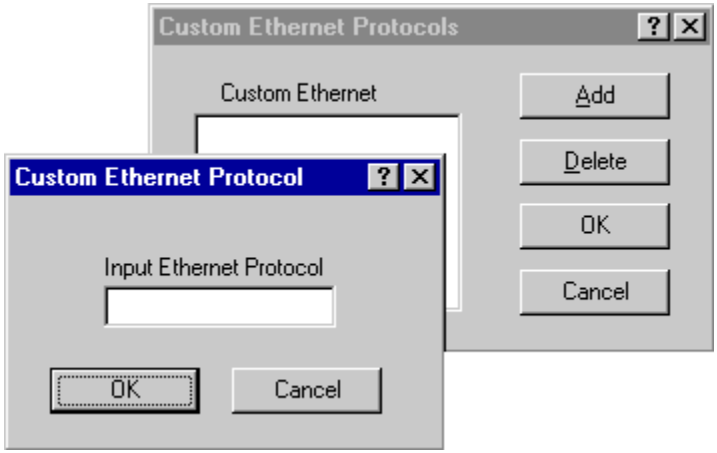
By default, the brouter is configured to pass all network protocols. When you click Edit, you will be presented with a list of protocols which you can select for filtering. After selecting the protocols, highlight them on this dialog box. Then, click Bridge or Deny to determine how each protocol will be treated. The radio buttons in the Protocol Filtering box determine how unselected protocols are treated.

Edit Button - Ethernet Protocols

Some common Ethernet protocols and their associated ID numbers have been placed in this table. Select one from this list if you want to set a filter for it.

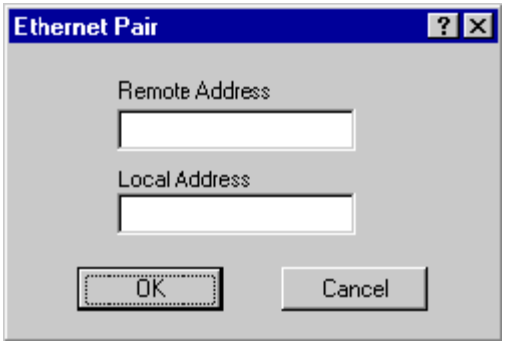


If the protocol you want to filter is not presented here, click Custom, Add and enter the hex ID for that protocol.



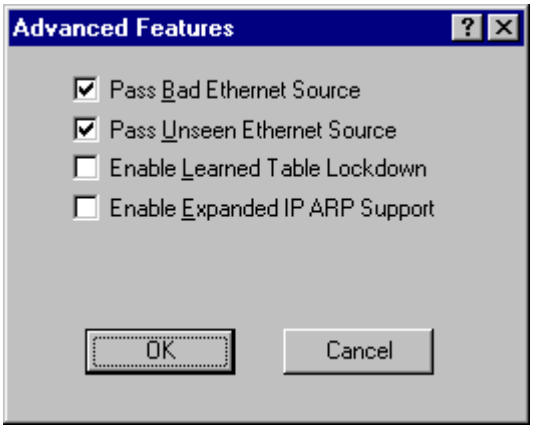
MAC Filtering

By default, the brouter is configured to pass all traffic between all MAC-Address pairs. To add an address pair into the filter, click Add on the MAC Filtering box. First, enter the Remote Address, which will be the MAC Address that resides on the remote side of the brouter. Second, enter the Local Address, which will be the MAC Address that resides on the local side of your connection. The local and remote interfaces are defined on either the Interface Setup or Advanced Interface Setup dialog box. It is recommended that you define the RF port as the Remote Interface (default setting).



Advanced Features Button

Clicking Advanced displays this dialog box. Select the appropriate check box for your network. The check boxes are described below:



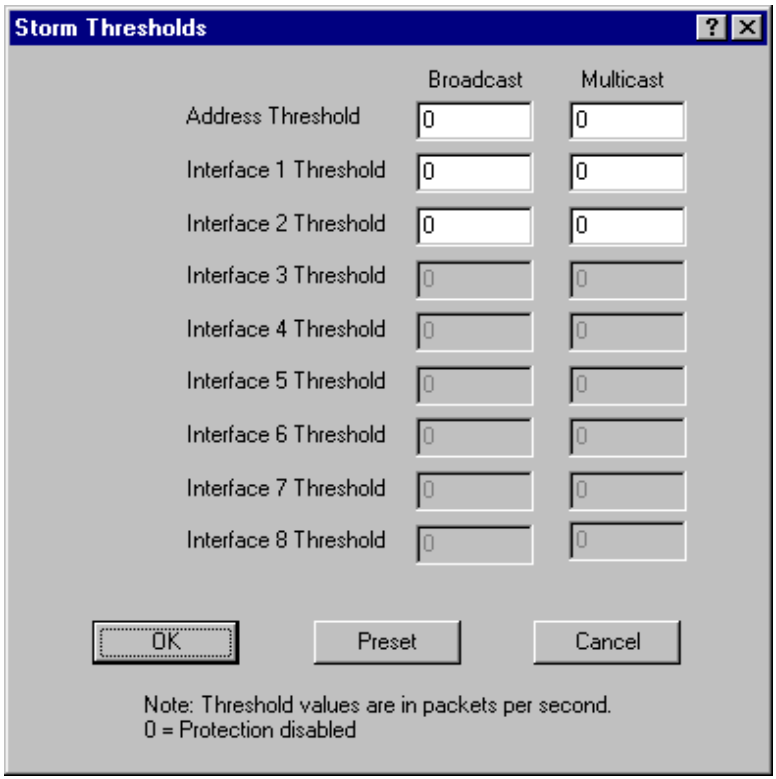
- Pass Bad Ethernet Source
  The standard Ethernet bridges we have tested will pass Ethernet packets with a broadcast or multicast address as their source (i.e., packets with their first bit set to 1). The Ethernet specification for Transparent (i.e. Non-Source-Routing) bridges does not allow these types of packets, which are considered bad packets. Our studies have shown that a common failure mode of many Ethernet interfaces and networking software is to transmit packets like these. If you do not need to permit Source-Routing packets, we suggest that you deny these packets. The default setting is selected to permit these packets.
- Pass Unseen Ethernet Source
  Standard Ethernet bridges will always forward packets with destination addresses that have not been learned (i.e., have not previously been seen as a source address of a packet). This characteristic is needed in order for the Ethernet bridge to operate correctly. The downside to this, as our studies have shown, is the failure mode of many Ethernet interface cards will send out erroneous packets with good CRCs but with random Ethernet destination and source addresses. Standard bridges will permit these erroneous packets because they have not "learned" the random destination, and then add this packet's random source address to their finite learned table. This situation is not uncommon and can greatly hinder the operation of standard bridges. If you choose to deny unlearned packets, the brouter will not forward unicast packets to Ethernet addresses that have not already been seen as a source address. This scheme works for most protocols because it relies on the characteristics of most upper-layer protocols to transmit ARP requests or hello packets. After careful testing and consideration, only qualified network engineers should select the Deny option. The default value for this setting is selected.

- *Enable Learned-Table Lockdown*
  A standard bridge watches the source address of each packet it receives on any of its interfaces. As new addresses are seen, entries are added to the *learned table* that contains each source address and the interface number that address was received on. If a source address is later seen on a different interface, the bridge will immediately change the interface number in the learned-table entry. This condition could happen in a network that is operating well if someone moved a computer to a different part of the network. This could also happen if someone was trying to capture network packets by fooling the bridge. Enabling learned-table lockdown will prevent the interface number from being changed once the source address has been seen. A standard bridge will also time-out the learned-table records every 10 minutes. If learned-table lockdown is enabled, these records will not be timed out. Once a record is learned, it will not change or be deleted until either the bridge reboots or the learned table become completely filled and needs to be reset. (NOTE: A typical SPEEDLAN learned table can contain over 12,000 records.) The default value for this setting is disabled.
- *Enable Expanded IP ARP Support*
  Enabling this feature will cause the bridge to also watch the IP/ARP packets that occur on the network. The SPEEDLAN 4100 & 4200 brouters take no action in response to IP/ARP packets (since that is the role of an IP router) except to add the IP address to its IP/ARP table. This feature is helpful on an IP network because it will build a database of MAC-layer-address-to-IP address pairs. An SNMP monitoring program, such as the SPEEDLAN Configurator, can at any time extract this information. NOTE: 1) The IP/ARP table is never timed out in this mode. 2) This feature is not available if the brouter is routing IP. The default value for this setting is disabled.

- Permit Ethernet Broadcasts
  Standard Ethernet bridges will always forward broadcast packets. Many protocols do not use broadcasts (e.g., AppleTalk Phase II, DECnet, and others). However, IP/ARP does use broadcasts. If you do not use IP or any other protocol that requires broadcasts, you can deny them. Shutting off broadcast packets will reduce the traffic being sent across your wireless network link. This will also greatly reduce the number of interrupts that each computer connected to your network experiences. Networks with a high number of broadcasts will slow down the processing of all attached computers, even those that aren't using the network.
- Permit Ethernet Multicasts
  Standard Ethernet bridges will always forward multicast packets. Some protocols do not use multicast packets, such as TCP/IP and Novell IPX. If you do not use protocols that use multicast packets, you can drop them by disabling multicast on the brouter. This will reduce the traffic that is sent across the wireless network link. In addition, it reduces the number of interrupts that each computer connected to your network experiences.

Storm Thresholds Button

Click Storm Thresholds to keep broadcast and multicast storms from spreading throughout the network. Network storms are common and can cause bridges, routers (brouters), workstations, servers, and PCs to slow down or crash. Storms occur if network equipment is configured incorrectly, if network software is not functioning properly, or if poorly designed programs such as network games are used. These settings are disabled by default.

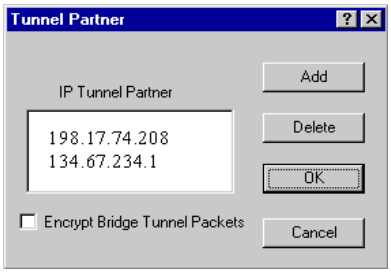


- Address Threshold
  This setting determines the maximum number of broadcast or multicast packets that can occur during a one-second period before a storm condition is declared for a particular Ethernet address (host). Once it is determined that a storm is occurring, any additional broadcast or multicast packets from that host address will be denied until the storm is determined to be over. The storm will be determined to be over when 30 seconds have passed in which every one-second period has less then the stated threshold in broadcast or multicast packets. The settings for broadcast packets and multicast packets are configured independently.

- Interface Threshold
  This setting determines the maximum number of broadcast or multicast packets that can occur during a one-second period before a storm is declared for the assigned interface. Once it is determined that a storm is occurring, any additional broadcast or multicast packets received on that interface will be denied until the storm is determined to be over. The storm will be determined to be over once a one-second period has occurred with no broadcast or multicast packets received on that interface. The settings for broadcast packets and multicast packets are configured independently.
- Preset Button
  This button sets the broadcast and multicast storm thresholds to the recommended values. These values have been determined to offer good protection without interfering with the operation of the typical network. These values may need to be tuned for your particular network.

Tunnel Partners Button

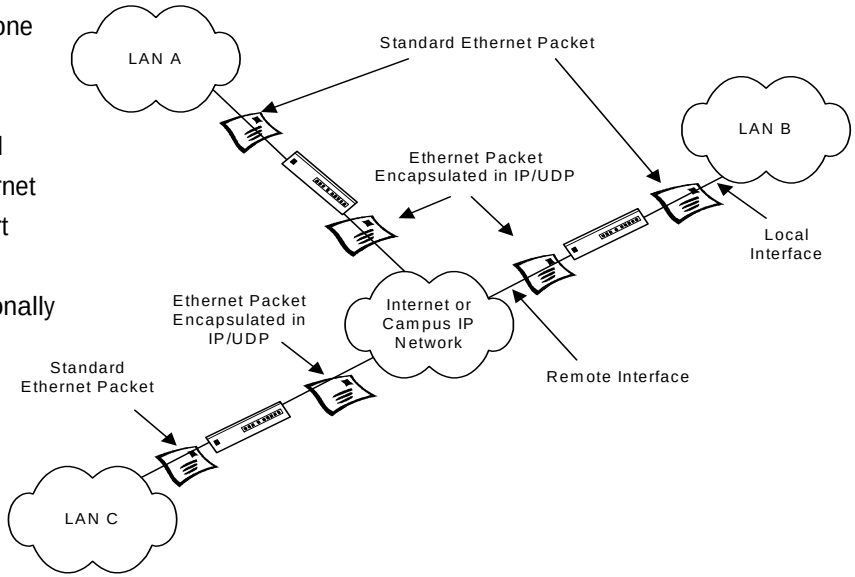
Click Tunnel Partners to encapsulate Ethernet packets received from the local interface in an IP/UDP packet and then send them to one or more tunnel partners. Tunneling can be used to set up virtual Ethernet networks. In the General Setup dialog box, if the Remote Bridging using IP Tunnels is enabled, Tunnel Partners can be set up. This dialog box specifies the IP addresses of each of the bridge/routers that are to participate in the tunnel group. Specify the addresses of all the bridges that are participating in the tunnel group but DO NOT specify the IP addresses on this brouter.



- Encrypt Bridge Tunnel Packets
  If purchased, a brouter (from Wave Wireless) may contain a special software-encryption algorithm that is distinct from the optional SPEEDLAN encryption chip on the brouter. If Data Encryption is enabled on the General Setup dialog box and if an Encryption Key is set up in the Data Encryption menu, enabling encryption here will cause all Ethernet packets transmitted to tunnel partners to be encrypted and encapsulated inside IP packets. The IP packet itself cannot be encrypted because industry-standard IP routers, like those on the Internet, would not be able to forward the encrypted packets.

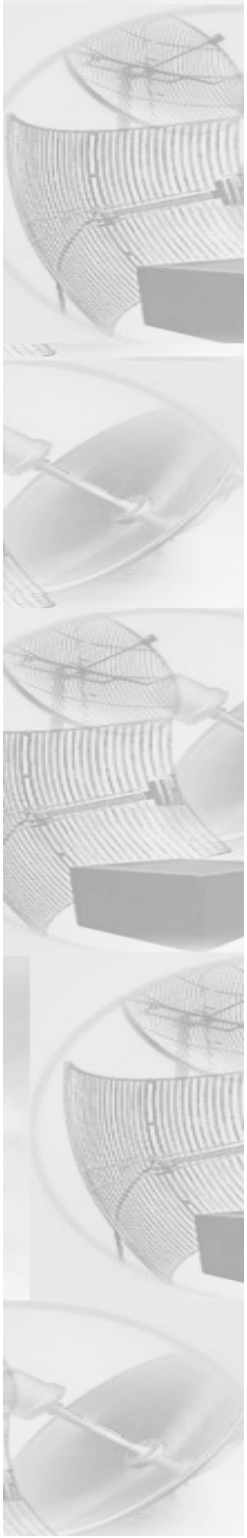
The three brouters are set up to tunnel one or more protocols and each is a tunnel partner to the other two brouters. This configuration allows LAN A, LAN B, and LAN C to become a virtual private Ethernet network with the Internet as the transport mechanism for data between them. The encapsulated data packets can be optionally encrypted to make the virtual private network more secure.

Generic Ethernet Tunneling (Through an IP Network)



Notes:

Chapter 7
Setting Up the IP Addresses (IP Host Setup)



If you do not understand the basics of IP addressing, DHCP, or NAT, please read the next section, Part I - Quick Overview of IP Addressing below. Otherwise, skip to *Part II - Setting Up the IP Address, page 7-10*.

Part I - Quick Overview of IP Addressing

IP Addressing is important because it tells the network how to locate the computers or network equipment connected to it. IP addresses are given so each computer or equipment on the network contains a unique address. In addition, network addresses and node addresses, depending on the Class (A, B, C, etc.), contain their own unique address as well. IP addressing provides the following information:

- Provides communication between different platforms and diverse systems
- Provides universal data transfer over large geographic distances
- Has been "adopted" as a standard in the computer industry

What is an IP address?

An IP address contains 32 bits of information, which is divided into the following:

- Two sections: the network address and the node address (also known as the host address)
- To keep it simple, lets call it four bytes (octets)

Note: Each octet contains 8 bits, which are equivalent to 1 byte. Each octet is separated by a period (.).

The following examples show the conversion of the same IP address into several different formats:

- Decimal (130.57.30.56)
- Hexadecimal (82.39.1E.38)
- Binary (10000010.00111001.00011110.00111000).

Internet Address Classes

The first octet defines the "class" of the address, which is the only method to tell the size of the network (how big) and where the internet address belongs. There are three main classes:

- Class A: 35.0.0.0
- Class B: 128.5.0.0
- Class C: 192.33.33.0

-non-bolded text = Part of network address
-bolded text = Part of local address (node section)

This definition is not random; it is based on the fact that routers, by reading just the first three bits of the address field, designate which network class it belongs to. This selection simplifies the way routers handle the messages (packets) and speed up the forwarding process.

In fact, IP defines five classes:

- Class A addresses use 8 bits (1 octet) for the network portion and 24 bits (3 octets) for the node (or host) section of the address. This provides up to 128 networks with 16.7 million nodes for each network.
  - First byte is assigned as network address
  - Remaining bytes used for node addresses
  - Format: network, node, node, node
  - In IP address 49.22.102.70, "49" is network address and "22.102.70" is the node address—all machines on this network have the "49" network address assigned to them
  - Maximum of 224 or 16,777,216 nodes

- Class B addresses use 16 bits (two octets) for the network portion and 16 bits for the node (or host) section of the address. This provides up to 16, 384 networks with 64,534 nodes for each network.
  - First two bytes are assigned as network address
  - Remaining bytes used for node addresses
  - Format: network, network, node, node
  - In IP address 130.57.30.56, "130.57" is the network address, and "30.56" is the node address
  - Maximum of 216 or a total of 65,534 nodes

- Class C addresses use 24 bits (3 octets) for the network portion and 8 bits (two octets) for the node (or host) section of the address. This provides 16.7 million networks with 256 nodes for each network.
  - First three bytes are assigned as network address
  - Remaining byte used for node address
  - Format: network, network, network, node
  - In IP address 198.21.74.102, "198.21.74" is the network address, and "102" is the node address
  - Maximum of 28 or 254 node addresses
- Class D
  - Range is 224.0.0.0 to 239.255.255.255
  - Used for multicast packets (i.e., host sends out router discovery packets to learn all of the routers on the network)
- Class E
  - Range is 240.0.0.0 to 255.255.255.255
  - Reserved for future use

Note: Class D & E should NOT be assigned to net assignment of IP addresses. In addition, the first octet, 127, is reserved. In each network definition, the first node number (i.e., "0") is used to define the network, as well as the last number (i.e., "255"). The last number is known as the broadcast address.

Public IP addresses can be obtained from the following address:

Network Solutions
InterNIC Registration Services
505 Huntmar Park Drive
Herndon, VA 22070
hostmaster@internic.net

Note: Non-public addresses can include a network address assigned from the network administrator or from the IP provider. Also, there is one network in each class that is defined for private use, allowing the creation of internal networks. These addresses are Class A: 10.0.0.0, Class B: 172.10.0.0, and Class C: 192.168.0.0.

Subnetting a Network

The increasing number of hosts and networks make impractical address blocks that are not smaller than 245. In order keep the IP address small, so routers can manage them without changing the whole protocol, a smaller network definition is created. This is called a subnet. Subnets are intended to:

- Reduce network traffic
- Optimize performance
- Simplify management
- Create more effective and efficient addresses for large geographic distances

Default Subnet masks

- Class A: 255.0.0.0
- Class B: 255.255.0.0
- Class C: 255.255.255.0

Note: Subnet mask is bolded.

What is a Subnet?

Subnetting allows you to create multiple networks within one Class A, B, or C network. Each data link (octet) contains its own unique identifier also known as the subnet. Also, each node on the same data link must belong on the same subnet as well.

What is a Subnet Mask?

A subnet mask allows you to mask section(s) (depending on the class specified) of the octets in the network address. Each octet used in the subnet mask is assigned to a data link. The leftover octet(s) are assigned to the remaining nodes.

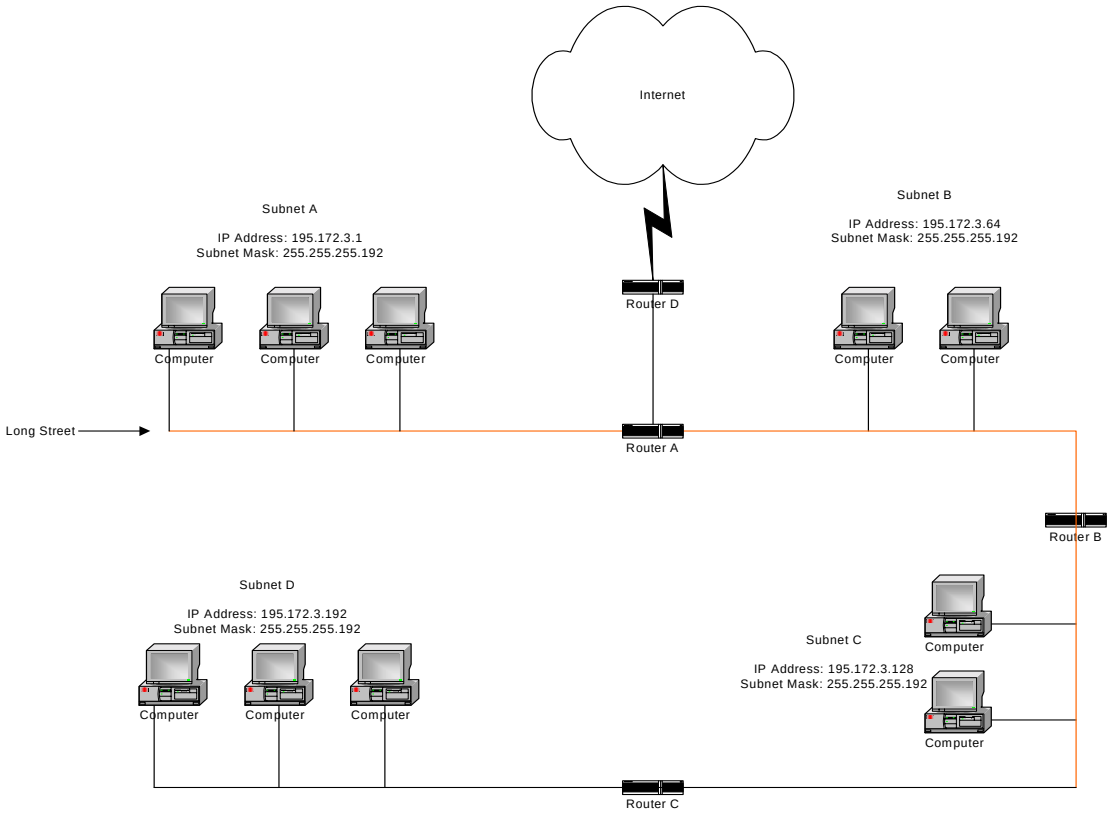
For more information on subnetting, see the example below and *Diagram of Subnetting a Network, page 7-7*.

Example of Subnetting:

For example, a Class C network (255.255.255.0) contains three masked octets (255.255.255). The last octet (0) is leftover for remaining nodes (i.e., computers).

If Router D is reading IP Addresses 195.172.3.1 (let's call this IP Address 1) and 195.172.3.64 (let's call this IP Address 2) on this Class C network, it would send IP Address 1 to Subnet A and IP Address 2 to Subnet B. The remaining nodes in each subnet (A through D) on this network can contain up to 254 pieces of network equipment (computers, printers, fax machines, bridges or routers, etc.).

Diagram of Subnetting a Network



Still confused?

An easier method to explain this concept is to use the classic "mailing" analogy used in IP addressing. Consider that this network, called Long Street, is four blocks long. There are 254 houses on Long Street, and each block contains 64 houses. Houses 1 to 63 reside on Block A. Houses 64 to 127 reside on Block B. Houses 128 to 191 reside on Block C. Houses 192 to 254 reside on Block D. Think of each block as a subnet. This means that Blocks A, B, C, and D are all part of Long Street, which is also known as the network in this example. The mailman would organize the letters (or IP addresses for network equipment) by creating four piles (one for each block, or subnet). As soon as the mailman picks up pile A in his hand, he knows which block to turn on. This same reasoning applies to piles B, C, and D as well. Router D knows exactly which subnet to transfer (or turn) the packets to by reading its IP and subnet mask address. Note that each subnet on this network is 255.255.255.192. Why is 192 the last octet in the subnet mask and not 64? The last octet, 192, is the mask that allows 64 "houses" to know that the mailman (or router) is coming in advance. The "houses" will know it's mailman "Jim" by looking at the IP number.

Note: If the network is managed by a Simple Network Management Protocol for local or Internet access, each brouter must contain a unique IP Address. This is a benefit of static or dynamic addressing.

How does a network administrator assign an IP address?

IP addresses are supplied by the network administrator, the ISP, or hosting company.

The two types of IP addressing—manual (static) and automatic (dynamic) addressing—are described below.

- Manual (static) Addressing
  Each device connected to the Internet must have its own unique IP address. Also, if a computer is being used as a server, you will assign it a permanent IP address. This enables other computers to connect to it. Static addressing is also beneficial to users that need to maintain a "constant" connection to the Internet. This will enable users to easily access the IP address.
- Automatic (dynamic) Addressing
  A DHCP (Dynamic Host Configuration Protocol) server assigns the IP address to each computer as the computer connects to the network. If a computer moves to a new network (i.e., great for temporary employees or mobile users), it must be assigned a new IP address for that network. DHCP can be used to manage these assignments automatically. DHCP is described in further detail below.

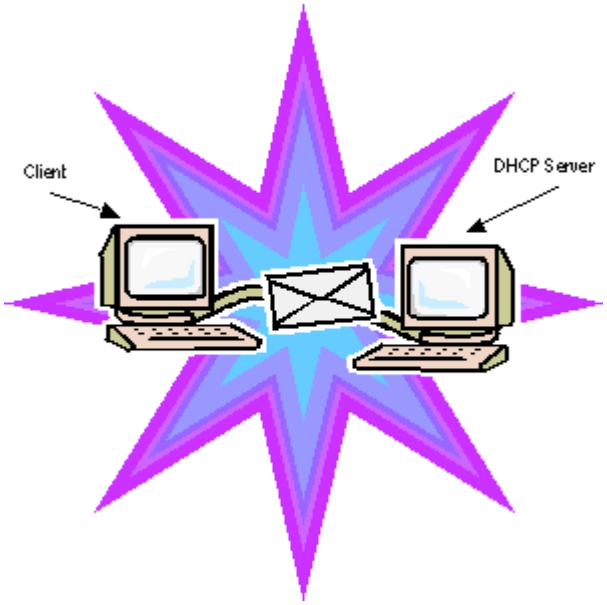
What is DHCP?

Dynamic Host Configuration Protocol (DHCP) allows network administrators to assign dynamic IP addresses for the period of time needed to connect to the Internet. Think of DHCP as leasing an apartment. A prospective tenant may not need to live in an apartment for two years, maybe just a year. Therefore, the tenant will only sign a one-year lease agreement. For example, each time a computer is set up to connect to the Internet, the network administrator uses DHCP to automatically assign the computer a unique IP address. That computer will give up its IP address when it is no longer needed (when the lease has ended) allowing new a computer (or a new tenant) on the same network to use it. This benefits educational and corporate settings where users often log on to different computers. In this case more IP addresses outnumber computers because you can quickly reconfigure the network if needed from a centralized location.

Servers that utilize DHCP resolve security issues, costly IP addressing services, and compatibility problems. DHCP is an alternative to BOOTP, which reduces the agony of assigning static IP addresses and also provides advanced configuration options.

Note: The figure on the next page may help you understand how DHCP assigns an IP address.

Figure of DHCP Addressing



1 The client asks DHCP server for IP address and configuration if needed.
2 The DHCP server assigns an available IP address to client.
3 The client takes IP address from DHCP server and requests any additional configuration needed.
4 DHCP server confirms IP address and configuration.

What is NAT?

Network Address Translation (NAT) is the conversion of an Internet Protocol address (IP address) used within one network to a different IP address within another network. One network is designated the inside network and the other is the outside network.

Network Address Translation (NAT) occurs when there is a translation among an Internet Protocol (IP address) used within one network (designated as inside network) to a different IP addresses within another network (designated as outside network). Network Address Translators (NATs) allow companies to decrease the number of global IP addresses. This enables companies to communicate with other devices on the Internet using a single IP address (or more than one IP address).

For example, a company can provide its clients with one IP address, allowing access to the company's firewall only. This IP address is not a "real" address on the company's internal network, but it is successfully translated to the correct IP location through NAT (i.e., NAT router). Therefore, the company controls access through firewalls and provides multiple IP addresses to outside customers without excessive limited resources, or "global" Internet IP protocols.

Part II - Setting Up the IP Address

Note: Before you begin, confirm that you have properly read the configuration from the SPEEDLAN brouter you want to configure. Then, perform the following tasks: Open the SPEEDLAN Configurator. From the File menu, choose Open Remote Config.... Then, click Scan. The Scan dialog box appears. Select the appropriate brouter and click OK. Click OK again. A message box appears confirming that the "Configuration has been read from the Bridge" (i.e., 128.104.224.1). Click OK.

To set up the IP address, do ONE of the following:

- Enable DHCP client for dynamic addressing. For more information, see *Enabling the DHCP Client and Choosing the Appropriate Interface, page 7-11*,

OR

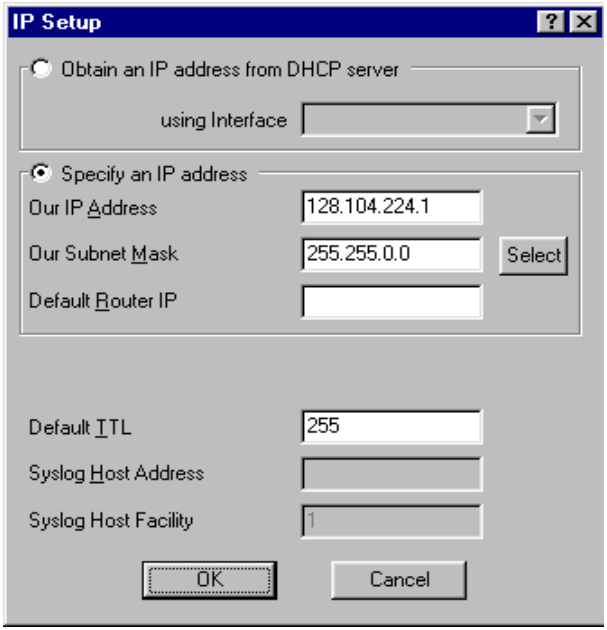
- Assign a static IP address. For more information, see *Assigning a Static IP Address, page 7-12*.

Enabling the DHCP Client and Choosing the Appropriate Interface

Note: Before you begin, confirm that you have properly read the configuration from the SPEEDLAN brouter you want to configure. Then, perform the following tasks: Open the SPEEDLAN Configurator. From the File menu, choose Open Remote Config.... Then, click Scan. The Scan dialog box appears. Select the appropriate brouter and click OK. Click OK again. A message box appears confirming that the "Configuration has been read from the Bridge" (i.e., 128.104.224.1). Click OK.

To enable the DHCP client and choose the appropriate interface, do the following:

1 From the Setup menu, choose IP Setup. The IP Setup dialog box appears.



2 Select the Obtain an IP address from DHCP Server option.

3 Next, select the interface for Ethernet or wireless network from the Using Interface drop-down list. Make sure that you select the interface where the DHCP server is located.

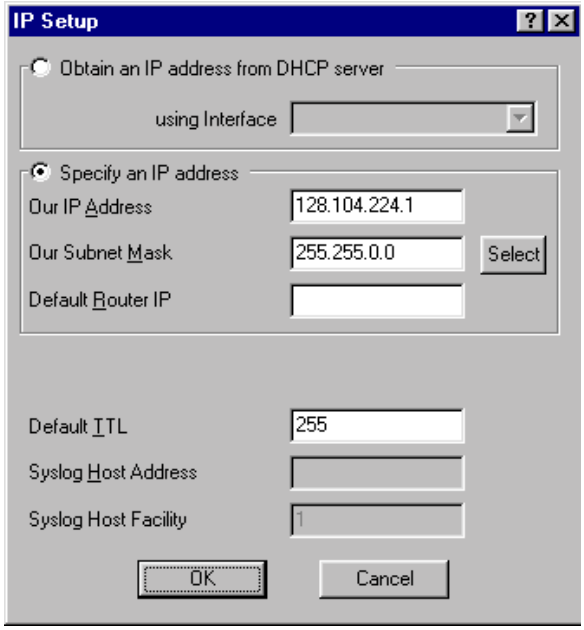
Note: The information for Default TTL should already be entered. The IP host on the Internet sends out each packet with a default "Time to Live" parameter. If you want to override the factory default of 64 attempts, you can specify your new default here. This parameter should not be changed less you are very familiar with IP functionality and how the Time to Live parameter will affect how packets are treated by your network, as well as the network to which you are bridged (or routed).

Assigning a Static IP Address

Note: Before you begin, confirm that you have properly read the configuration from the SPEEDLAN brouter you want to configure. Then, perform the following tasks: Open the SPEEDLAN Configurator. From the File menu, choose Open Remote Config.... Then, click Scan. The Scan dialog box appears. Select the appropriate brouter and click OK. Click OK again. A message box appears confirming that the "Configuration has been read from the Bridge" (i.e., 128.104.224.1). Click OK.

To assign a static IP address, do the following:

1 From the Setup menu, choose IP Setup. The IP Setup dialog box appears.



2 Select the Specify an IP address option. Enter the following information:

- Our IP Address
  The unique number assigned by the network administrator, ISP or host provider. This tells network the location (IP address) of the this device on the Internet (i.e., 128.104.224.1).
- Our Subnet Mask
  This term allows network administrators to mask section(s) (depending on the class specified) of the octets in the network address. Each octet used in the subnet mask is assigned to a data link. The leftover octet(s) are assigned to the remaining nodes.

Note: For more information, see *Subnetting a Network, page 7-5*. Once the packet has traveled to the appropriate network, it goes through a masking process. A subnet mask is composed of zeros (0s) and ones (1s). This tells the router which addresses to look under and which ones not to look under. Therefore, subnet masking allows the router to transfer the packet traffic more quickly than a network without a subnet. Again, this address is obtained from the network administrator, IP host, or host provider.

- Default Router IP
  If you have an established network, use the IP address for the router already set up for that network. If you do not have an established network, leave this entry blank.
- Default TTL
  This information should already be entered. The IP host on the Internet will send out each packet with a default "Time to Live" parameter. If you want to override the factory default of 64 attempts, you can specify your new default here. This parameter should not be changed unless you are very familiar with IP functionality and how the Time to Live parameter will affect how packets are treated by your network, as well as the network to which you are bridged (or routed).

Note: Click Select to view the IP Mask List. Select the appropriate IP Mask and click OK.

3 After you have finished entering the appropriate information, click OK.

4 Now save the changes to the brouter. From the File menu, choose Save Config.

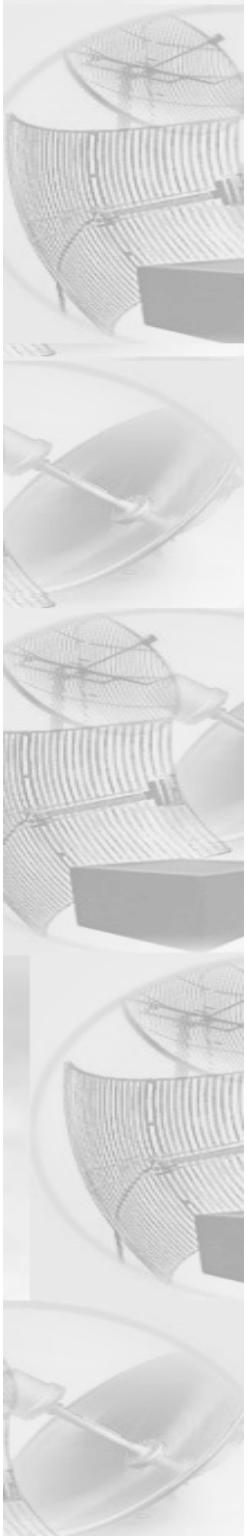
5 A message box appears informing you that the information will be saved to the brouter (i.e., 128.104.22.4). Click Yes.

6 The Configurator confirms that the configuration has been saved. Click OK. The computer will reboot at this point.

Note: You are finished with this section.

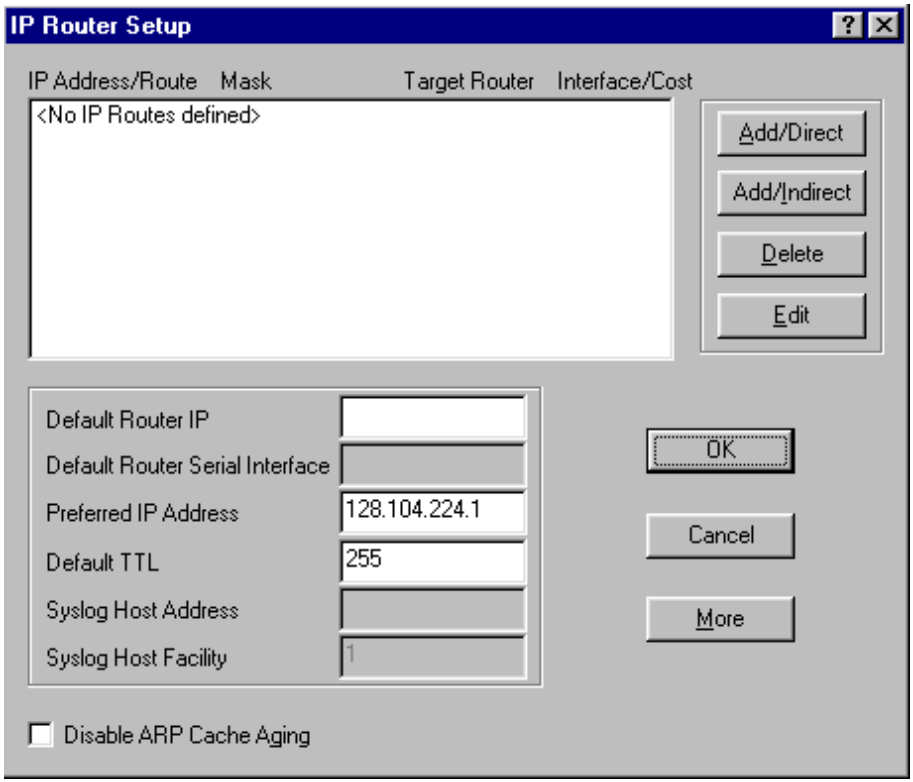
Notes:

Chapter 8
IP-Router Setup



IP Routing Setup

IP Routing in the General Setup dialog box must be enabled for this dialog box to appear. Then, choose IP Routing Setup from the Setup menu on the SPEEDLAN Configurator. This dialog box must be completed before saving any configuration in which IP Routing has been enabled. Saving the configuration with incomplete entries in the route table will render the SPEEDLAN 4100 & 4200 inoperable. Enter the appropriate information as described below:

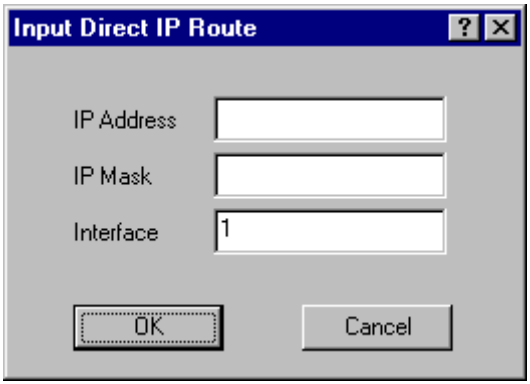


- Default Router (IP Address)
  This entry should be set to the IP address of the default router that the SPEEDLAN 4100/4200 is to use when it does not know where to route a particular IP packet.
- Default Router Interface
  This entry should be set to the interface to which the default router is connected.
- Preferred IP Address
  From time to time routers will transmit unsolicited IP packets such as SNMP Traps, Syslog, RIP, or IP ARP packets. Most routers randomly use one of the IP addresses from one of the router's interfaces as the source IP address for these packets. On the brouter you can specify the source IP address that you prefer to use for these packets.

- Default TTL
  IP hosts on the Internet send out packets with a default "Time To Live" parameter. If you want to override the factory default of 64 attempts, specify your new default value here.
- Disable ARP-Cache Aging
  Use this option if you want to keep a permanent record of the IP to Ethernet addresses table for each computer directly connected to an interface on the brouter. This feature is helpful when used in conjunction with a corporate-wide SNMP monitoring tool to create a database of all Ethernet-to-IP address combinations on your network. A standard IP router and the bridge will age their ARP cache entries. It will time out and delete the ARP entries after a certain specified period (usually 10 minutes). The brouter has the option of not aging (deleting) any ARP cache entries. This will not normally cause any IP network problems, but this could result in a large ARP cache table. Since the typical brouter can hold over 10,000 ARP entries, this is not normally a problem.

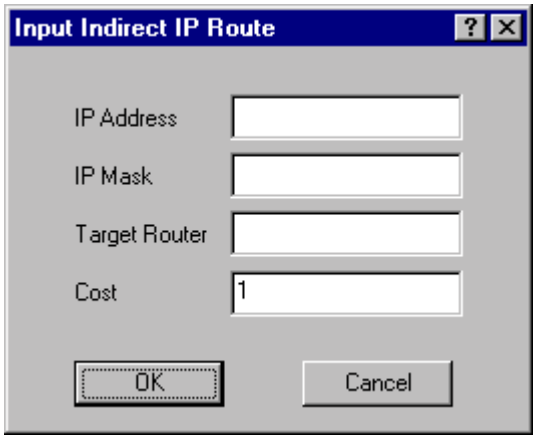
Add/Direct Button

Click this button to specify the direct routes for each of the interfaces on the brouter. Direct routes are those that are directly connected to the interfaces. As an example, if Interface 1 is to have subnet 128.146.6.0 connected to it and an IP address of 128.146.6.1 with a subnet mask of 255.255.255.0, an entry in this dialog box should be set up as: IP Address = 128.146.6.1; IP Mask = FFFFFF00; and Interface = 1.



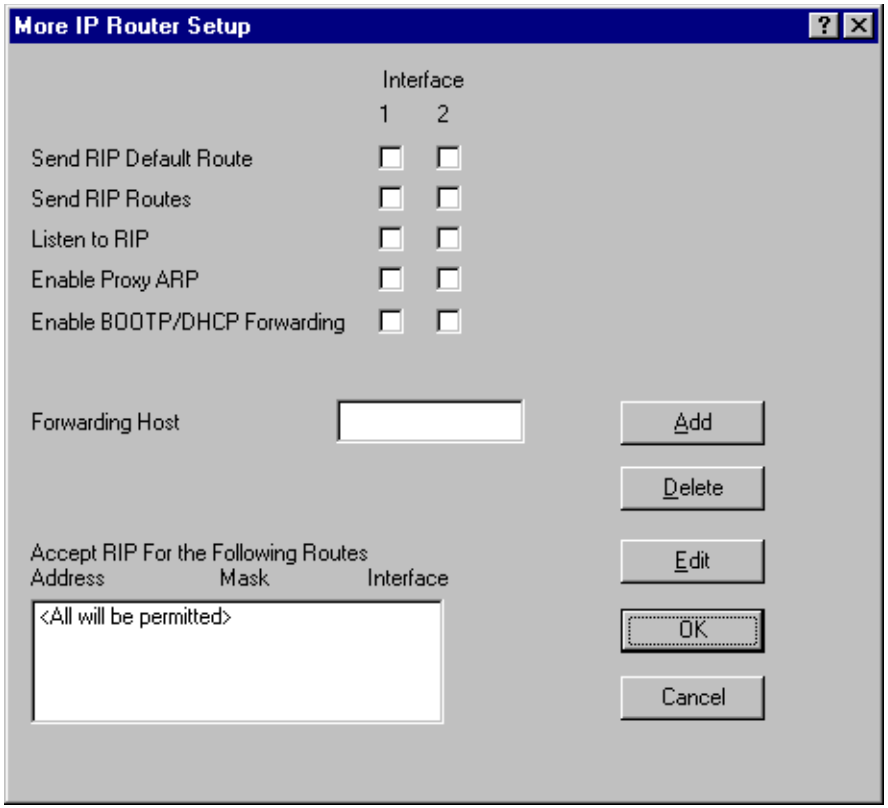
Add/Indirect

Click this button to specify the indirect routes for this brouter. These routes are sometimes referred to as static routes. You can use indirect routes to define the way to get to subnets that are attached to other routers in your network. As an example, if subnet 198.17.74.0 is attached to router 128.146.11.20, in order for this brouter to route packets to 198.17.74.1 you should specify an entry that is set up as: IP Address = 198.17.74.0; IP Mask = FFFFFF00; Next Hop = 128.146.11.20 with Cost = 1.



More Button - RIP Routing

Click this button on the IP Router Setup dialog box to enable RIP. Wave Wireless brouters support what is known as RIP (Routing Information Protocol). RIP allows users to permit network equipment to communicate with each other to handle the routing plan of your network. Select the appropriate check boxes as described below:



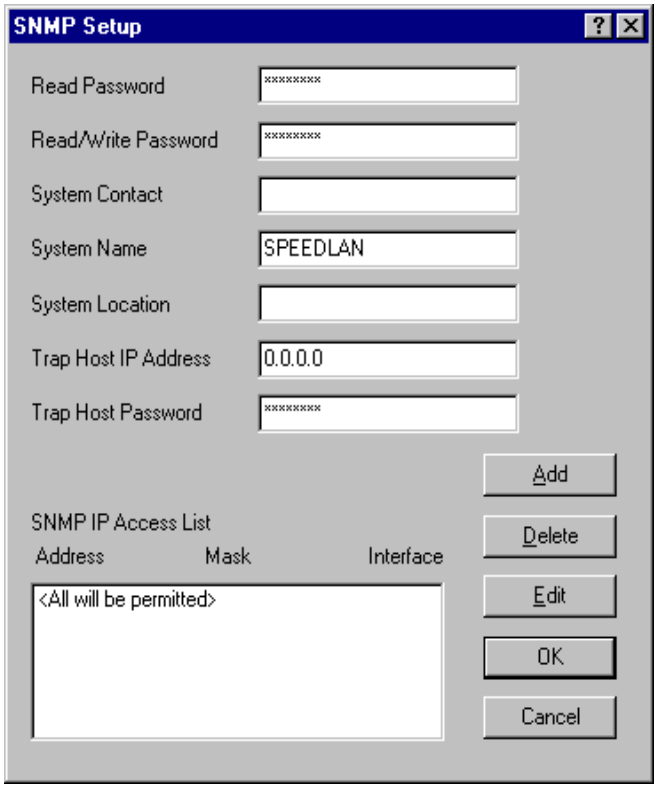
- Send RIP Default Route
  Enabling this feature instructs the brouter to inform the network (via RIP) that it is the default router for that network. This feature should only be enabled if this brouter is the only default router on the local network.
- Send RIP Routes
  Enabling this feature instructs the brouter to forward all route information gathered and stored by this brouter through the interface(s) selected. This is normally used in conjunction with Listen to RIP which instructs the brouter to gather RIP information from other RIP devices on your network.

- Listen to RIP
  This function enables the brouter to listen for and update its RIP information. The routes gathered in this manner come from other RIP-enabled routers on your network. This feature is normally used in conjunction with Send RIP Routes, which instructs the brouter to pass along all RIP information it has gathered to other RIP devices on your network.
- Enable Proxy ARP
  This feature allows the brouter to be used as the proxy host for users on the local network. This instructs the brouter to act as a "proxy" for the local destination host. This is used in circumstances that require connections not normally permitted for individual users on a network.
- Enable BOOTP/DHCP Forwarding
  This feature allows the brouter to pass BOOTP and DHCP requests across the wireless network.
- Forwarding Host
  Defines the IP address of the device configured to act as the forwarding host for BOOTP and DHCP messages in a routed network.
- Accept RIP For the Following Routes
  Normally RIP instructs the brouter to forward all route information gathered to all RIP devices located on you network. Specifying devices in the RIP Access List allows you to limit which devices will be sent RIP. The devices specified in this list will be the only devices to receive RIP, while all other devices will be denied the RIP information stored on this brouter.

Chapter 9
SNMP Setup

SNMP Setup

Choose SNMP Setup from the Setup menu of the SPEEDLAN Configurator to set up SNMP.



- Read Password
  This is the read-only password used for SNMP support. It is the SNMP password needed to read the Flash ROM Configuration and SNMP MIB variables. The factory-default value for this variable is the string "public".
- Read/Write Password
  This is the read/write password used for SNMP support. It is the SNMP password needed to write the Flash ROM configuration and SNMP MIB variables into the brouter. The string should be set to a value that is known only by you. The factory-default value for this variable is the string "public" and should be changed to a string known only to you.
- System Contact
  This field should contain the identification of the contact person for this SNMP-managed node, together with information on how to contact this person.

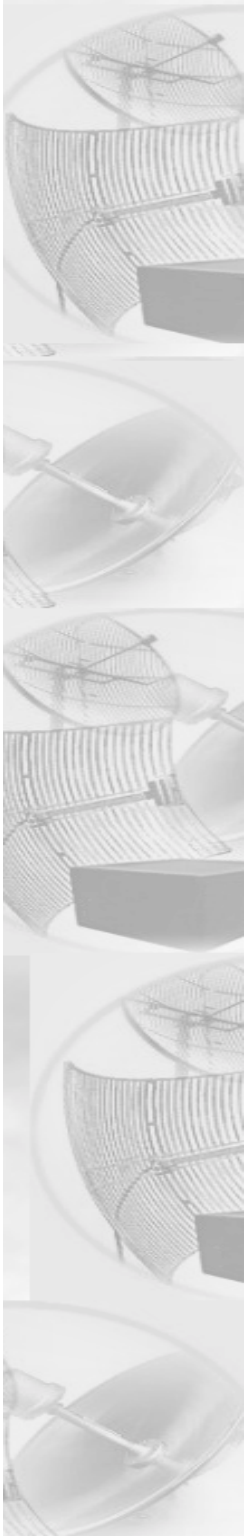
- System Name
  This field should contain the administratively assigned name for this managed node. By convention, this is the node's fully qualified Internet Domain name (e.g., "bridge20.speedlan.com").
- System Location
  This field should contain the physical location of this node. (e.g., "telephone closet, 3rd floor").
- Trap Host IP Address
  This is the IP address of a network-connected host that is set up to receive SNMP Trap messages from this brouter. If you do not have an SNMP Trap Host, set this to 0.0.0.0.
- Trap Host Password
  This is the SNMP read/write password (community name) of the host that is set up to receive SNMP Trap messages. This field is ignored if the Trap Host IP Address described above is 0.0.0.0.
- SNMP IP Access List
  You can optionally set up a list of networks, subnets, and hosts that are authorized to access the brouter via SNMP.

TIP

To modify the SNMP Access List, click Add, Delete, or Edit.

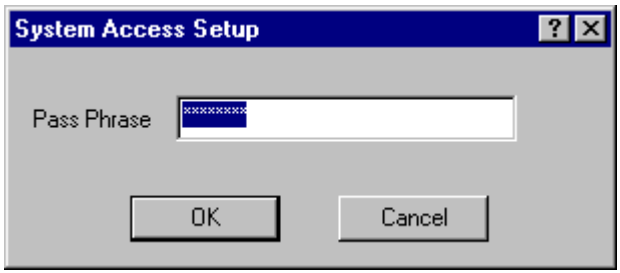
Note:

Chapter 10
System Access Setup



System Access Setup

Choose System Access Setup from the Setup menu of the SPEEDLAN Configurator to enter a password for the System Access Pass Phrase. This will enable you to create a connection between the equipment or wireless brouters. The default for the Pass Phrase is "public".



All wireless units connected to the brouter are restricted to systems based on the System Access Pass Phrase. Any wireless brouter that does not have the correct System Access Pass Phrase will not be to establish a wireless data connection.

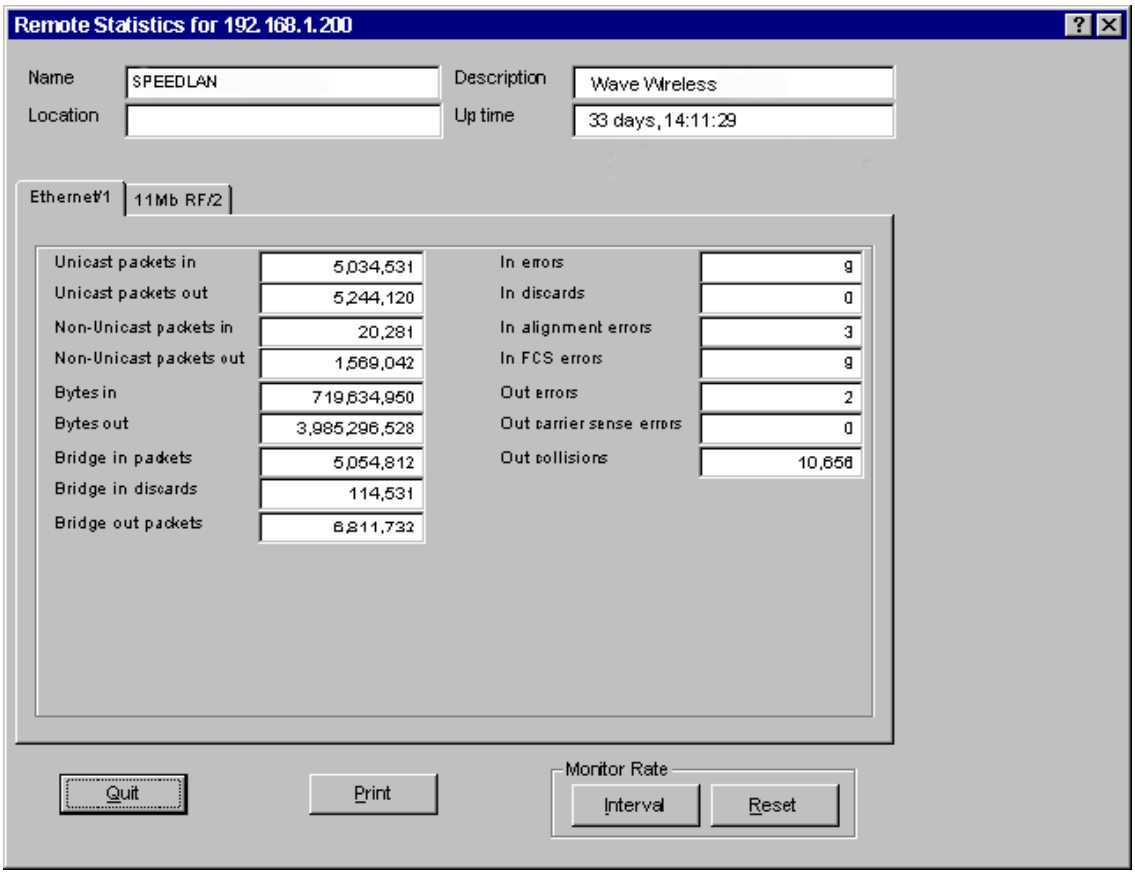
Chapter 11
SNMP Monitoring

TIP

To monitor the SNMP results, choose the appropriate selection by choosing Monitor (on the SPEEDLAN Configurator) + Advanced + your selection.

Remote Statistics

In the Remote Statistics dialog box, you are presented with information regarding the way a brouter handles packets as they are passing through an interface. Below you will find many useful items for diagnosing and gathering traffic statistics for each interface.

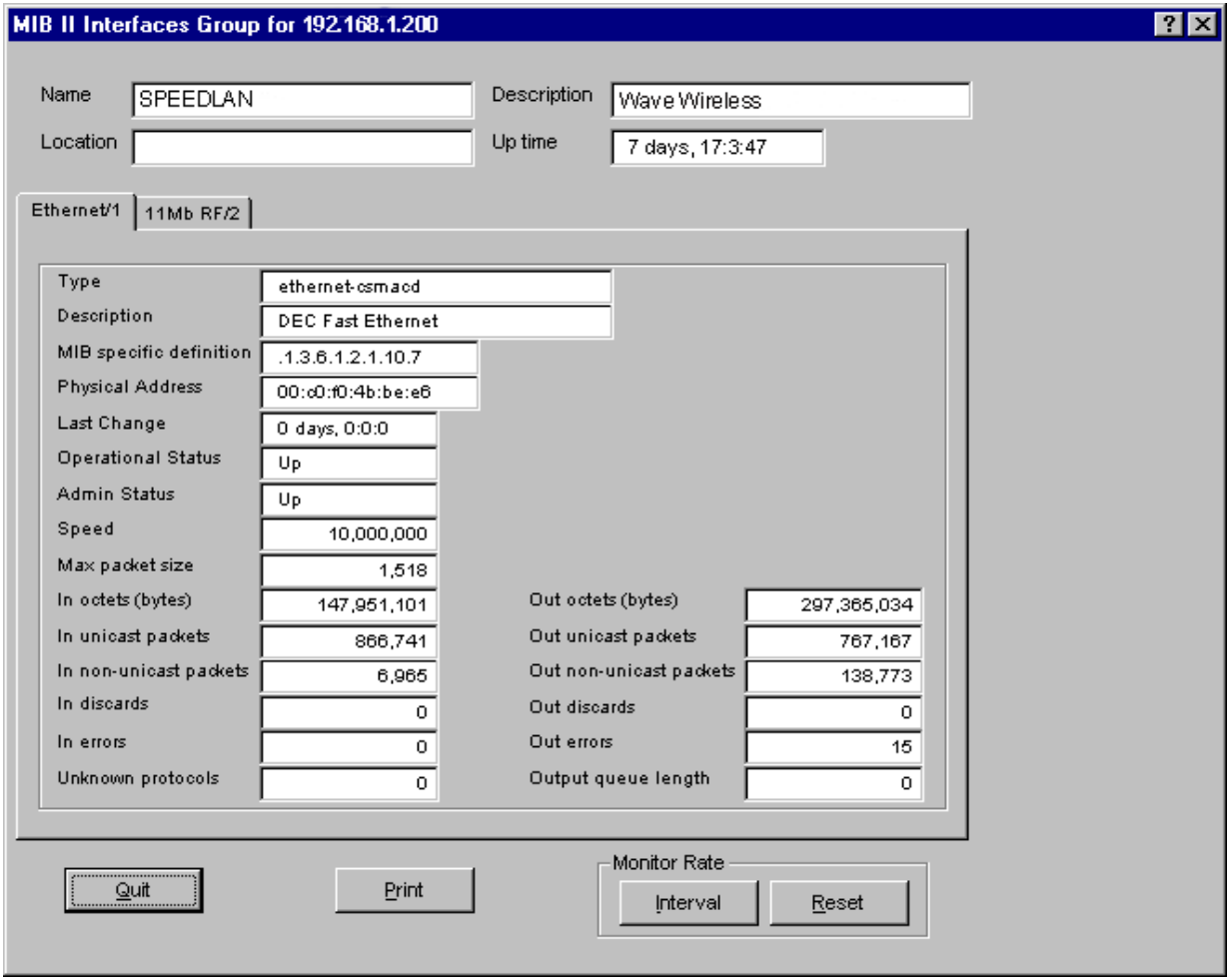


- Unicast packets in
  The number of subnetwork-unicast packets delivered to a higher-layer protocol.
- Unicast packets out
  The total number of octets (bytes) transmitted out of the interface, including framing characters.
- Non-Unicast packets in
  The number of non-unicast (i.e., subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher-layer protocol.
- Non-Unicast packets out
  The total number of octets (bytes) transmitted out of the interface, including framing characters.
- Bytes in
  Total number of octets (bytes) received on the interface, including framing characters.
- Bytes out
  The total number of packets that have higher-layer protocols requested be transmitted to a non-unicast (i.e., a subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.
- Bridge in discards
  The count of valid frames that have been received which were discarded (i.e., filtered) by the forwarding process.
- Bridge out packets
  The number of frames that have been transmitted by this port to its segment. Note that a frame transmitted on the interface corresponding to this port is not counted by this object unless it is for a protocol being processed by the local bridging function.
- In errors
  The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
- In discards
  The number of inbound packets which were chosen to be discarded even though they were deliverable. One possible reason for discarding such a packet could be to free up buffer space.
- In Alignment Errors
  A count of frames received on a particular interface that are not an integral number of octets in length and do not pass the FCS check.

- In FCS Errors
  A count of frames received on a particular interface that are an integral number of octets in length, but do not pass the FCS check.
- Out Errors
  The number of outbound packets that could not be transmitted because of errors.
- Out Carrier Sense Errors
  The number of times that the carrier-sense condition was lost or never asserted when the SPEEDLAN 4100 & 4200 attempted to transmit a frame on a particular interface.
- Out Collisions
  A count of successfully transmitted frames on a particular interface for which transmission is inhibited by exactly one or more collisions, plus the number of times that a collision is detected on a particular interface later than 512 bit-times into the transmission of a packet.

Interface Monitor

The interfaces table contains information on the brouter's interface(s). Each interface is thought of as being attached to a `subnetwork'. Note that this term should not be confused with `subnet' which refers to an address-partitioning scheme used in the Internet suite of protocols.



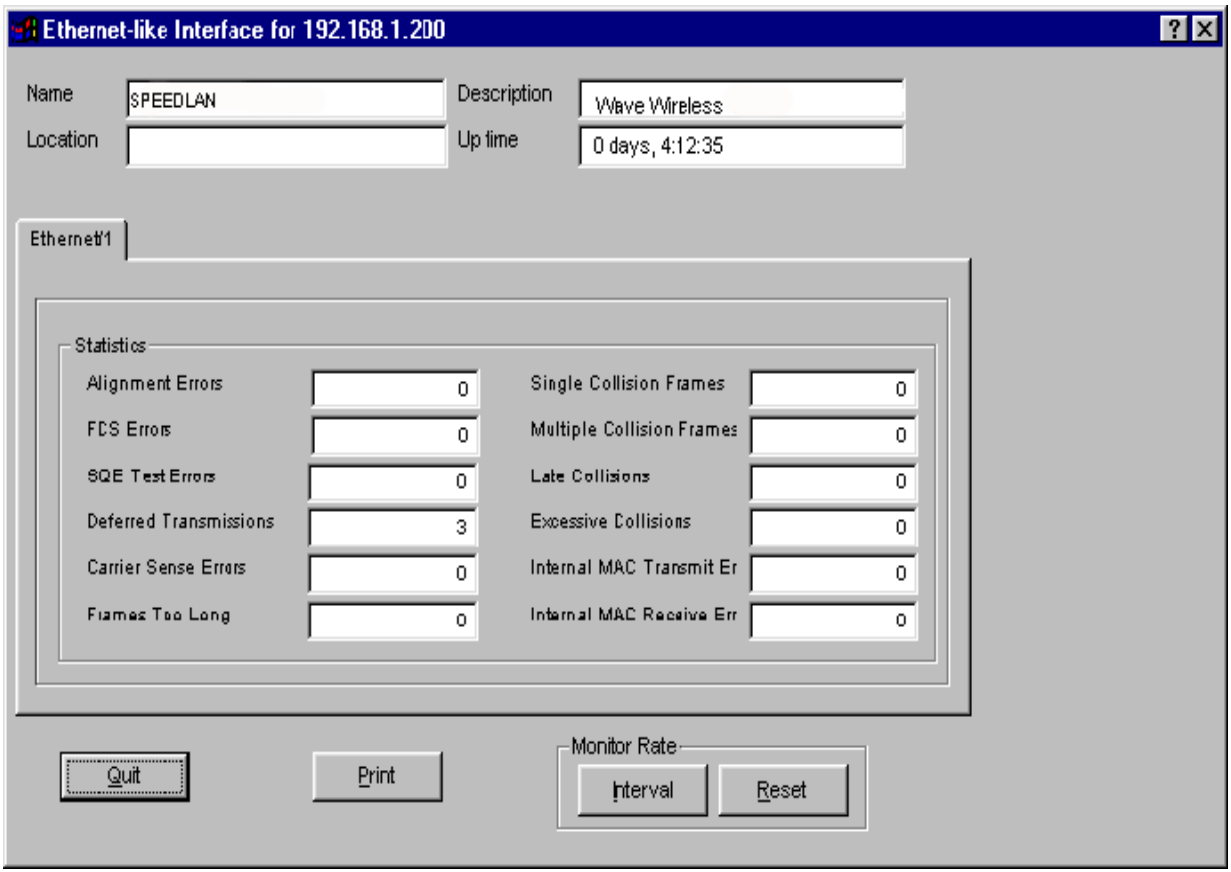
- Type
  The type of interface, distinguished according to the physical-link protocols immediately below the network layer in the protocol stack. The possible types are: other, regular1822, hdh1822, ddn-x25, rfc877-x25, ethernet-csmacd, iso88023-csmacd, iso80024-tokenbus, iso88025-tokenring, iso99026-man, starLan, proteon-10Mbit, proteon-80Mbit, hyperchannel, fddi, lapb, sdlc, ds1, e1, basicISDN, PrimaryISDN, propPointToPointSerial, ppp, softwareloopback, eon, ethernet-3Mbit, nsip, slip, ultra, ds3, sip, frame-relay.

- Description
  A textual string containing information about the interface. This string should include the name of the manufacturer, the product name, and the version of the hardware interface.
- MIB specific definator
  A reference to MIB definitions specific to the particular media being used to realize the interface. For example, if the interface is being realized by an Ethernet, then the value of this object refers to a document defining objects specific to the Ethernet. If this information is not present, its value will be set to 0.
- Physical Address
  The interface's address at the protocol layer immediately below the network layer in the protocol stack. For interfaces which do not have such an address (e.g., a serial line), this object should contain an octet string of zero length.
- Last Change
  The value of sysUpTime at the time the interface entered its current operational state. If the current state was entered prior to the last reinitialization of the local network-management subsystem, then this object contains a value of zero.
- Operational Status
  The state of the interface. The testing state indicates that no operational packets can be passed. Up - ready to pass packets; Down - cannot pass packets; testing - in some test mode.
- Admin Status
  The desired state of the interface. The testing state indicates that no operational packets can be passed.
- Speed
  An estimate of the interface's current bandwidth in bits per second. For interfaces which do not vary in bandwidth or whose bandwidth can't be accurately estimated, this object should contain the nominal bandwidth.
- Max packet size
  The size of the largest datagram which can be sent/received on the interface, specified in octets. For interfaces used for transmitting network datagrams, this is the size of the largest network datagram that can be sent on the interface.
- In octets (bytes)
  The total number of octets (bytes) received on the interface, including framing characters.
- In unicast packets
  The number of subnetwork-unicast packets delivered to a higher-layer protocol.
- In non-unicast packets
  The number of non-unicast (i.e., subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher-layer protocol.

- In discards
  The number of inbound packets to which were chosen to be discarded even they were deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
- In errors
  The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
- Unknown protocols
  The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
- Out octets (bytes)
  The total number of octets (bytes) transmitted out of the interface, including framing characters.
- Out unicast packets
  The total number of packets that higher-layer protocols requested be transmitted to a sub-network-unicast address, including those that were discarded or not sent.
- Out non-unicast packets
  The total number of packets that higher-layer protocols requested be transmitted to a non-unicast (i.e. a subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.
- Out errors
  The number of outbound packets that contained errors preventing them from being transmitted via this interface.
- Output queue length
  The total number of octets (bytes) waiting to be transmitted via this interface.

Ethernet-like Interface Monitor

This displays information on the interfaces available for the device selected for Ethernet monitoring.

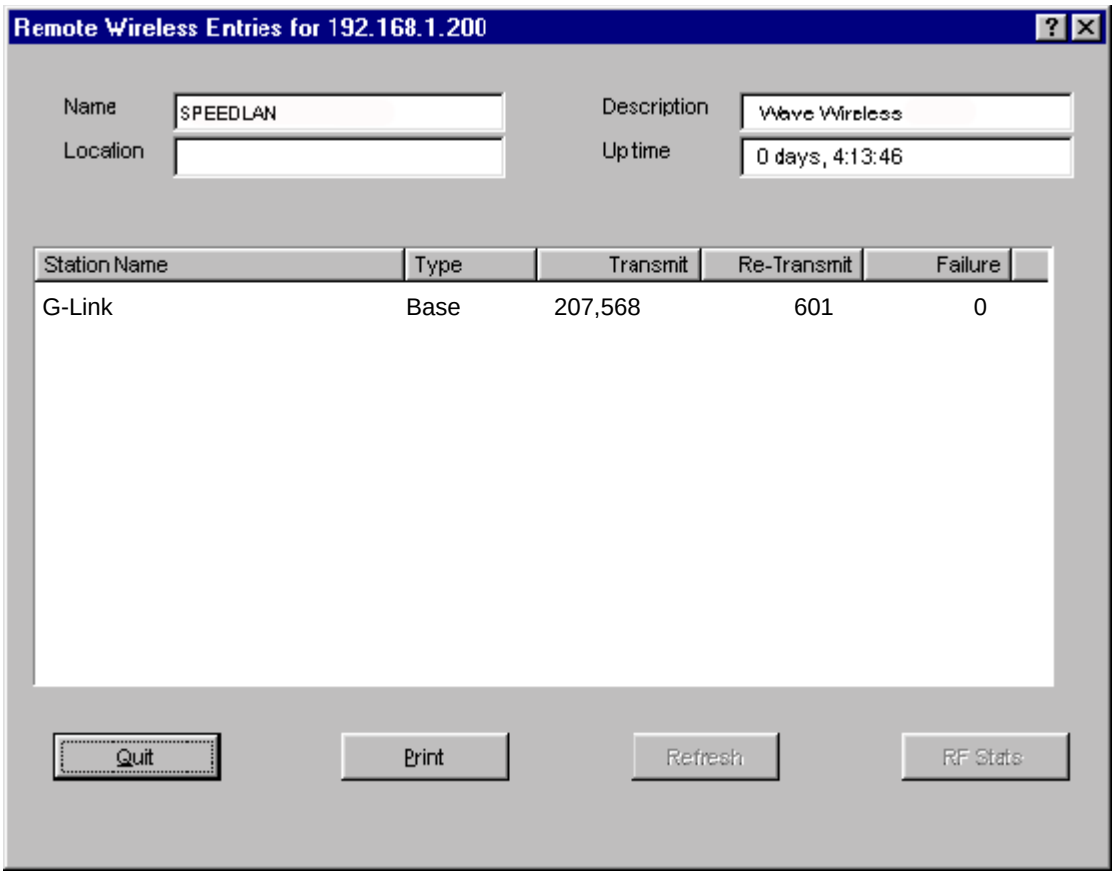


- Alignment Errors
  These alignment errors appear when the station discards the transmission alignment. Errors received on the Ethernet interface that are not an intergral number of octets in length and do not pass the FCS check. This also applies to FCS Errors below.
- FCS Errors
  These are data link protocols used with the frame check sequence, which allows the receiver to detect collisions.
- SQE Test Errors
  These test errors appear in the System Quality Evaluation process of the interface.
- Deferred Transmissions
  These are the number of packets that were tossed.

- Carrier Sense Errors
  These are errors appearing when two devices are trying to transmit at once. Therefore, a collision occurs and is detected by all sense devices, and the transmission is delayed.
- Frames Too Long
  This error appears when the data link header is too long.
- Single Collision Frames
  Packets that had a single collision during transmission requiring a single re-transmission.
- Multiple Collision Frames
  Packets that had a multiple collision during transmission requiring a multiple re-transmission.
- Late Collisions
  A packet that was not delivered to the transceiver on time.
- Internal MAC Transmit Errors
  An internal error within the Medium Access Protocol during the transmission process.
- Internal MAC Receive Errors
  An internal error within the Medium Access Protocol during the receiving process.

Campus PRC Station Entries

This displays the wireless stations connected to the brouter.

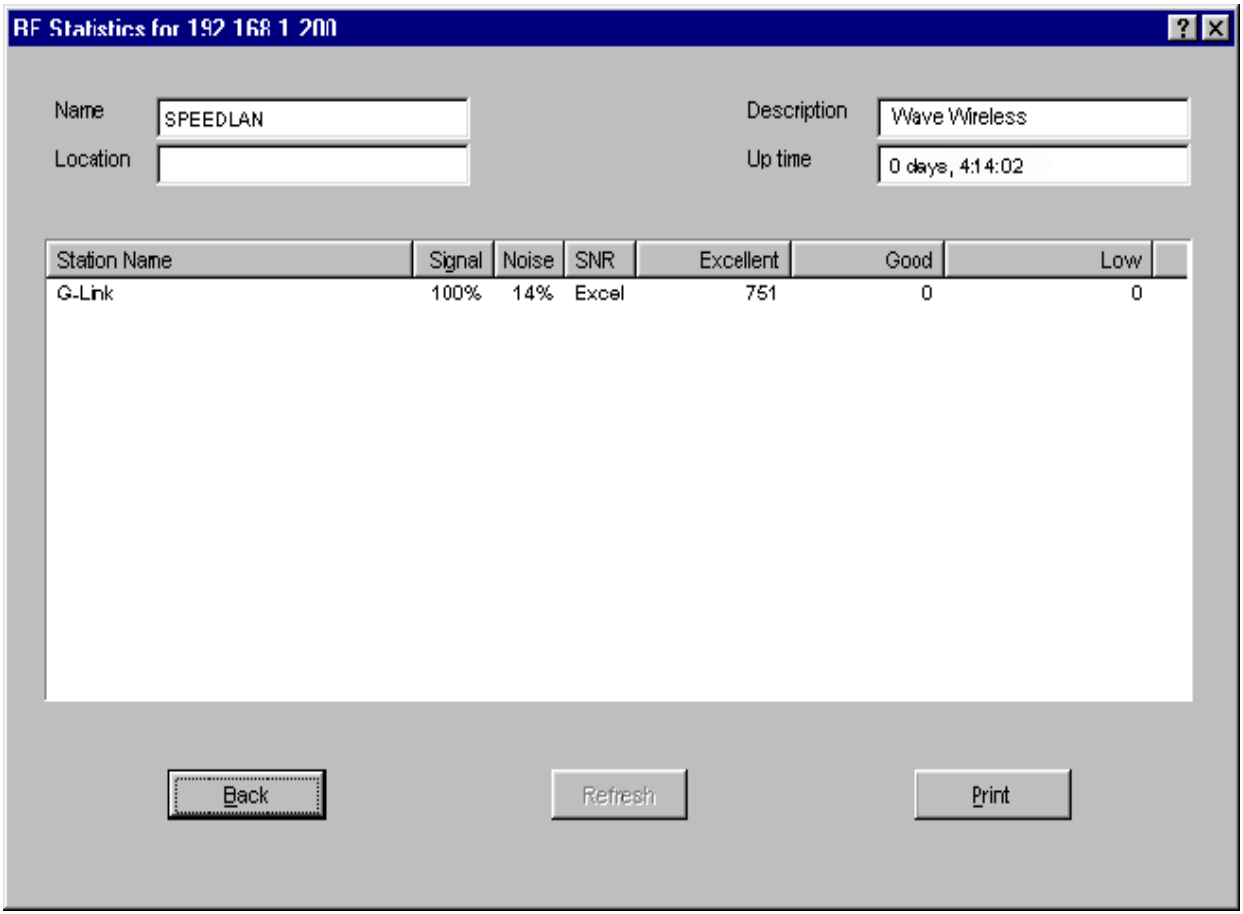


- Station Name
  Name of system assigned in the SNMP Setup for a brouter or in the Network Control Panel for Single Device Adapters (Note: Single Device Adapters will only communicate with a SPEEDLAN 8000 series base station. They will appear on the Wireless Remote Entries dialog box of a 4000 series base station, if the base can hear their RF signal.)
- Type
  Valid entries are: Base, Remote, Peer, and Offline.
- Transmit
  Number of transmissions from the wireless station.
- Re-Transmit
  Number of re-transmissions from the wireless station.

Note: A high number of re-transmit errors usually indicates that the signal quality is poor.

- Failure
  Number of transmission failures from the wireless station.

Note: Click RF Stats to view the radio frequency statistics for the wireless station connected to the brouter (as shown below). Then, click Back to return to this dialog box.



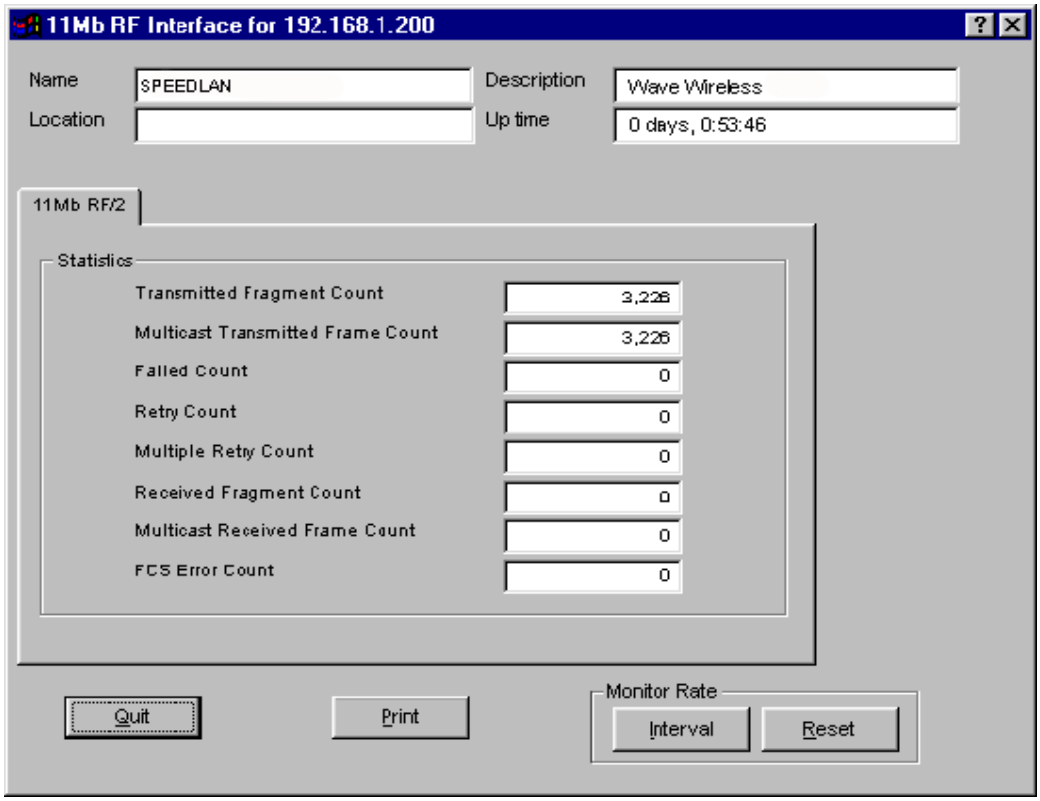
- Station Name
  Name of the brouter.
- Signal
  The higher the Signal Level, the better. This ratio should be between 50 to 70%. In order for the link to be successful, you should have approximately 20 points higher than the noise.
- Noise
  The higher the Signal Level, the better. This ratio should be between 50 to 70%. In order for the link to be successful, you should have approximately 20 points higher than the noise.

- SNR (Signal-to-Noise Ratio)
  Number of the signal divided by the number of noise. The higher the SNR is, the better.
- Excellent, Good, Low
  This displays the packet transmission rate. The packet count should be 98% or better.

Note: Click Back to return to the Campus PRC information.

11Mb RF Interface

This displays the interface(s) connected to the brouter.

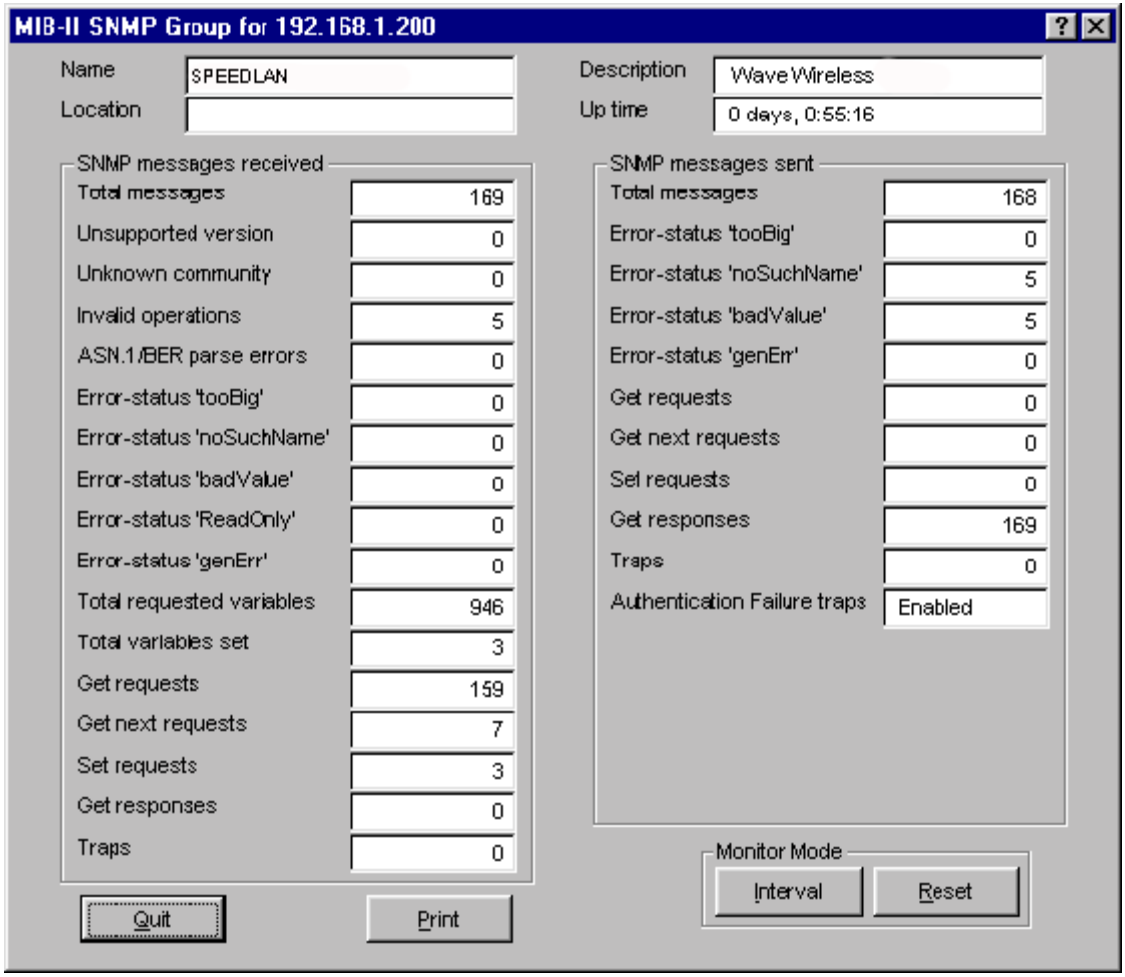


- Transmitted Fragment Count
  The number of frames transmitted.
- Multicast Transmitted Frame Count
  The number of multicast frames transmitted.
- Failed Count
  The number of frames that did not transmit.

- Multiple Retry Count
  The number of multiple attempts to resend a frame.
- Received Fragment Count
  The number of frames received.
- Multicast Received Frame Count
  The number of multicast frames received.
- FCS Error Count
  The number of data link protocols used with the frame check sequence, which allows the receiver to detect collisions.

SNMP Monitor

This displays the SNMP messages that are received or sent.



SNMP Messages Received

- Total Messages
  The total number of SNMP messages received.
- Unsupported Version
  The total number of SNMP messages which were delivered to the SNMP protocol entity and were for an unsupported SNMP version.

- Unknown Community
  The total number of SNMP messages delivered to the SNMP protocol entity which used an SNMP community name not known to the brouter.
- Invalid Operations
  The total number of SNMP messages delivered to the SNMP protocol entity which represented SNMP operations not allowed by the SNMP community named in the message.
- ASN.1/BER parse errors
  The total number of ASN.1 or BER errors encountered by the SNMP protocol entity when decoding received SNMP messages.
- Error-status `too big'
  The total number of SNMP PDUs delivered to the SNMP protocol entity for which the value of the error-status field was `too big'.
- Error-status `noSuchName'
  The total number of SNMP PDUs delivered to the SNMP protocol entity for which the value of the error-status field was `noSuchName'.
- Error-status `badValue'
  The total number of SNMP PDUs delivered to the SNMP protocol entity for which the error-status field was indicated `badValue'.
- Error-status `ReadOnly'
  The total number of valid SNMP PDUs delivered to the SNMP protocol entity for which the value of the error-status field was `ReadOnly'. It should be noted that it is a protocol error to generate an SNMP PDU which contains the value `ReadOnly' in the error-status field; use this field to detect incorrect implementations of SNMP.
- Error-status `genErr'
  The total number of SNMP PDUs delivered to the SNMP protocol entity for which the error-status field was `genErr'.
- Total requested variables
  The total number of MIB objects retrieved successfully by the SNMP protocol entity as the result of receiving valid SNMP Get-Request and Get-Next PDUs.
- Total variables set
  The total number of MIB objects altered successfully by the SNMP protocol entity as the result of receiving valid Set-Request PDUs.
- Get requests
  The total number of SNMP Get-request PDUs accepted and processed by the SNMP protocol entity.

- Get next requests
  The total number of SNMP Get-next PDUs accepted and processed by the SNMP protocol entity.
- Set requests
  The total number of SNMP Set-request PDUs accepted and processed by the SNMP protocol entity.
- Get responses
  The total number of SNMP Get-response PDUs accepted and processed by the SNMP protocol entity.
- Traps
  The total number of SNMP Trap PDUs accepted and processed by the SNMP protocol entity.

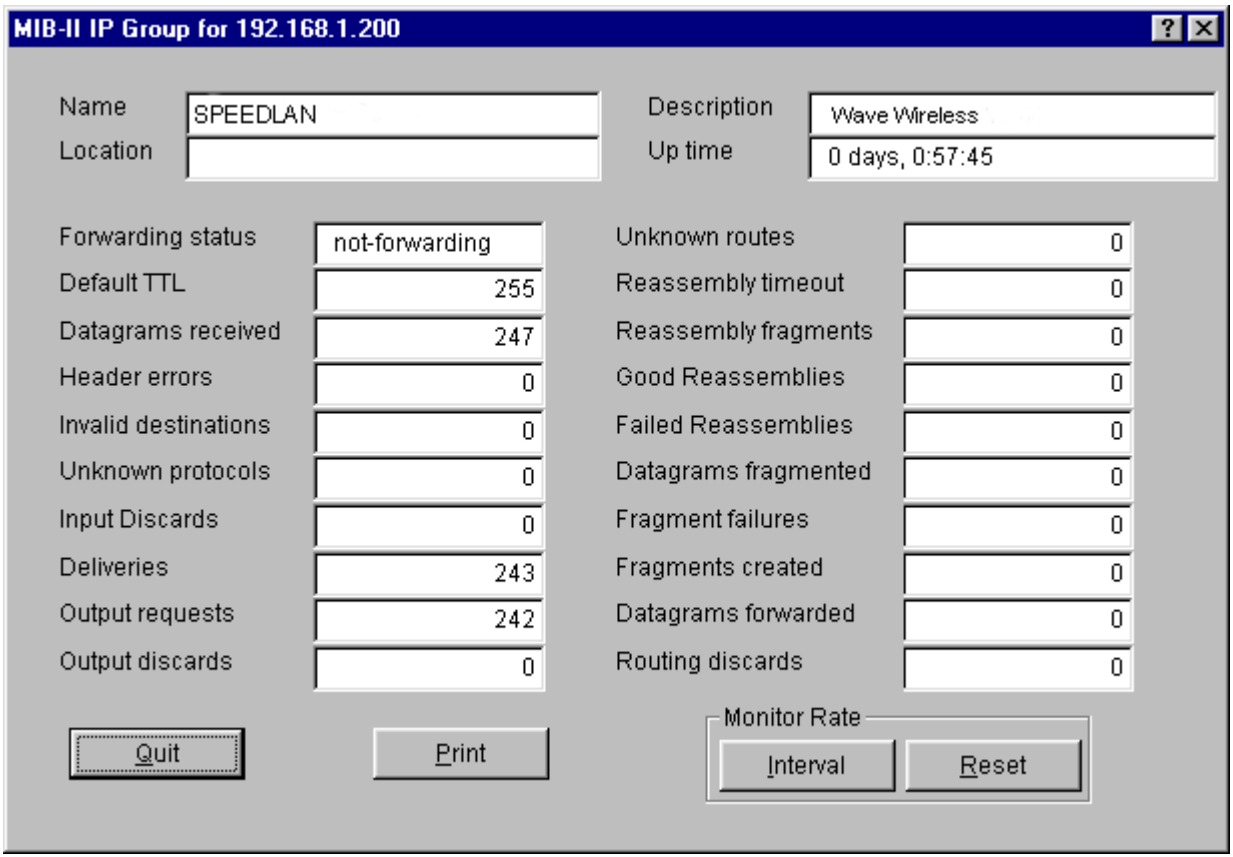
SNMP Messages Sent

- Total Messages
  The total number of SNMP messages passed from the SNMP protocol entity to the transport service.
- Error-status `tooBig'
  The total number of SNMP PDUs generated by the SNMP protocol entity for which the value of the error-status field was `tooBig'.
- Error-status `noSuchName'
  The total number of SNMP PDUs generated by the SNMP protocol entity for which the value of the error-status field was `noSuchName'.
- Error-status `badValue'
  The total number of SNMP PDUs generated by the SNMP protocol entity for which the value of the error-status field was `badValue'.
- Error-status `genErr'
  The total number of SNMP PDUs generated by the SNMP protocol entity for which the value of the error-status field was `genErr'.
- Get requests
  The total number of SNMP Get-request PDUs generated by the SNMP protocol entity.
- Get next requests
  The total number of SNMP Get-next-request PDUs generated by the SNMP protocol entity.
- Set requests
  The total number of SNMP Set-request PDUs generated by the SNMP protocol entity.
- Get responses
  The total number of SNMP Get-response PDUs generated by the SNMP protocol entity.

- Traps
  The total number of SNMP Trap PDUs generated by the SNMP protocol entity.
- Authentication Failure Traps
  Indicates whether the SNMP agent process is permitted to generate authentication-failure traps.

IP Monitor

The brouter keeps the standard SNMP MIB II statistics on IP type protocols as indicated below.



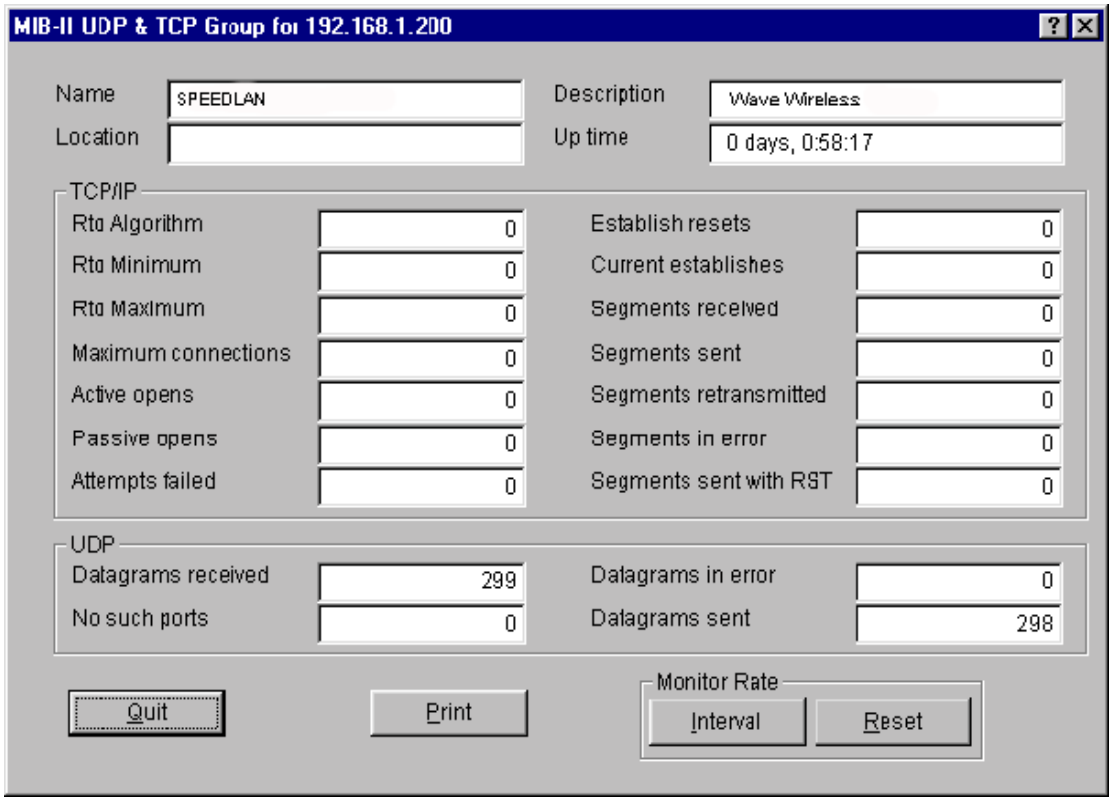
- Forwarding Status
  Indicates whether this entity is acting as an IP gateway in respect to the forwarding of datagrams received by, but not addressed to this entity. IP gateways forward datagrams, and IP hosts do not (except those source-routed via the host). Note that for some managed nodes, this object may take on only a subset of the possible values.

- Default TTL
  The default value inserted into the Time-To-Live field of the IP header of datagrams originated at this entity, whenever a TTL value is not supplied by the transport-layer protocol.
- Datagrams received
  The total number of IP datagrams received by the host.
- Header errors
  The number of input datagrams discarded due to errors in their IP headers, including bad checksum errors, version-number mismatch, other format errors, time-to-live exceeded, errors discovered in processing their IP options, etc.
- Invalid destinations
  The number of input datagrams discarded because the IP address in their IP header's destination field was not a valid address for this entity to receive. This count includes invalid addresses (i.e., 0.0.0.0) and addresses of unsupported classes (i.e., Class E). For entities which are not IP gateways and therefore do not forward datagrams, this counter includes datagrams discarded because the destination address was not a local address.
- Unknown protocols
  The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol.
- Input Discards
  The number of input IP datagrams for which no problems were encountered to prevent their continued processing, but which were discarded anyway (e.g., for lack of buffer space). Note that this counter does not include any datagrams discarded while awaiting re-assembly.
- Deliveries
  The total number of input datagrams successfully delivered to IP user-protocols.
- Output requests
  The total number of IP datagrams that are user-protocols (including ICMP) supplied to IP in-requests for transmission. Note that this counter does not include any datagrams counted in Datagrams forwarded.
- Output discards
  The number of output IP datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded anyway (e.g., for lack of buffer space). Note that this counter would include datagrams counted in Datagrams forwarded if any such packets met this (discretionary) discard criterion.

- Unknown routes
  The number of IP datagrams discarded because no route could be found to transmit them to their destination. Note that this counter includes any packets counted in Datagrams forwarded which meet this `no-route'criterion, as well as any datagrams which a host cannot route because all of its default gateways are down.
- Reassembly timeout
  The maximum number of seconds that received fragments are held while they are awaiting reassembly at this entity.
- Reassembly fragments
  The number of IP datagrams received which needed to be reassembled at this entity.
- Good Reassemblies
  The number of IP datagrams successfully reassembled.
- Failed Reassemblies
  The number of failures detected by the IP reassembly algorithm (for whatever reason - timed out, errors, etc.). Note that this is not necessarily a count of discarded IP fragments since some algorithms (notably the algorithm in RFC 815) can lose track of the number of fragments by combining them as they are received.
- Datagrams fragmented
  The number of IP datagrams that have been successfully fragmented at this entity.
- Fragment failures
  The number of IP-datagram fragments that have been discarded because they needed to be fragmented at this entity but could not be because the datagram's "don't fragment" flag was set.
- Fragments created
  The number of IP-datagram fragments that have been generated as a result of fragmentation at this entity.
- Datagrams forwarded
  The number of input datagrams for which this entity was not their final IP destination, as a result of which an attempt was made to find a route to forward them to that final destination. In entities which do not act as IP gateways, this counter will include only those packets which were Source-Routed via this entity, and for which Source-Route option processing was successful.
- Routing discards
  The number of routing entries which were chosen to be discarded even though they were valid. One possible reason for discarding such an entry could be to free up buffer space for other routing.

IP/TCP/UDP Monitor

The brouter keeps the standard TCP/UDP statistics on IP protocols as indicated below.



TCP

- Rto Algorithm
  The algorithm used to determine the timeout value used for retransmitting unacknowledged octets, which can be: "other" - none of the following; "constant" - a constant rto; "rsre" - MIL-STD-1778, Appendix B; "vanj" - Van Jacobson's algorithm.
- Rto Minimum
  The minimum value permitted by a TCP implementation for the retransmission timeout, measured in milliseconds. More refined semantics for objects of this type depend upon the algorithm used to determine the retransmission timeout. In particular, when the timeout algorithm is "rsre", an object of this type has the semantics of the LBOUND quality described in RFC 793.
- Rto Maximum
  The maximum value permitted by a TCP implementation for the retransmission timeout, measured in milliseconds. More refined semantics for objects of this type depend upon the

algorithm used to determine the retransmission timeout. In particular, when the timeout algorithm is rsre, an object of this type has the semantics of the LBOUND quality described in RFC 793.

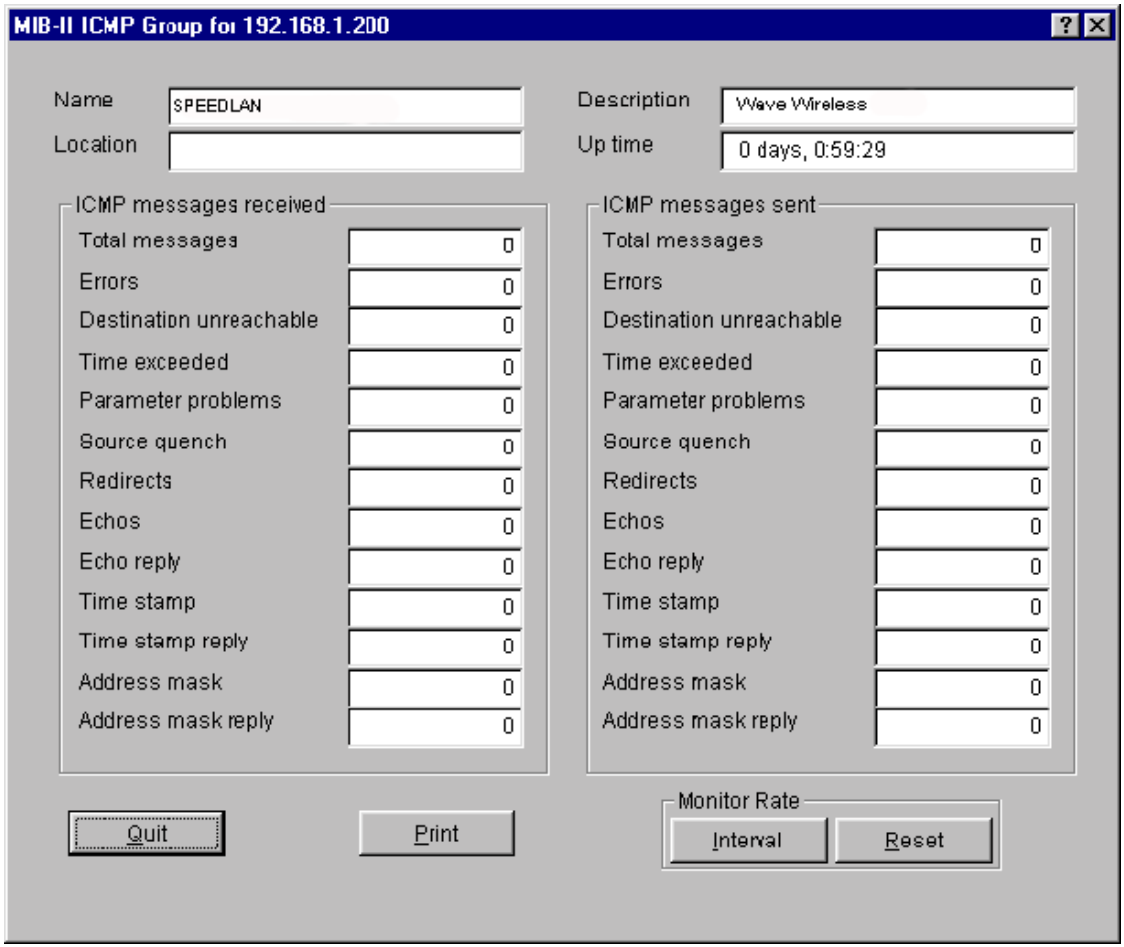
- Maximum connections
  The limit on the total number of TCP connections the entity can support. In entities where the maximum number of connections is dynamic, this object should contain the value -1.
- Active opens
  The number of times TCP connections have made a direct transition to the SYN-SENT state from the CLOSED state.
- Passive opens
  The number of times TCP connections have made a direct transition to SYN-SENT state from the LISTEN state.
- Attempts failed
  The number of times TCP connections have made a direct transition to the CLOSED state from either the SYN-SENT state or the SYN-RCVD state, plus the number of times TCP connections have made a direct transition to the LISTEN state from the SYN-RCVD state.
- Establish resets
  The number of times TCP connections have made a direct transition to the closed state from either the ESTABLISHED state or the CLOSE-WAIT state.
- Current establishes
  The number of TCP connections for which the current state is either ESTABLISHED or CLOSE-WAIT.
- Segments received
  The total number of segments received, including those received in error. This count includes segments received on currently established connections.
- Segments sent
  The total number of segments sent, including those on current connections but excluding those containing only retransmission octets.
- Segments retransmitted
  The total number of segments retransmitted -- that is, the number of TCP segments transmitted containing one or more previously transmitted octets.
- Segments in error
  The total number of segments received in error (i.e., with bad TCP checksums).
- Segment sent with RST
  The number of TCP segments sent containing the RST flag.

UDP

- Datagrams received
  The total number of UDP datagrams delivered to UDP users.
- No such port
  The total number of received UDP datagrams for which there was no application at the destination port.
- Datagrams in error
  The number of received UDP datagrams that could not be delivered for a reason other than the lack of an application at the destination port.
- Datagrams sent
  The total number of UDP datagrams sent from this entity.

ICMP Monitor

The brouter keeps the standard statistics on ICMP as indicated below.



ICMP Messages Received

- Total messages
  The total number of ICMP messages which the entity received. Note that this counter includes all those counted by received Errors.
- Errors
  The number of ICMP messages which the entity received but determined as having ICMP-specific errors (bad checksums, bad length, etc).
- Destination unreachable
  The number of ICMP Destination Unreachable messages received.

- Time exceeded
  The number of ICMP Time Exceeded messages received.
- Parameter problems
  The number of ICMP Parameter Problem messages received.
- Source quench
  The number of ICMP Source Quench messages received.
- Redirects
  The number of ICMP Redirect messages received.
- Echoes
  The number of ICMP Echo (request) messages received.
- Echo reply
  The number of ICMP Echo Reply messages received.
- Time stamp
  The number of ICMP Timestamp (request) messages received.
- Time stamp reply
  The number of ICMP Timestamp Reply messages received.
- Address mask
  The number of ICMP Address Mask (request) messages received.
- Address mask reply
  The number of ICMP Address Mask Reply messages received.

ICMP Messages Sent

- Total messages
  The total number of ICMP messages which this entity attempted to send. Note that this counter includes all those counted by ICMP out Errors.
- Errors
  The number of ICMP messages which this entity did not send due to problems discovered within ICMP, such as a lack of buffers. This value does not include errors discovered outside the ICMP layer such as the inability of IP to route the resultant datagram. In some implementations there may be no types of errors which contribute to this counter's value.
- Destination Unreachable
  The number of ICMP Destination Unreachable messages sent.
- Time exceeded
  The number of ICMP Time exceeded messages sent.
- Parameter problems
  The number of ICMP Parameter Problem messages sent.

- Source quench
  The number of ICMP Source Quench messages sent.
- Redirects
  The number of ICMP Redirect messages sent.
- Echoes
  The number of ICMP Echo (request) messages sent.
- Echo Reply
  The number of ICMP Echo Reply messages sent.
- Time Stamp
  The number of ICMP Time Stamp (request) messages sent.
- Time Stamp Reply
  The number of ICMP Time Stamp Reply messages sent.
- Address mask
  The number of ICMP Address Mask (request) messages sent.
- Address mask reply
  The number of ICMP Address Mask Reply messages sent.

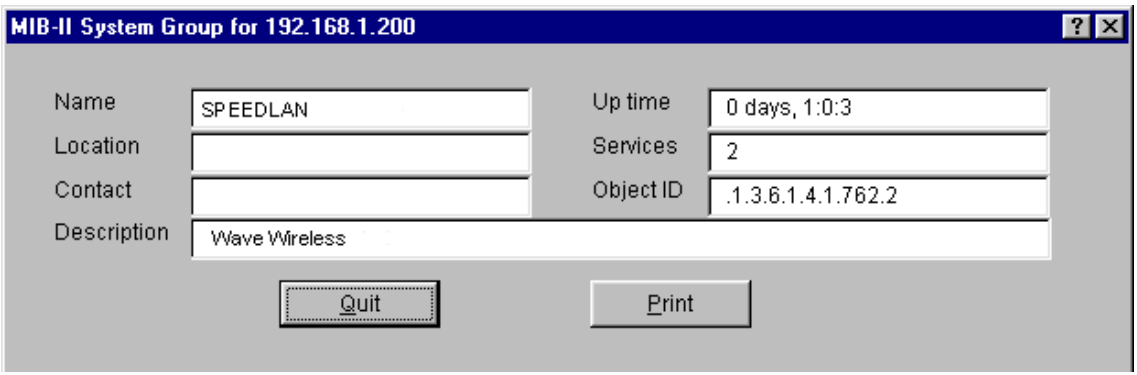
Note:

Chapter 12
Tables

To monitor the SNMP results, choose the appropriate selection by choosing Monitor (on the SPEEDLAN Configurator) + Advanced + your selection.

System Information

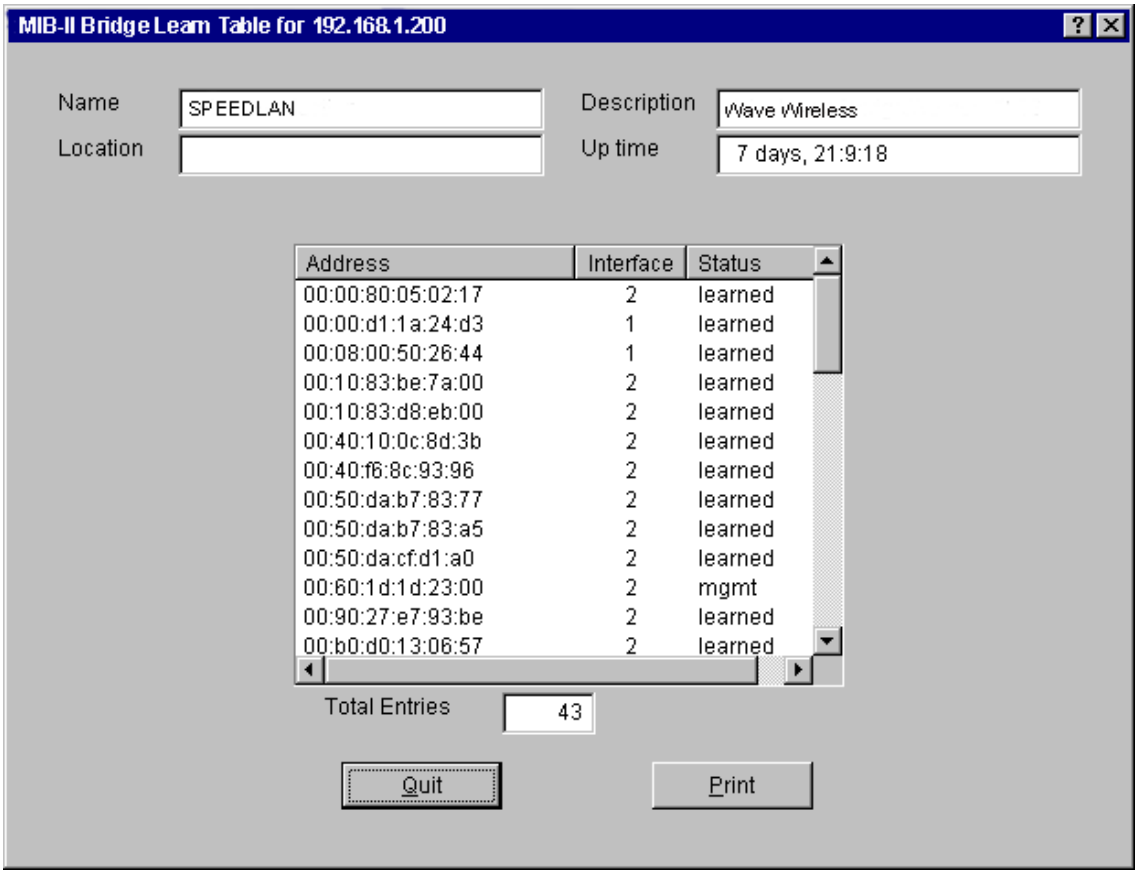
System Information displays information about the brouter's Management Information Base Group. The brouter keeps the standard SNMP MIB II statistics on system-related information as indicated below.



- Name
  An administratively-assigned name for this managed node. By convention, this is the node's fully-qualified domain name.
- Location
  The physical location of this node (e.g., `telephone closet, 3rd floor').
- Contact
  The name/position of the contact person for this managed node, together with information on how to contact this person.
- Description
  This value contains the full name and version identification of the system's hardware type, software operating system, and network software.
- Up time
  The time since the network-management portion of the system was last re-initialized.
- Services
  The number of services handled by the brouter.
- Object ID
  The identification number of the brouter.

Bridge Learn Table

This table contains information about unicast entries for which the brouter has forwarding and/or filtering information. This information is used by the transparent bridging function to determine how to propagate a received frame.

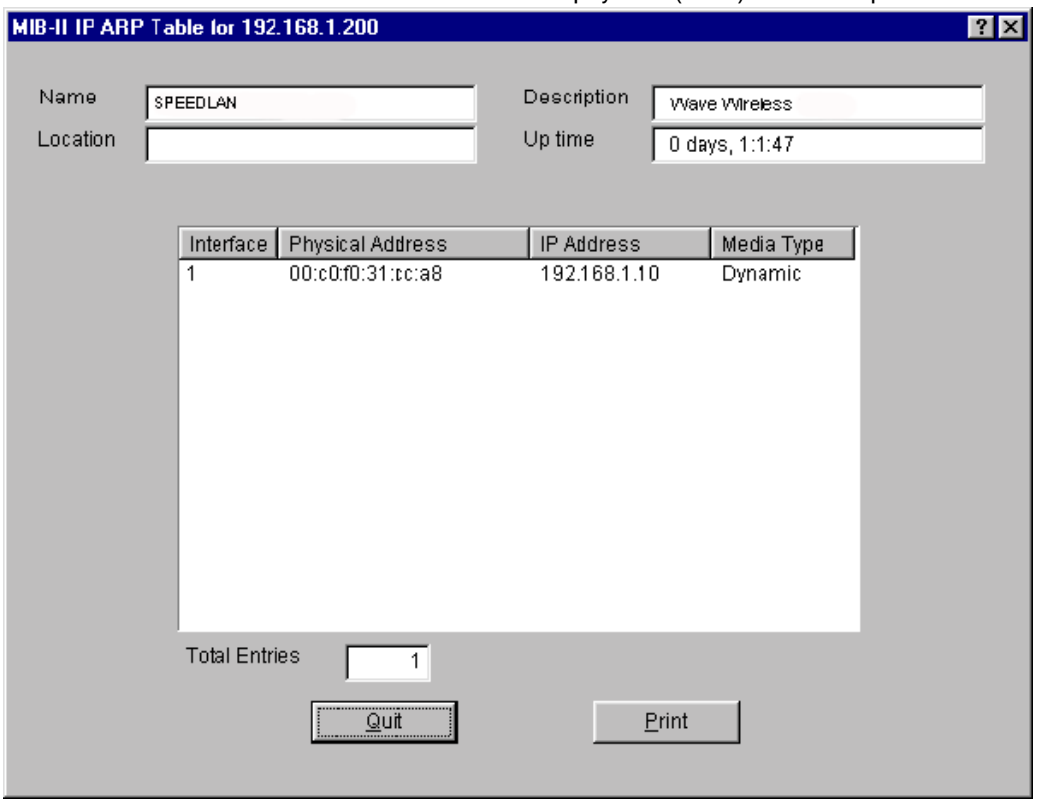


- Address
  A unicast MAC address for which the brouter has forwarding and/or filtering information.
- Interface
  Either the value 0 (zero), or the interface number on which a frame has been seen. A value of 0 (zero) indicates that the interface number has not been learned but the brouter does have some forwarding/filtering information about this address.

- Status
  The status of this entry. The meanings of the values are:
  - *other*
    None of the following.
  - *invalid*
    This entry is no longer valid, but has not been flushed from the table yet.
  - *learned*
    This entry was learned, and is being used.
  - *self*
    This entry represents one of the brouter's addresses. The interface value indicates which of the brouter's interfaces has this address.
  - *mgmt*
    This entry is also the value of an existing instance in the static table.

IP ARP Table

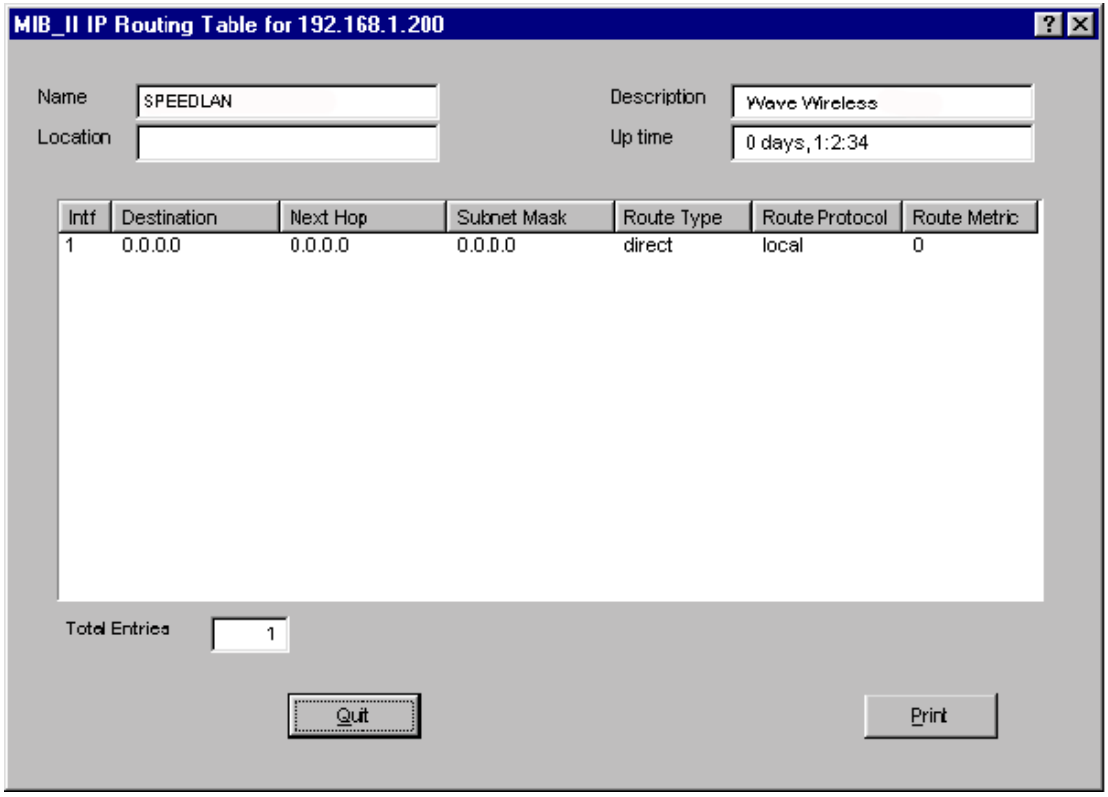
The IP ARP Table contains the IP-Address-to-`physical'-(MAC)-Address equivalences.



- Interface
  The interface on which this entry is effective.
- IP Physical Address
  The media-dependent `physical' (MAC) address. An example would be the MAC address of the Ethernet interface.
- IP Address
  The IP address corresponding to the media-dependent `physical' (MAC) address.
- Media Type
  The type of mapping:
  - *other*
    none of the following
  - *invalid*
    an invalidated mapping
  - *dynamic*
    a mapping that can change with circumstances
  - *static*
    a mapping which does not change

IP Route Table

The brouter keeps the standard SNMP MIB II statistics on the IP routing table, which contains an entry for each route presently known.

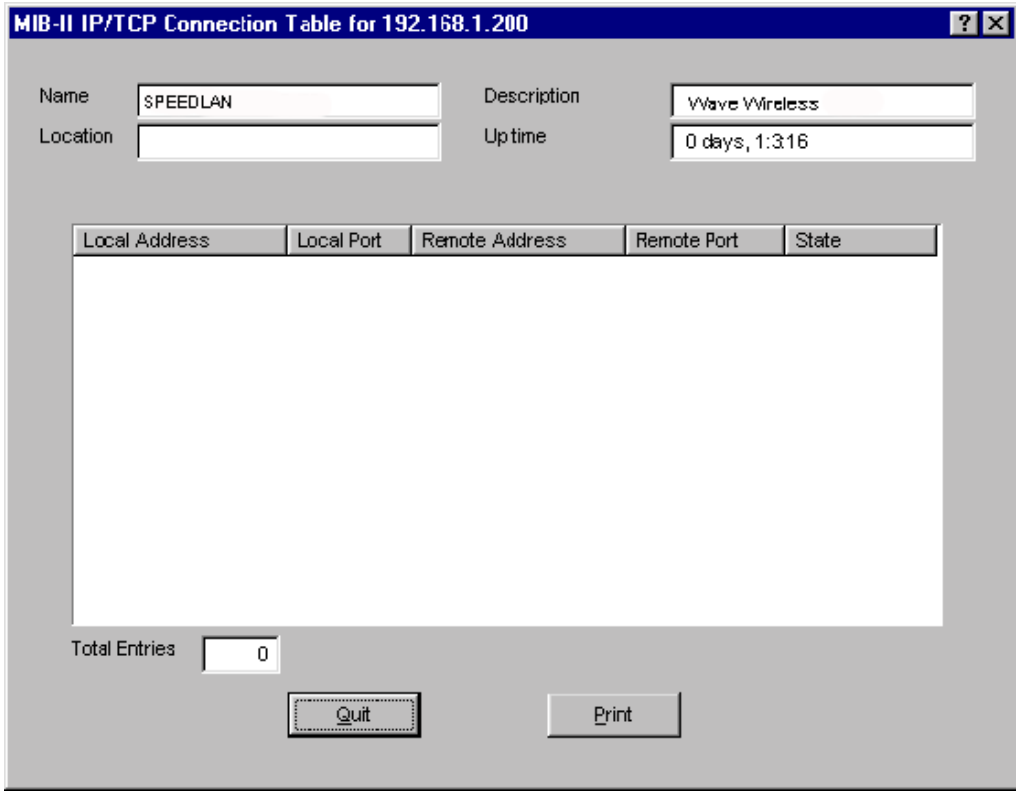


- Intf
  The local interface through which the next hop of this route should be reached.
- Destination
  The destination IP address of this route. An entry with a value of 0.0.0.0 is considered a default route. Multiple routes assigned to a single destination can appear in the table, but access to such multiple entries is dependent on the table-access mechanisms defined by the network-management protocol in use.
- Next Hop
  The IP address of the next hop of this route.

- Subnet Mask
  Indicates the mask to be a logical-ANDed with the destination address before being compared to the value in the Destination field. For systems that do not support arbitrary subnet masks, an agent constructs the value of the Subnet Mask by determining whether the value of the correspondent Destination field belongs to a Class A, B, or C network.
- Route Type
  Type of route. This can be:
  - *other*
    none of the following
  - *invalid*
    an invalidated route
  - *direct*
    route to directly connected (sub-)network
  - *indirect*
    route to a non-local host/network/subnetwork.
- Route Protocol
  The routing mechanism by which this route was learned. Inclusion of values for gateway-routing protocols is not intended to imply that hosts should support those protocols. The values are as follows:
  - *other*
    none of the following
  - *local*
    non-protocol information
  - *netmgmt*
    entries set via a network-management protocol
  - *icmp*
    obtained via ICMP (e.g., ICMP `redirect')
  - *egp*
    all gateway-routing protocols
  - *ggp*
    all gateway-routing protocols
- Route Metric
  The primary routing metric for this route. The semantics of this metric are determined by the routing protocol specified in the route's Route Protocol value. If this metric is not used, its value should be set to -1.

IP/TCP Connection Table

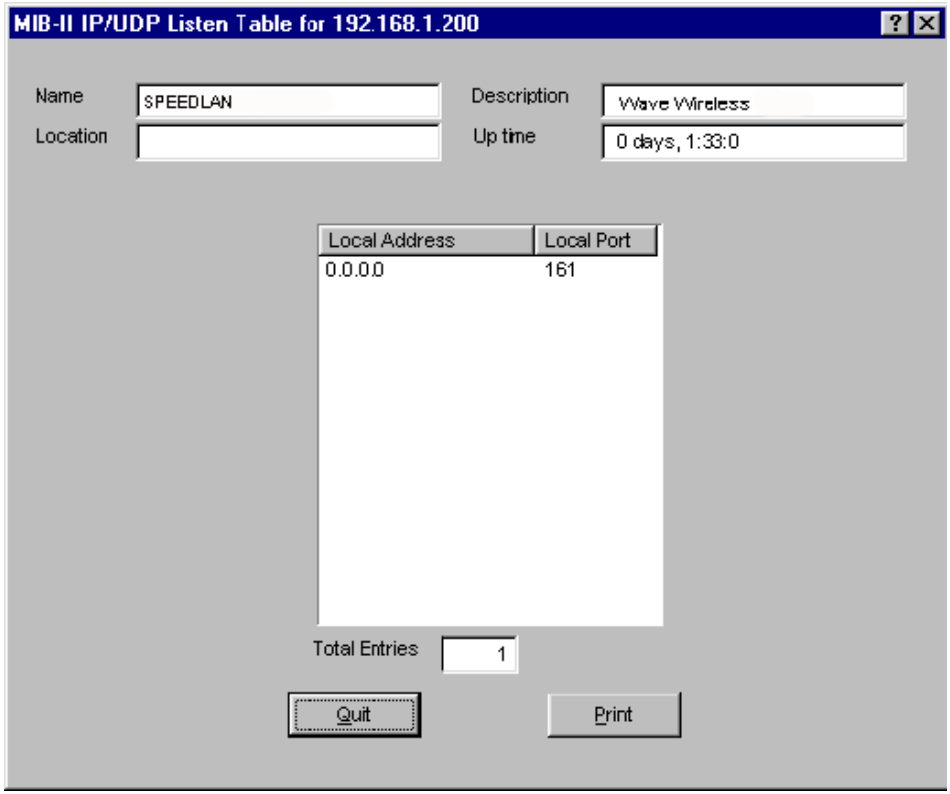
This table reports the states of the TCP connections and contains the following fields as indicated below.



- Local Address
  The local IP address for this TCP connection. In the case of a connection in the listen state which is willing to accept connections for any IP interface associated with the node, the value 0.0.0.0 is used.
- Local Port
  The local port number for this TCP connection.
- Remote Address
  The remote IP address for this TCP connection.
- Remote Port
  The remote port number for this IP connection.
- State
  The state of this TCP connection, which can be one of the following: closed, listen, synSent, synReceived, established, finWait1, finWait2, closeWait, LastAck, closing, timeWait, deleteTCB.

IP/UDP Listener Table

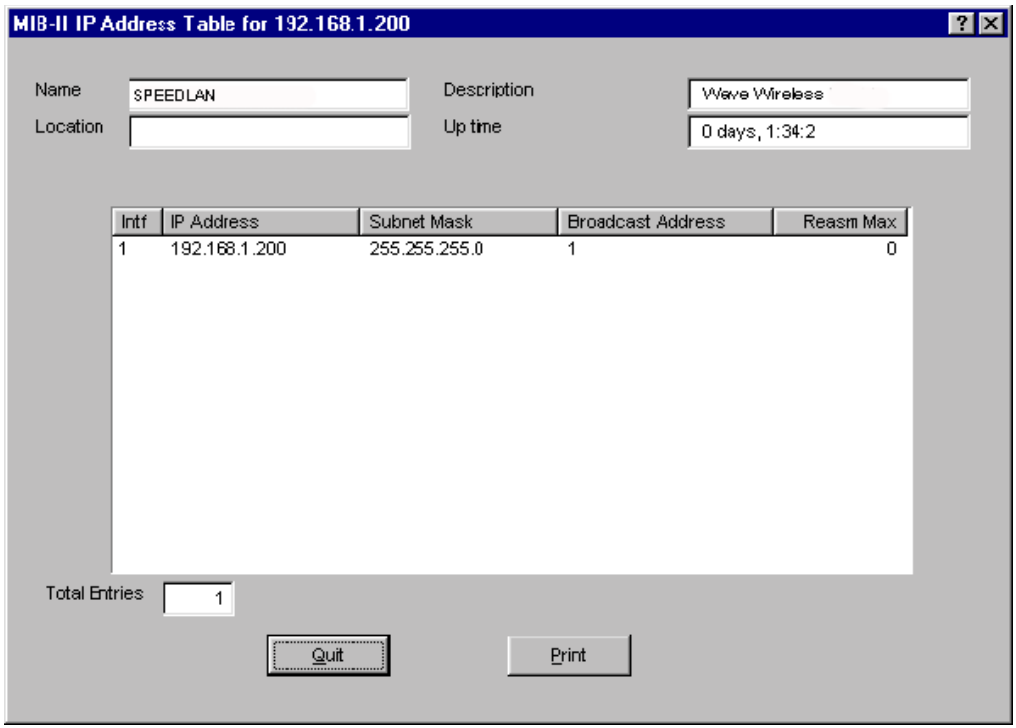
This table reports the states of the UDP connections and contains the following fields as indicated below.



- Local Port
  The local port number for this UDP connection.
- Local Address
  The local IP address for this UDP connection. In the case of a connection in the listen state which is willing to accept connections for any IP interface associated with the node, the value 0.0.0.0 is used.

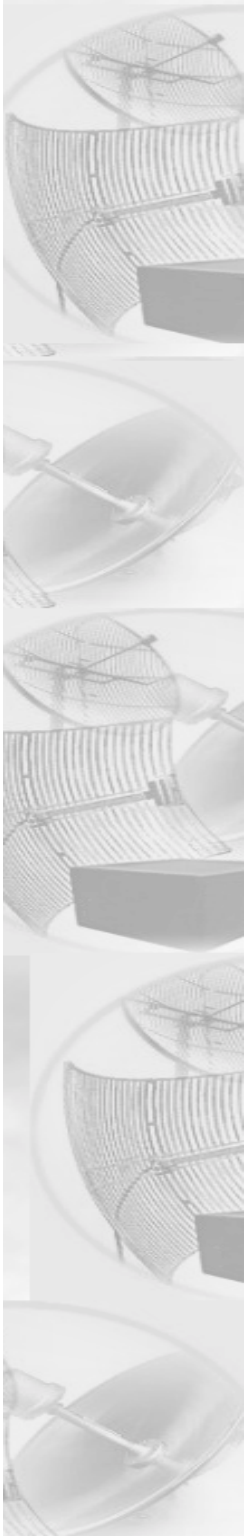
Local IP-Address Table

The table displays addressing information that is relevant to the entity's IP addresses.



- Intf
  The interface to which the entry is applicable.
- IP Address
  The IP address to which this entry's addressing information pertains.
- Subnet Mask
  The subnet mask associated with the IP address of this entity. The value of the mask is an IP address with all the network bits set to 1 and all the host bits set to 0.
- Broadcast Address
  The value of the least-significant bit in the IP broadcast address used for sending datagrams on the logical interface associated with the IP address of this entry. For example, when the Internet standard all-ones broadcast address is used, the value will be 1. This value applies to both the subnet- and network-broadcast address used by the entity on this logical interface.
- Reasm Max
  The size of the largest IP datagram which this entity can re-assemble from incoming IP fragmented datagrams received on this interface.

Chapter 13
Analyzing Wireless Equipment



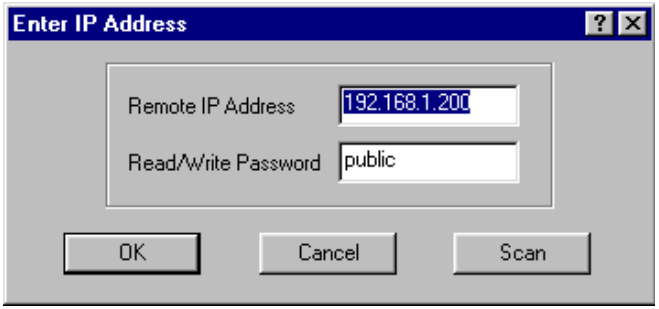
Select Another Device

Use this feature to select another pair of bridges, routers or remote brouters. This is a helpful feature when running a wireless link test. Note that you must scan the brouter before selecting another device.

To select another wireless device, do the following:

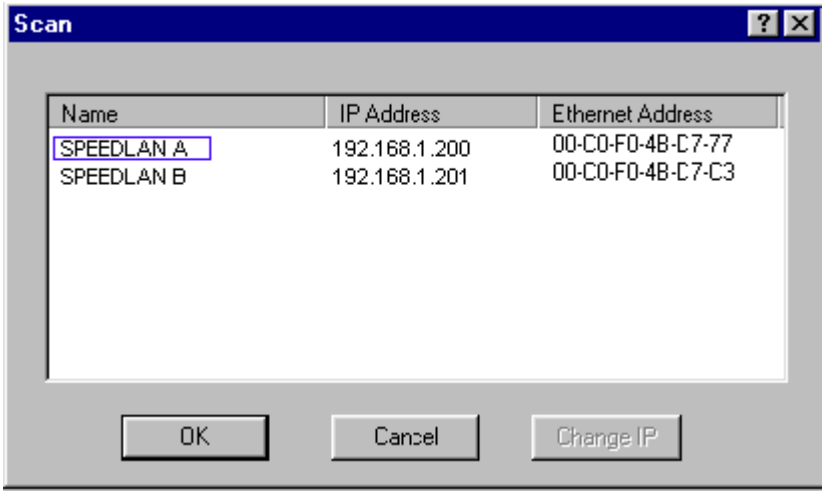
1 From the Analyze, menu, choose Select Another Device.

2 The Enter IP Address dialog box appears.



3 Verify the information in the Enter IP Address dialog box and click Scan. This opens the Scan dialog box, which allows you to select the new pair.

4 Select the pair and click OK. Verify the Remote and IP Address and Read/Write Password in the Enter IP Address dialog box. Then, click OK. The SPEEDLAN Configurator confirms that the device was located. Click OK again. You have successfully selected another device and test the pair as needed.

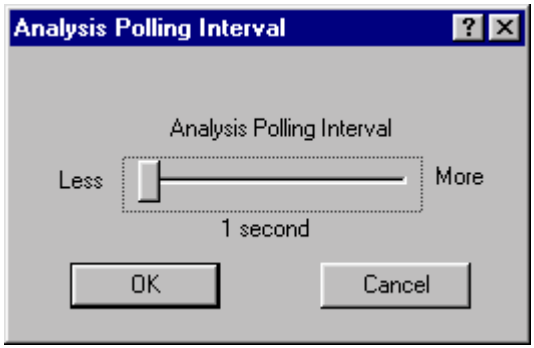


Analysis Polling Interval

Use the feature to set the rate at which the SPEEDLAN Configurator polls the brouter during analysis. Note that you must scan the brouter before setting the interval rate.

To set the rate of the interval, do the following:

1 From the Analyze menu, choose Analysis Interval. The Analysis Polling Interval dialog box appears.



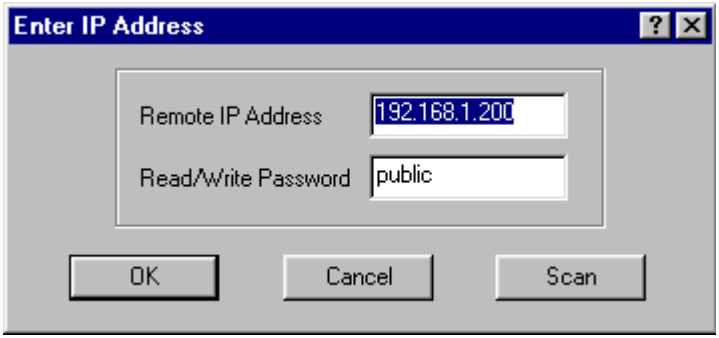
2 Use your mouse and move the interval to the rate of your specification. Then, click OK.

Wireless Link Test

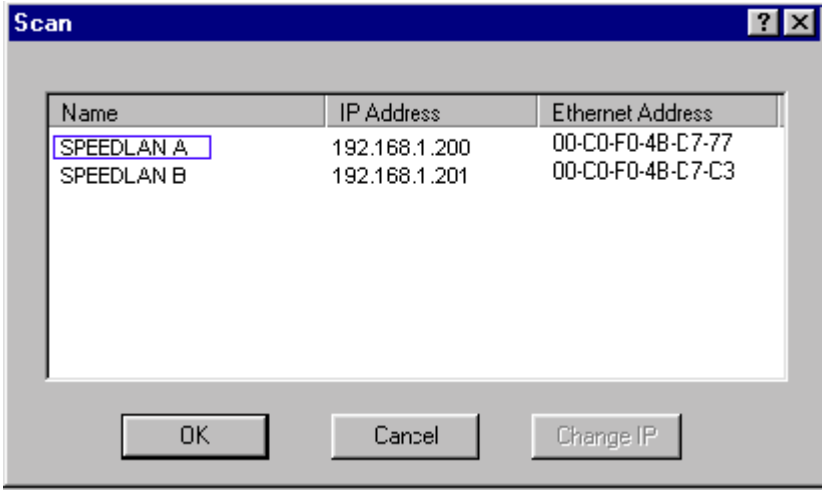
Run the wireless link test to verify that your equipment is communicating properly at the RF level. This test can be performed when you are performing a bench test for the brouter or from the actual link. This process will help you during your performance evaluation. If you already scanned the brouter (or bridge pair), skip to Step 5.

To initialize a link test, do the following:

1 From the File menu, choose Open Remote Config. Then, click Scan.



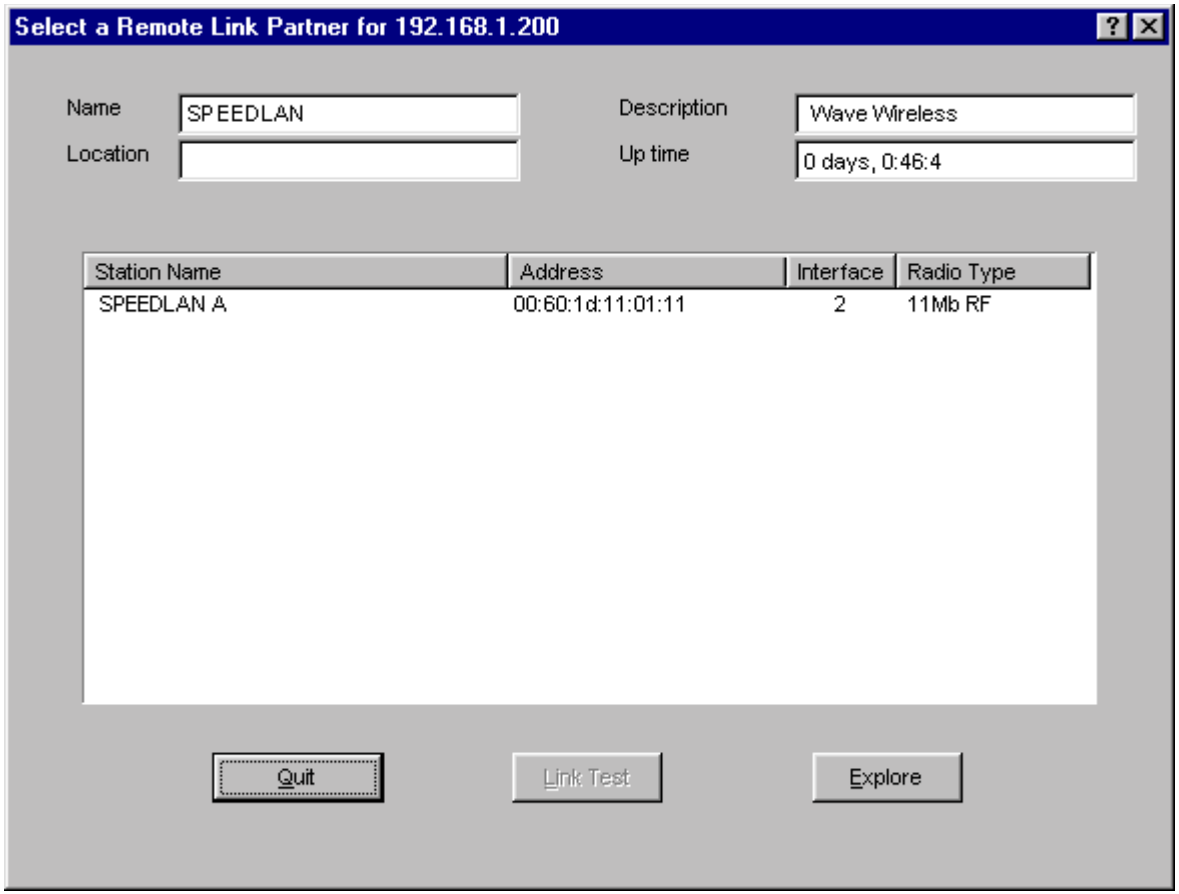
2 Select the name of the brouter that you want to initialize.



3 Click OK to confirm that the IP address is correct.

4 Click OK again. You should receive the following message: "Configuraton has been read from the Bridge (ip xxx.xxx.xxx.xxx)."

5 From the Analyze menu, choose Wireless Link Test. The Select a Remote Link Partner (for your bridge pair) appears.

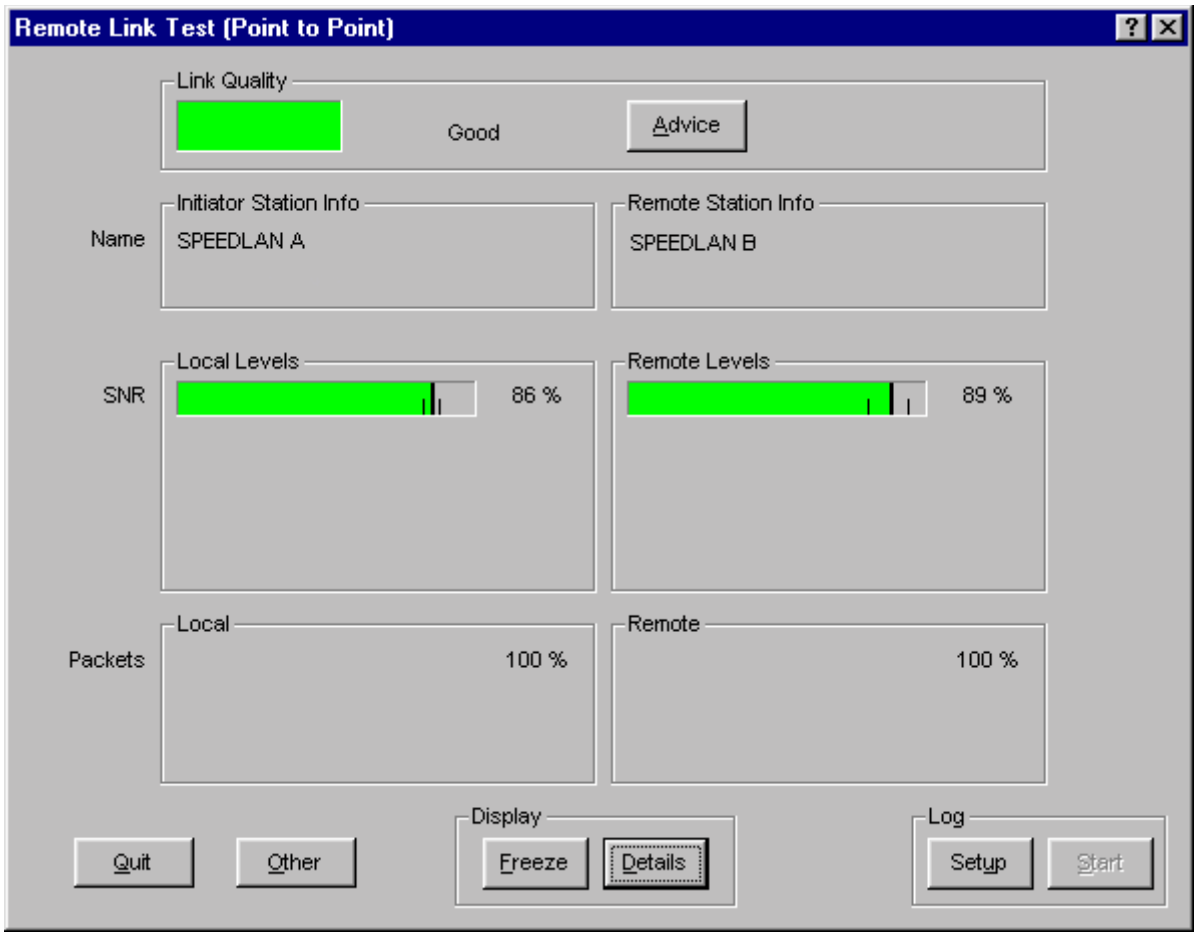


6 Select the Station Name or (name of bridge pair) of the brouter or clients that you want to test.

Description of Wireless Link Test Window

- **Name**
  Name of the initiator station of the wireless link test.
- **Description**
  Initiator station brouter type and firmware version.
- **Location**
  Location of the initiator station. (This is only available if entered in the SNMP Setup options by selecting SNMP Setup from the Setup menu.)

- Up Time
  Amount of time that the initiator station has been running since the last reboot.
- Station Name
  Name of the remote partners that are currently communicating with the initiator station.
- Address
  MAC address of the interface of the remote partner.
- Interface
  The interface of the initiator station that the remote partner is communicating to.
- Radio Type
  The type of radio specified in the Remote Partner.



7 Next, click Link Test. The wireless link test should begin as displayed on the next page.

Note: For more detailed information, click Details (located near the bottom of the Remote Link Test dialog box).

Important Wireless Statistics

Some of the most important wireless statistics are the following:

- Link Quality
  This displays the quality of the link.
  - Green = Good activity
  - Yellow = Acceptable activity
  - Red = Poor activity
- SNR (Signal-to-Noise Ratio)
  Number of the signal subtracted by the number of noise. The higher the SNR is, the better.
- Signal
  The ratio of the standard deviation of the signal to the standard deviation of the noise.
- Noise
  Since the spread spectrum signals run clearly, the noise level is usually very low. The lower the noise, the better.
- Packets
  This displays the percentage of test packets successfully received at each end. A higher percentage is better.

TIP

If you are loosing a large percentage of packets, try realigning the antenna or changing its polarization (keeping in mind tht the antenna polarization must be the same at both ends of the wirless link. Then, run the wireless link test again.

- Log
  You can log the results of the link test into an ASCII text file. You can run the performance over time and create a graphic to view the past to current results.

8 To exit this test, click Quit. Rerun the wireless link test after you have configured each brouter or implemented any antenna alignments to verify that all equipment is communicating successfully.

9 Fine tune antennas to maximize signal level at each site and repeat the link test again to confirm good performance.

Antenna Alignment

Use this feature to continuously broadcast packets in order to test optimum antenna alignment. Note that you must scan the brouter before running this test.

WARNING! This test will broadcast a large amount of test packets across the wireless link. It will interfere with normal wireless network operation.

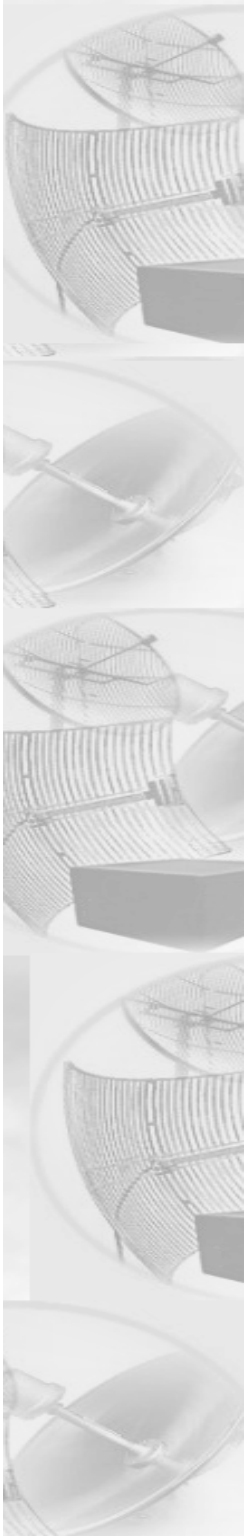
To run the antenna alignment test, do the following:

1 From the Analyze menu, choose Antenna Alignment. The Antenna Alignment dialog box appears.

2 Enter the following information:

- Interface to run test on
  Each brouter contains serveral network interfaces to which it may be connected. The network interfaces are numbered (i.e., 1,2,3...). The number of inteface can be found by choosing Interface Setup from the Setup menu.
- Seconds to run test (0=Stop)
  This is simply the length (in seconds) of the antenna alignment test.
- Transmit Rate
  This is the speed (measured in Hertz) of the signal transmission.

Glossary for Standard Data Communications



Glossary for Standard Data Communications

Alignment
In order to create a successful link, all related equipment should be associated to its respective attachments or equipment.

Amplitude
The magnitude of a waveform when measured from the mid-point to the peak of the wave.

Analog
A signal in the form of a continuously varying quantity such as voltage, frequency or phase.

Antenna
Device used to concentrate and direct the energy of a signal into a tight beam. Parabolic or dish, grid, and Yagi are different varieties of antennas.

Antenna Gain
The ratio of the power radiated by an antenna in a specific direction versus the power required to produce this same strength if an isotropic antenna were used.

Attenuation
The measure of the loss of power in a microwave signal as it travels between two points. It is measured in decibels (dB).

Attenuator
Attenuators simulate antennas during bench tests.

Azimuth
This is the direction of antenna pointing relative to true north.

Band
A portion of the electromagnetic frequency spectrum.

Bandwidth
The range of frequencies over which a device will transmit information.

Bit
An abbreviation for binary digits.

Bit Error Rate

A measure of the number of errors in a digital transmission. Typically given as an exponential number that represents the ratio of errors to total bits. Example: 1E-03 = 0.001 = 1.0 x 10-3 and 1.0E-6 = 0.000001 = 1.0 x 10-3. A single element in a binary code. A measure of the number of errors in a digital transmission. Typically given as an exponential number that represents the ratio of errors to total bits. Example: 1E-03 = 0.001 = 1.0 x 10-3 and 1.0E-6 = 0.000001 = 1.0 x 10-3.

Bridge

The function of a bridge is to connect separate networks together. This device operates at the DataLink Layer of the OSI model. Bridges connect different network types (such as Fast Ethernet and Ethernet) or networks of the same type. Bridges allow only necessary traffic to pass through the designated segments. When the bridge receives a packet, the bridge determines the destination and source segments. If the segments are the same, the packet is dropped, or filtered. If the segments are different, then the packet is “forwarded” to the correct segment. Additionally, bridges do not forward bad or misaligned packets. Bridges are also called “store-and-forward” devices because they look at the whole Ethernet packet before making filtering or forwarding decisions. Filtering packets, and regenerating forwarded packets enables bridging technology to split a network into separate collision domains.

Brouter

This device is a combination of a router and a bridge in one product.

Byte

A data unit consisting of eight bits.

Cable

A transmission medium of copper wire or optical fiber wrapped in a protective cover.

Channel

A specific band of frequencies designated for a specific purpose; the data path between two nodes.

Channel Service Unit/Data Service Unit (CSU/DSU)

Manages digital transmission and monitors signals for problems. Performs many functions similar to a modem with the exception of converting digital signals to/from analog since the end device and transmission facility are both digital.

Channel Spacing

The amount of space signals can flow through.

Class

Understanding this methodology is difficult, even for customers. Therefore, let's explain this in easier terms. The first octet (or octets) defines the "class" (indicated by the word "net" in this example) of the address, which is the only method to tell the size of the network (how big) and where the internet address belongs. The remaining octets indicate availability for network equipment (i.e., computer or other network equipment). The three main classes are: Class A, Class B, and Class C.

- Class A: Net, Node, Node, Node 255.0.0.0 (last three octets are available for equipment)
- Class B: Net, Net, Node, Node 255.255.0.0 (last two octets are available for equipment)
- Class C: Net, Net, Net, Node 255.255.255.0 (last octet is available for equipment)

Coaxial Cable

A type of transmission line consisting of a center conductor wire surrounded by insulation that is in turn surrounded by a conductive shield made of metal foil or wire braid. Often used to connect the RF unit and modem unit of a wireless system.

Code Division Multiple Access (CDMA)

A system in which all users occupy the same bandwidth. Uncorrelated codes are used to allow for higher bandwidth occupancy. This is also known as the spread spectrum system.

Common Management Information Protocol (CMIP)

A network management protocol that is consistent with an Open Systems Interconnection (OSI) network communication model.

Company name

This is the name of the company that owns or maintains the radio given to the terminal.

Console

This device allows you to communicate through the Telnet client to access the configuration software.

Crimp

Crimp the connector to secure the conductors.

Customer Premise Equipment (CPE)

Any equipment located at the customer site. Usually in reference to those that are connected to a network.

Data Communication Equipment (DCE)

A definition of an interface standard that determines how it is connected to another device. For most modems, it resolves issues of interface between Data Terminal Equipment (DTE) and the network.

Data Terminal Equipment (DTE)
Hardware that provides for data communications. See also DCE above.

dBm
Decibels (dB) relative to 1 milliwatt.

dBw
Decibels (dB) relative to 1 watt.

Decibel (dB)
The standard unit of measurement for expressing relative signal power. It is dimensionless and is instead referenced to a certain level.

Diffraction
The distortion of a wave as it is partially obstructed by an object in its path.

Digital Signal Processor (DSP)
A specialized computer chip designed to perform speedy and complex operations on digitized waveforms.

Direct Sequence (DS)
A type of spreading technique that multiplies a higher rate PN code to the signal in order to spread the energy of the narrow band signal over a much wider bandwidth for transmission.

Direct Sequence Speed Spectrum (DSSS)
DSSS may be seen as the result of two processes. Data is multiplied with a higher rate digital sequence (spreading code). The sequence has many “chips” for every data bit. The resultant signal modulates the RF carrier.

E1
European Standard also used in South American nations, among others. Speed is 2.048 Mega bits per second (Mbps). Uses the G.703 data interface.

Elevation
1. Height above sea level. 2. The vertical angle in degrees between the ground and the direction the antenna is pointed.

ESD
Electro-Static Discharge happens when there is a transfer between objects at diverse voltages.

Ethernet

This is the most popular physical layer LAN technology in use today. Other LAN types include Token Ring, Fast Ethernet, Fiber Distributed Data Interface (FDDI), Asynchronous Transfer Mode (ATM) and Local Talk. Ethernet is popular because it strikes a good balance between speed, cost and ease of installation. These benefits, combined with wide acceptance in the computer marketplace, create the ability to support virtually all-popular networks and make Ethernet an ideal networking technology for most computer users today. The Institute for Electrical and Electronic Engineers (IEEE) defines the Ethernet as IEEE Standard 802.3. This standard defines rules for configuring an Ethernet, as well as specifying how elements in an Ethernet network interact with one another. By adhering to the IEEE standard, network equipment and network protocols will communicate efficiently.

Ethernet Switch

This device helps expand the Ethernet network. LAN switches can link four, six, ten or more networks together, and have two basic architectures. This switch “cuts through” and “stores and forwards” as well. This technique takes more time to examine the entire packet, but it allows the switch to catch certain packet errors and keep them from propagating through the network. A switch also operates between the DataLink and Network Layer of the OSI model. It reads the MAC address and will either bridge it to the Physical Layer or route to the Network Layer.

Fade Margin

The difference between the receiver signal input level and the receiver sensitivity. Fade margin is usually considered the safety factor allowing the system to remain operating under additional forms of attenuation.

Fading

The loss of signal strength due to changes in the atmosphere.

Fault

This section of the browser gives the user a detailed list of alarm activity. Along with the alarm activity, the Event Log also time stamps an alarm, so the user is able to determine when an event occurred, and at what time the event cleared. The date and time fields are derived from the time read by the radio on the network time server.

Federal Communications Commission (FCC)

Government organization appointed by the U.S. President that regulates interstate communications (by use of licenses, standards, rates, etc.).

Firmware

Alterable programs in semitransparent storage (e.g., some type of read-only or flash reprogrammable memory).

Forward Error Correction (FEC)

The ability of a receiving station to correct a transmission error. The transmitter sends redundant information along with the original bits and the receiver uses this information to find and correct errors. This can increase the throughput of a data link operation.

Framing

Dividing data for transmission into groups of bits, and adding a header and a check sequence to form a frame.

Frequency

The number of complete cycles per second existing in a waveform. Note that frequency is measured in Hertz (Hz).

Frequency Hopping (FH)

A type of spreading technique using a PN code to change the signal's frequency between several pre-assigned values (hopping). Although the signal itself looks like a narrow band signal at any given point in time, it acts like a spread signal because of the frequency hopping.

Fresnel Zone

An imaginary ellipse surrounding the direct transmission path formed by all the points from which a reflected wave would have an increased path length of multiple of the transmitted signal's wavelength. At least 60% of the Fresnel zone must be unobstructed.

Full Duplex

Independent, simultaneous two-way transmission going in both directions.

Gain

The increase in signal power caused by a device such as a transmitter or antenna.

GHz

GigaHertz. Billions of Hertz.

Ground elevation

This is the approximate mean sea level (AMSL) of the terminal.

Half Duplex

A one-way directional communication line going in both directions. Only one signal can be transmitted or received at a time

Hertz (Hz)
A unit of measurement equal to one cycle per second.

Hexadecimal (Hex, or H)
A Base-16 numbering system. This means 16 sequential numbers are used as a base unit (i.e., “0-9” and “A-F”).

Hop
A term used to describe a single radio path between two points.

Host
This term is interchangeable with the definition “node,” which means this is a point on the network. The host is also any device on the network that has two-way communication to any point on the network, as well as the Internet.

Hot-standby
A condition whereby when the primary method of communication goes down, the secondary method instantly takes over.

Hub
This device on a network collects, receives, and repeats data to its forwarded destination on the network. A hub is also known as a switch.

HyperTerminal
This provides you details of the internal configuration of the ODU. In the HyperTerminal, you can also change the port settings for the modem connection and adjust the settings to make a call.

IDU
Indoor Unit (i.e., Modem Unit).

IF Cable
In an SPEEDCOM system, this is the coaxial cables that connects the modem unit to the RF unit. These cables are terminated with male TNC-type connectors at both ends.

Interface
The standard signal for connecting a microwave system to the connecting equipment.

Interference
Unwanted signals that cause performance degradation or loss of information.

Intermediate Frequency (IF)

The frequency to which a microwave signal is converted to permit signal processing. This range is typically around 70 to 200 MHz.

Internet

This is a system of linked networks that are worldwide in scope and facilitates data communicate service such as remote login, file transfer, electronic mail, the World Wide Web and newsgroups. With the meteoric rise of demand for connectivity, the Internet has become the communications highway for millions of users. The Internet was initially restricted to military and academic institutions in its infancy, but now it is a full-fledged information channel for any and all forms of information and commerce. Internet web sites now provide personal, educational, political and economic resources to every cornet of the planet.

IP Address

This address tells the network how to locate the computers or network equipment connected to it. IP addresses are given so each computer or equipment on the network contains a unique address.

ISM (Industrial, Scientific, and Medical Bands

Ranges are 900 to 928 MHz; 2.4 to 2.4835 GHz; and 5.725 to 5.85 GHz. The FCC for unlicensed use allocated these bands with a restriction on the output power.

Isotropic

Uniform in all directions.

Kbps

Thousands of bits per second.

KHz (KiloHertz)

Thousands of Hertz. Each wireless phone call occupies only a few KiloHertz.

LAN

This is a local area network that enables computers, network equipment, or other peripherals to communicate on a small network.

Last mile

Any type of telecommunications technology where data (voice, video, etc) is traveled within relatively short distances to maintain to highest quality of bandwidth and throughput.

Latitude
This is the geographic latitude of the location of the terminal.

LED
This is a light-emitting diode, which is a semiconductor, that sends out visible light when an electrical current moves through it.

Left arrow
This is the left arrow key on your keyboard.

Light Emitting Diode (LED)
An electronic device that emits light with little generation of heat.

Line Interface Unit (LIU)
The first unit inside the modem units encountered by signals from the user.

Line of Sight (radio) (LOS)
A condition whereby the antennas of a given link have a sufficient path for communication. It requires that at least 60% of the Fresnel zone between them be unobstructed. (Do not confuse with Loss of Signal.)

Liquid Crystal Display (LCD)
The display on the Modem Unit used to configure and monitor the system.

Local Area Network (LAN)
A short distance data communications network used to link together computers and peripheral devices (such as printers) under some form of standard control.

Loopback
This is the process of sending out a test signal to the device on the network so that you know if your signal was successful or unsuccessful.

Loss of Signal (LOS)
The signal from the user's device does not appear in the DSX or E1 interface. (This is not to be confused with Line of Sight.)

MAC address
In a LAN environment each computer contains its own Medium Access Control (MAC) address which is the embedded and unique hardware number. For computers on Ethernet LANs, this is the same number as its Ethernet address. This address is controlled at the DataLink Layer of the OSI model, and is in a hexadecimal format separated by four octets (i.e., 82.39.1E.38).

Major alarm
Indicates that the alarm may cause service interruption.

MAN
This is a metropolitan network that enables computers, network equipment, other peripherals, and more than one LAN to communicate within the city or nearby limits.

Management Information Base (MIB)
A database of network parameters used by SNMP and CMIP to monitor and change network device settings. It provides a logical naming of all information resources on the network pertinent to the network's management.

Mean Time Between Failure (MTBF)
A measure of the theoretical times a component or device will operate without failing.

MHz (MegaHertz)
Millions of Hertz.

Minor alarm
Indicates that the radio is placed in a condition that may affect the 100 Mb throughput, but can be restored (i.e., turning off loopback functions).

Modulation
The process of varying characteristics of a carrier signal to represent changes in the transmitted information.

MOdulator-DEModulator (MODEM)
A device that converts a digital signal to analog, or vice versa, and is used to transfer data between computers over communications lines.

Msps
Million of samples per second.

Multi-path fading

The condition in which the “true” signal from an antenna reflects off an object (usually the ground) and, as a result, the reflected signal causes destructive interference at the receiving antenna. Multi-path fading affects linearly polarized signals more than circularly polarized signals.

Network

A set of connections that allow them to exchange data with each other, which enables multiple users to share to communicate data through the accepted path(s).

Network

Two or more locations tied together with equipment and communications channels.

Node

This is a point on the network such as a computer, server, peripheral (printer, scanner, etc).

Noise

Any unwanted signal or disturbance that degrades the quality of a transmitted signal.

Obstruction

Any man-made or natural object that blocks, diffracts, or reflects a transmitted signal.

Octet

There are four octets in an IP address. Each octet contains 8 bits, which are equivalent to 1 byte. Each octet is separated by a period (.).

OD

Outside diameter of pipe for mounting an antenna.

Outdoor Unit

The Outdoor Unit (ODU) provides the baseband and RF signal processing required to convert the 100Base-T signal from the CPI to an RF frequency at 23, 26, 29, or 38 GHz. The ODU mounts to an antenna through an integral “Quick-Fit” connection that does not require any external waveguide. The ODU housing is ruggedized to protect the RF and modem electronics contained inside. It is capable of simultaneously transmitting and receiving 100 Mbps of data traffic over the air.

Packet

A unit of data transmitted between a receiver and a sender. Each packet contains embedded information, as well as place to go on the network (known from the IP address).

Part 15 (of FCC rules)
The section of the FCC Code of Federal Regulations defines the restrictions regarding the use of Spread Spectrum systems.

Passive Repeater
A re-radiation device associated with a transmitting/receiving antenna system that re-directs intercepted radio frequency energy without boosting or processing the signal.

Path Length
The distance between two ends of a wireless system.

Path Loss
The decrease in signal power experienced when a signal is transmitted between two points.

Path Profile
A drawing of the terrain (including buildings, trees, hills, lakes, etc.) along a transmission path to determine if a given path is viable for the communication link. This is usually done with a computer.

Personal Communication Services (PCS)
A lower powered, higher frequency competitive technology to cellular.

Polarization
The direction of the amplitude of a radio wave. Polarization is usually horizontal or vertical.

Pole Height
This is the height of the antenna supporting structure.

Power Output
The power produced by a transmitter. This is measured in decibels per meter (dBm).

Processing Gain
The ability of the spread spectrum decoder to recover the received signal out of noise. It is essentially the increase in ability to recover the signal in the presence of an interfering carrier of the same or greater level.

Propagation
The transmission of a wave along a given path through a medium.

Protocol

A network protocol is the standard that allows computers to communicate with each other. A protocol defines how computers identify one another on the network, the form that the data should take in transit, and how this information is processed once it reaches its final destination. Protocols also define procedures for handling lost or damaged transmissions or "packets." IPX (for Novell Netware), TCP/IP (for UNIX, Windows NT, Windows 95 and 98 and other platforms), DECnet (for networking Digital Equipment Corp. computers), AppleTalk (for main Macintosh computers), and NetBIOS/NetBEUI (for LAN and Windows NT networks) are some of today's most popular networks. Although each network protocol is different, they all share the same physical cabling. This common method of accessing the physical network allows multiple protocols to peacefully coexist over the network media, and allows the builder of the network to use common hardware for a variety of protocols. This concept is known as "protocol independence," which means that devices that are compatible at the physical and data link layers allowing the user to run many different protocols over the same medium.

Pseudo-random Noise code (PN code)

A high rate digital code that mimics random noise-like properties. It is multiplied with a lower rate data signal in order to achieve spread spectrum transmission signals. The receiver then multiplies the same code back into the transmission to recover the data signal.

Public Switched Telephone Network (PSTN)

This refers to a worldwide voice telephone network accessible to all those with telephones and access privileges.

Quadrature Amplitude Modulation (QAM)

A method for modulating a signal by which more than one bit can be sent simultaneously.

Quadrature Phase Shift Keying (QPSK)

Phase-shift keying in which there are four phase states or positions in the time or frequency domains within a single period.

Radiation

The flow of electromagnetic energy from a transmitter.

Radiation Pattern

An illustration of the energy level radiated by an antenna in every direction.

Radio address

This is the physical location (street name) of the terminal. This is also displayed at the bottom of the web page.

Radio Frequency (RF)

The frequency at which microwave systems transmit.

Received Signal Strength Indicator (RSSI)

The RSSI Voltage provided at the output of the RF Unit that is used to indicate the RF Input Level.

Reflection

The sharp change in direction of a wave after hitting an obstruction in its path.

Refraction

The bending of a wave as it moves from one medium to another.

Reliability

A measure of the percentage of time the system is operating. Reliability is usually a measure of both the availability of the signal and the MTBF of the equipment.

Responsible personnel

This is the person(s) responsible for maintaining the radio system.

RF Signal Level

The strength of the power received by the RF Unit from the antenna.

Right arrow

This is the right arrow key on your keyboard.

Router

This device filters out network traffic by specific protocol rather than by packet address. This device operates at the Network layer of the OSI model. Routers also divide networks logically instead of physically. An IP router can divide a network into various subnets so that only traffic designated for particular IP addresses can pass between segments. Network speed often decreases due to this type of intelligent forwarding. Such filtering takes more time than exercised in a switch or bridge, which only looks at the Ethernet address. In more complex networks, overall efficiency is improved by using routers.

Rx (Receiver)

This is where the packet is going.

Server

A computer that is responsible for tracking, as well as receiving and sending requests from other computers connected to it (on the same network).

Sidelobe

These are 20 dB lower than the main lobe, and it is critical from a performance standpoint that antennas are aligned with respect to the main lobe. Failure to do so may cause the radio to be interfered with or the radio may interfere with other systems.

Signal level

This is the value of the signal level at the receiving end of the transmission path.

Simple Network Management Protocol (SNMP)

The standard protocol for TCP/IP network management that has the most common worldwide use.

Site ID (Unique)

This is the alphanumeric site address given to the terminal by you (the user).

Spread Spectrum Technology (SST)

A method of encoding (with a PN code) a digital signal in a transmitter so as to spread it over a wide range of frequencies so that the average signal power is close to the noise floor. The same code is known to the receiver and is used to decode the signal. Keeping the code secret provides communications security.

Submask

This term allows you to mask section(s) (depending on the class specified) of the octets in the network address. Each octet used in the subnet mask is assigned to a data link. The leftover octet(s) are assigned to the remaining nodes.

Subnet

This term allows you to create multiple networks within one Class A, B, or C network. Each data link (octet) contains its own unique identifier also known as the subnet. Also, each node on the same data link must belong on the same subnet as well.

Symbol Threshold

After a signal has been acquired, the acquisition algorithm in the spread-spectrum chip continues to run a cross-correlation between the expected PN sequence and the received signal, but now uses the Symbol Threshold for comparison. If the result of the cross-correlation drops below the Symbol Threshold, the signal is considered to have been lost, and the algorithm begins trying to acquire the signal again.

System Gain

The sum of the transmitter power output and the receiver sensitivity. System gain is an important measure of a system's ability to overcome attenuation and perform to a satisfactory level. These are measured in decibels per meter (dBm).

Tx (Transceiver)

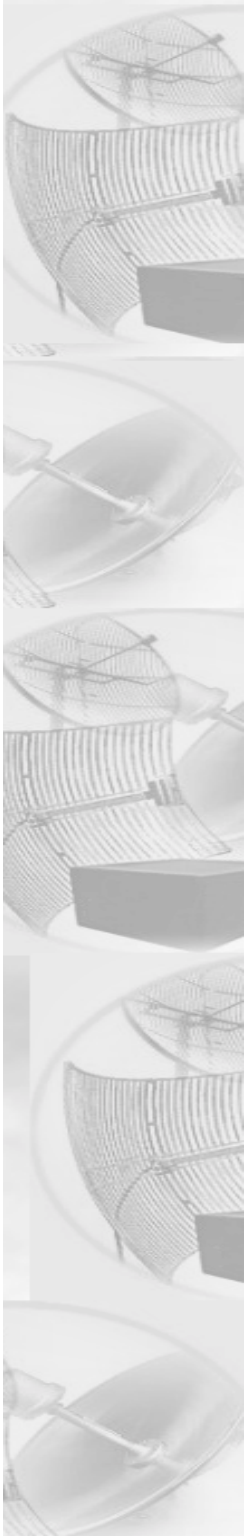
This is where the packet is coming from.

WAN

A wide-area metropolitan network is a connection between LANs, which may be privately owned or rented.

Notes:

Appendix
Protocols & Ethernet Addresses



Common Ethernet Protocols

This table contains the protocols that can be specified in SPEEDLAN's "Ethernet Protocol Menu".

- *0600 Xerox NS IDP
- 0601 XNS Address Translation (3Mb only)
- *0800 DOD Internet Protocol (IP)
- 0801 X.75 Internet
- 0802 NBS Internet
- 0803 ECMA Internet
- *0804 CHAOSnet
- 0805 X.25 Level 3
- *0806 Address Resolution Protocol (ARP) (for IP and for CHAOS)
- 0807 XNS Compatibility
- 081C Symbolics Private
- 0888-088A Xyplex
- 0900 Ungermann-Bass network debugger
- 0A00 Xerox IEEE802.3 PUP
- 0A01 Xerox IEEE802.3 PUP Address Translation
- *0BAD Banyan Systems
- 0BAF Banyan VINES Echo
- 1000 Berkeley Trailer negotiation
- 1001-100F Berkeley Trailer encapsulation for IP
- 1234 DCA - Multicast
- *1600 VALID system protocol
- 1989 Artificial Horizons Aviator dogfight simulator on Sun
- 3C00 3Com NBP virtual circuit datagram (like XNS SPP) not registered
- 3C01 3Com NBP System control datagram not registered
- 3C02 3Com NBP Connect request (virtual cct) not registered
- 3C03 3Com NBP Connect response not registered
- 3C04 3Com NBP Connect complete not registered
- 3C05 3Com NBP Close request (virtual circuit) not registered
- 3C06 3Com NBP Close response not registered
- 3C07 3Com NBP Datagram (like XNS IDP) not registered
- 3C08 3Com NBP Datagram broadcast not registered
- 3C09 3Com NBP Claim NetBIOS name not registered
- 3C0A 3Com NBP Delete NetBIOS name not registered
- 3C0B 3Com NBP Remote adapter status request not registered
- 3C0C 3Com NBP Remote adapter response not registered
- 3C0D 3Com NBP Reset not registered
- 4242 PCS Basic Block Protocol
- 4321 THD - Diddle
- 6000 DEC unassigned, experimental
- 6001 DEC MOP Dump/Load Assistance
- 6002 DEC MOP Remote Console
- 6003 DECnet Phase IV, DNA Routing
- 6004 DEC Local Area Transport (LAT)
- 6005 DEC diagnostic protocol (at interface initialization?)
- 6006 DEC customer protocol
- 6007 DEC Local Area VAX Cluster (LAVC SCA)
- 6008 & 6009 DEC unassigned
- 6010-6014 3Com Corporation
- 7000 Ungermann-Bass download
- 7001 Ungermann-Bass NIUs
- 7002 Ungermann-Bass diagnostic/loopback
- 7003 Ungermann-Bass ??? (NMC to/from UB Bridge)
- 7005 Ungermann-Bass Bridge Spanning Tree
- 7007 OS/9 Microware
- 7009 OS/9 Net?
- 7020-7029 LRT (England) (now Sintrom)
- 7030 Racal-Interlan
- 7034 Cabletron
- 8003 Cronus VLN
- 8004 Cronus Direct
- 8005 HP Probe protocol
- 8006 Nestar
- 8008 AT&T/Stanford University local use
- 8010 Excelan
- 8013 Silicon Graphics diagnostic
- 8014 Silicon Graphics network games
- 8015 Silicon Graphics reserved
- 8016 Silicon Graphics XNS NameServer, bounce server
- 8019 Apollo DOMAIN
- 802E Tymshare
- 802F Tigan, Inc.
- *8035 Reverse Address Resolution Protocol (RARP)

- 8036 Aeonic Systems
- 8037 IPX - Novell Netware
- 8038 DEC LanBridge Management
- 8039 DEC unassigned (DSM/DTP?)
- 803A DEC unassigned (Argonaut Console?)
- 803B DEC unassigned (VAXELN?)
- 803C DEC unassigned (NMSV? DNA Naming Service?)
- 803D DEC Ethernet CSMA/CD Encryption Protocol
- 803E DEC unassigned (DNA Time Service?)
- 803F DEC LAN Traffic Monitor Protocol
- 8040 DEC unassigned (NetBIOS Emulator?)
- 8041 DEC unassigned (MS/DOS?, Local Area System Transport?)
- 8042 DEC unassigned
- 8044 Planning Research Corp.
- 8046 & 8047 AT&T
- 8049 ExperData
- 805B VMTP (Versatile Message Transaction Protocol, RFC-1045)
- 805C Stanford V Kernel, version 6.0
- 805D Evans & Sutherland
- 8060 Little Machines
- 8062 Counterpoint Computers
- 8065 & 8066 University of Mass. at Amherst
- 8067 Veeco Integrated Automation
- 8068 General Dynamics
- 8069 AT&T
- 806A Autophon
- 806C ComDesign
- 806D Compugraphic Corporation
- 806E-8077 Landmark Graphics Corporation
- 807A Matra
- 807B Dansk Data Elektronik
- *807C Merit Internodal (or University of Michigan?)
- 807D-807F Vitalink Communications
- 8080 Vitalink TransLAN III Management
- 8081-8083 Counterpoint Computers
- 8088-808A Xyplex
- * 809B EtherTalk (AppleTalk Phase I over Ethernet)
- 809C-809E Datability
- 809F Spider Systems Ltd.
- 80A3 Nixdorf Computers
- 80A4-80B3 Siemens Gammasonics Inc.
- 80C0-80C3 DCA (Digital Comm. Assoc.) Data Exchange Cluster
- 80C6 Pacer Software
- 80C7 Applitek Corporation
- 80C8-80CC Intergraph Corporation
- 80CD-80CE Harris Corporation
- 80CF-80D2 Taylor Instrument
- 80D3-80D4 Rosemount Corporation
- 80D5 IBM SNA Services over Ethernet
- 80DD Varian Associates
- 80DE-80DF TRFS (Integrated Solutions)
- 80E0-80E3 Allen-Bradley
- 80E4-80F0 Datability
- 80F2 Retix
- 80F3 AppleTalk Address Resolution Protocol (AARP)
- 80F4-80F5 Kinetics
- 80F7 Apollo Computer
- 80FF-8103 Wellfleet Communications(Bay Networks)
- 8107-8109 Symbolics Private
- 812B Talaris
- 8130 Waterloo Microsystems Inc.
- 8131 VG Laboratory Systems
- 8137 Novell (old) NetWare IPX (ECONFIG E option)
- 8138 Novell, Inc.
- 8139-813D KTI
- 814C SNMP over Ethernet (see RFC1089)
- 817D XTP
- 81D6 Lantastic
- 8888 HP LanProbe test?
- 9000 Loopback (Configuration Test Protocol)
- *9001 3Com XNS Systems Management
- *9002 3Com TCP/IP Systems Management
- 9003 3Com loopback detection
- AAAA DECnet? (Used by VAX 6220 DEBNI)
- FF00 BBN VITAL-LanBridge cache wakeups

Common Ethernet Vendor Addresses

This table contains the Vendor portion of the assigned Ethernet Addresses. They may be specified in SPEEDLAN "Ethernet Address Menu".

- 000002 BBN (internal usage only)
- 00000C Cisco
- 00000E Fujitsu
- 00000F NeXT (Apple Computer)
- 000010 Hughes LAN Systems (formerly Sytek)
- 000011 Tektronix
- 000015 Datapoint Corporation
- 000018 Webster (?)
- 00001B Novell
- 00001D Cabletron
- 000020 DIAB (Data Intdustrier AB)
- 000021 SC&C
- 000022 Visual Technology
- 000029 IMC
- 00002A TRW
- 0000037 Oxford Metrics Limited
- 00003C Auspex
- 00003D AT&T
- 00003F Syntrex Inc.
- 000044 Castelle
- 000046 ISC-Bunker Ramo, An Olivetti Company
- 000049 Apricot Ltd.
- 00004B A.P.T. Appletalk WAN router
- 00004C NEC Corporation
- 00004F Logicraft 386-Ware P.C. Emulator
- 000050 Radisys Corporation
- 000051 HOB Electronic GMGH & Co.
- 000052 ODS
- 000055 AT&T
- 000058 Racore Computer Products Inc.
- 00005A (Schneider & Koch in Europe and Syskonnect)
- 00005A Xerox 806 (unregistered)
- 00005D RCE
- 00005E U.S. Department of Defence (IANA)
- 000061 Gateway Communications
- 000062 Honeywell
- 000064 Yokogawa Digital Computer Corp.
- 000065 Network General
- 000068 Rosemount Controls
- 000069 Silicon Graphics(?)
- 00006B MIPS00006D Cray Communications, Ltd.
- 00006E Artisoft, Inc.
- 00006F Madge Networks Ltd.
- 000074 Ricoh Company Ltd.
- 000077 MIPS(?), Interphase(?)
- 000079 Networth Inc.
- 00007A Ardent
- 00007B Research Machines
- 00007D Cray Research Superservices Inc.
- 00007F Linotype)
- 000080 Imagen(?) Also shows as "Harris (3M) (new)"
- 000081 Synoptics
- 000084 Aquila (?), ADI Systems Inc.(?)
- 000086 Gateway (?), Megahertz Corporation(?)
- 000089 Cayman Systems Gatorbox
- 00008A Datahouse Information Systems
- 00008E Jupiter(?), Solbourne(?)
- 000093 Proteon
- 000094 Asante
- 000095 Sony/Tektronix
- 000097 Epoch
- 000098 Crossomm Corporation
- 000099 Memorex Telex Corporation
- 00009F Ameristar Technology
- 0000A0 Sanyo Electronics
- 0000A2 Wellfleet (Bay Networks)
- 0000A3 Network Application Technology (NAT)
- 0000A4 Acorn Computers Ltd.
- 0000A5 Compatible Systems Corporation
- 0000A6 Network General (internal assign- ment)
- 0000A7 Network Computing Devices (NCD) X-terminals

- 0000A8 Stratus Computer, Inc.
- 0000A9 Network Systems
- 0000AA Xerox machines
- 0000AC Apollo
- 0000AE Dassault Automatismes
- 0000AF Nuclear Data Acquisition Interface Modules (AIM)
- 0000B0 RND (RAD Network Devices)
- 0000B1 Alpha Microsystems Inc.
- 0000B3 CIMLinc
- 0000B5 Datability Terminal Servers
- 0000B6 Micro-Matic Research
- 0000B7 Dove Computer Corporation
- 0000BC Allen-Bradley Co. Inc.
- 0000C0 Western Digital (now SMC)
- 0000C1 Olicom A/S
- 0000C6 HP Intelligent Networks Operation
- 0000C8 Altos
- 0000C9 Emulex Terminal Servers
- 0000CC Densan Co. Ltd.
- 0000CD Industrial Research Ltd.
- 0000D0 Develcon Electronics, Ltd.
- 0000D1 Adaptec, Inc. "Nodem" product
- 0000D2 SBE Inc.
- 0000D7 Dartmouth College (NED Router)
- 0000D8 3Com? Novell? PS/2
- 0000DD Gould
- 0000DE Unigraph
- 0000E2 Acer Counterpoint
- 0000E3 Integrated Micro Products Ltd.
- 0000E6 Aptor Produits de Comm. Indust.
- 002015 Actis Computer SA.
- 002016 Showa Electric Wire and Cable Co.
- 002017 Orbotech
- 00201C Excel Inc.
- 00201E Netquest Corporation
- 00201F Best Power Technology Inc.
- 002021 Algorithms Software Pvt. Ltd.
- 002022 Teknique, Inc.
- 002024 Pacific Communications Sciences
- 002025 Control Technology Inc.
- 002027 Ming Fortune Industry Co. Ltd.
- 002028 West Egg Systems Inc.
- 002029 Teleprocessing Products Inc.
- 00202C Welltronix Co. Ltd.
- 00202E Daystar Digital
- 002030 Analog & Digital Systems
- 002032 Alcatel Taisel
- 002033 Synapse Technologies Inc.
- 002036 BMC Software
- 00203A Digital Biometrics Inc.
- 00203B Wisdm Ltd.
- 00203C Eurotime AB
- 00203F Juki Corporation
- 002042 Datametrics Corp
- 0000E7 Star Gate Technologies
- 0000E8 Accton Technology Corporation
- 0000E9 Isicad Inc.
- 0000ED April
- 0000EE Network Designers Limited(?)
- 0000EF Alantec
- 0000F0 Samsung
- 0000F2 Spider Communications
- 0000F3 Gandalf
- 0000F4 Allied Telesis, Inc.
- 0000F6 A.M.C. (Applied Microsystems Corp.)
- 0000F8 Digital Equipment Corp. (Compaq Computer Corp.)
- 0000FB Rechner Zur Kommunikation
- 0000FD High Level Hardware (Orion, UK)
- 000102 BBN internal usage (not registered)
- 000143 IEEE 802
- 000163 NDC (National Datacomm Corporation)
- 000168 W&G (Wandel & Goltermann)
- 0001C8 Thomas Conrad Corp.
- 000267 Node Runner Inc.
- 000701 Racal-Datacom
- 001700 Kabel

- 002002 Seritech Enterprise Co. Ltd.
- 002006 Garrett Communications Inc.
- 002008 Cable & Computer Technology
- 002009 Packard Bell Elec. Inc.
- 00200C Adastra Systems Corp.
- 00200E Satellite Technology Mgmt, Inc.
- 002011 Canopus Co. Ltd.
- 002014 Global View Co. Ltd.
- 002044 Genitech Pty. Ltd.
- 002045 Solcom Systems Ltd.
- 002048 Fore Systems Inc.
- 002049 Comtron Inc.
- 00204A Pronet GMBH
- 00204B Autocomputer Co. Ltd.
- 00204C Mitron Computer Pte. Ltd.
- 00204D Inovis GMBH
- 00204E Network Security Systems Inc.
- 00204F Deutsche Aerospace AG.
- 002050 Korea Computer Inc.
- 002051 Phoenix Data Communications Corp.
- 002053 Huntsville Microsystems Inc.
- 002056 Neoproducts
- 00205B Skyline Technology
- 00205D Nanomatic OY.
- 00205F Gammadata Computer GMBH
- 002061 Dynatech Communications Inc.
- 002063 Wipro Infotech Ltd.
- 002064 Protec Microsystems Inc.
- 002066 General Magic Inc.
- 002068 Isdyne
- 002069 ISDN Systems Corporation
- 00206A Osaka Computer Corporation
- 00206D Data Race Inc.
- 00206E Xact Inc.
- 002074 Sungwoon Systems
- 002076 Reudo Corporation
- 002077 Kardios Systems Corporation
- 002078 Runtop Inc.
- 00207F Kyoelsangyo Co. Ltd.
- 002082 Oneac Corporation
- 002083 Presticom Inc.
- 002084 OCE Graphics USA Inc.
- 002088 Global Village Communication
- 002089 T3Plus Networking Inc.
- 00208A Sonix Communications Ltd.
- 00208B Lapis Technologies Inc.
- 00208C Galaxy Networks Inc.
- 00208E Chevin Software Eng Ltd.
- 002095 Riva Electronics
- 002096 Siebe Environmental Controls
- 002099 Bon Electric Co. Ltd.
- 00209B Ersat Electronic GMBH
- 00209C Primary Access Corp.
- 00209D Lippert Automationstechnik
- 0020A1 Dovatron
- 0020A4 Multipoint Networks
- 0020A6 Proxim Inc.
- 0020A9 White Horse Industrial
- 0020AA NTL Advanced Products
- 0020AC Interflex Datensysteme GMBH
- 0020AE Ornet Data Communication Tech.
- 0020AF 3Com Corporation
- 0020EC Techware Systems Corp.
- 0020ED Giga-Byte Technology Co. Ltd.
- 0020EE Gtech Corporation
- 0020EF U S C Corporation
- 0020F1 Altos India Ltd.
- 0020F2 Spectrix Corp
- 0020F5 Pan Dacom TelecommunicationsGMBH
- 0020F6 NetTek & WaveBrouter Inc.
- 0020F8 Carrera Computers Inc.
- 0020FF Symmetrical Technologies
- 004001 Zero One Technology Co. Ltd.
- 004005 Linksys
- 004009 Tachibana Tectron Co Ltd.
- 00400C General Micor Systems Inc.

- 00400D Lannet Data Communications Ltd.
- 004010 Sonic Systems
- 004013 NTT Data Comm. Systems Corp.
- 004014 Comsoft GMBH
- 004015 Ascom Infrasys AG
- 00401F Colorgraph Ltd.
- 004020 Pinacl Communications
- 004023 Logic Corporation
- 004025 Molecular Dynamics
- 004026 Melco Inc.
- 004027 SMC Massachusetts Inc.
- 0020B0 Gateway Devices Inc.
- 0020B1 Comtech Research Inc.
- 0020B3 Scltec Communications Systems
- 0020B6 Agile Networks Inc.
- 0020BA Center for High Performance
- 0020BB Zax Corporation
- 0020BE LAN Access Corporation
- 0020BF Aehr Test Systems
- 0020C2 Texas Memory Systems Inc.
- 0020C5 Eagle Technology
- 0020C6 Nectec
- 0020C8 Larscom Inc.
- 0020C9 Victron BV
- 0020CA Digital Ocean
- 0020CC Digital Services Ltd.
- 0020CD Hybrid Networks Inc.
- 0020CE Logical Design Group Inc.
- 0020D1 Microcomputer Systems (M) SDN
- 0020D2 Rad Data Communications Ltd.
- 0020D3 QST (Quest Standard Telematique)
- 0020D6 Lannair Ltd.
- 0020DB XNET Technology Inc.
- 0020DC Densitron Taiwan Ltd.
- 0020E1 Alamar Electronics
- 0020E7 B & W Nuclear Service Company
- 0020E8 Datatrek Corporation
- 0020E9 Dantel
- 0020EA Efficient Networks Inc.
- 004074 Cable and Wireless Communications Inc.
- 004076 AMP Incorporated
- 004078 Wearnes Automation Pte Ltd.
- 00407F Agema Infrared Systems AB
- 004082 Laboratory Equipment Corp.
- 004085 SAAB Instruments AB
- 004086 Michels & Kleberhoff Computer
- 004087 Ubitrex Corporation
- 00408A TPS Teleprocessing Sys GMBH
- 00408C Axis Communications AB
- 00408E CXR/Digilog
- 00408F WM-Data Minfo AB
- 004091 Procomp Industria Electronica
- 004092 ASP Computer Products Inc.
- 004094 Shographics Inc.
- 004095 R.P.T. Intergroups Intl. Ltd.
- 004096 Telesystems SLW Inc.
- 00409A Network Express Inc.
- 00409C Transware
- 00409D Digiboard Inc.
- 00409E Concurrent Technologies Ltd.
- 00409F Lancast/Casat Technology Inc.
- 0040A4 Rose Electronics
- 0040A6 Cray Research Inc.
- 0040AA Valmet Automation Inc.
- 0040AD SMA Regelsysteme GMBH
- 0040E5 Sysbus Corporation
- 0040E7 Arnos Instruments & Computer Systems
- 0040E9 Accord Systems Inc.
- 0040EA Plain Tree Systems Inc.
- 0040ED Network Controls Int'natl Inc.
- 0040F0 Micro Systems Inc.
- 0040F1 Chuo Electronics Co. Ltd.
- 0040F4 Cameo Communications Inc.
- 0040F5 OEM Engines
- 0040F6 Katron Computers Inc.
- 0040F9 Combinet

- 0040FA Microboards Inc.
- 0040FD LXE
- 0040FF Telebit Corporation
- 00608C 3Com Corporation
- 008000 Multitech Systems Inc.
- 008004 Antlow Computers Ltd.
- 008005 Cactus Computers Inc.
- 008006 Compuadd Corporation
- 008007 DLOG NC Systeme
- 00800D Vosswinkel F.U.
- 00800F SMC (Standard Microsystem Corp.)
- 008010 Commodore
- 008015 Seiko Systems Inc.
- 008017 PFU
- 008016 Wandel and Goltermann
- 008018 Kobe Steel Ltd.
- 008019 Dayna Communications Inc.
- 00801A Bell Atlantic
- 0040AE Delta Controls Inc.
- 0040B4 3Com K.K.
- 0040B5 Video Technology Computers Ltd.
- 0040B6 Computerm Corporation
- 0040B9 MACQ Electronique SA.
- 0040BD Starlight Networks Inc.
- 0040C0 Vista Controls Corporation
- 0040C1 Bizerba-Werke Wilheim Kraut
- 0040C2 Applied Computing Devices
- 0040C3 Fischer and Proter Co.
- 0040C5 Micom Communications Corp.
- 0040C6 Fibernet Research Inc.
- 0040C8 Milan Technology Corp.
- 0040CC Silcom Manuf'g Technology Inc.
- 0040CF Strawberry Tree Inc.
- 0040D2 Pagine Corporation
- 0040D4 Gage Talker Corp.
- 0040D7 Studio Gen Inc.
- 0040D8 Ocean Office Automation Ltd.
- 0040DC Tritec Electronic GMBH
- 0040DF Digalog Systems Inc.
- 0040E1 Marner International Inc.
- 0040E2 Mesa Ridge Technologies Inc.
- 0040E3 Quin Systems Ltd.
- 0040E4 E-M Technology Inc.
- 00801B Kodiak Technology
- 008021 Newbridge Research Corp.
- 008023 Integrated Business Networks
- 008024 Kalpana Inc.
- 008026 Network Products Corporation
- 008029 Microdyne Corporation
- 00802A Test Systems & Simulations Inc.
- 00802C The Sage Group PLC
- 00802D XYLogics Inc.
- 00802E Plexcom, Inc.
- 008034 SMT-Goupil
- 008035 Technology Works
- 008037 Telefon AB LM Ericsson Crop.
- 008038 Data Research & Applications
- 00803B APT Communications Inc.
- 00803D Surigiken Co. Ltd.
- 00803E Synernetics
- 008042 Force Computers
- 008043 Networld Inc.
- 008044 Systech Computer Corp.
- 008045 Matsushita Electric Ind. Co.
- 008046 University of Toronto
- 008049 Nissin Electric Co. Ltd.
- 00804C Contec Co. Ltd.
- 00804D Cyclone Microsystems Inc.
- 008051 Fibermux
- 008052 Network Professor
- 008057 Adsoft Ltd.
- 00805A Tulip Computers Internat'l B.V.
- 00805B Condor Systems Inc.
- 008062 Interface Co.
- 008063 Richard Hirschmann GBMH & Co.
- 008067 Square D Company

- 008069 Computone Systems
- 00806A ERI (Empac Research Inc.)
- 00806B Schmid Telecommunication
- 00806C Cegelec Projects Ltd.
- 00806D Centrury Systems Corp.
- 00806E Nippon Steel Corporation
- 00806F Onelan Ltd.
- 008071 SAI Technology
- 008072 Microplex Systems Ltd.
- 008074 Fisher Controls
- 008079 Microbus Designs Ltd.
- 00807B Artel Communications Corp.
- 00807C FiberCom
- 00807E Southern Pacific Ltd.
- 008082 PEP Modular Computers GMBH
- 008086 Computer Generations Inc.
- 008087 Okidata
- 008088 Victor Company of Japan Ltd.
- 008089 Tecnetics (Pty) Ltd.
- 00808A Summit Microsystems Corp.
- 0080AF Allumer Co. Ltd.
- 0080B1 Softcom A/S
- 0080B2 NET (Network Equipment Technologies)
- 0080BA Specialix (Asia) Pte. Ltd.
- 0080C2 IEE 802 Committe, Fermi Nat'l Lab
- 0080C7 Xircom, Inc.
- 0080C8 D-Link (also Solectek Pocket Adapters)
- 0080C9 Alberta Microelectronic Centre
- 0080CE Broadcast Television Systems
- 0080D0 Computer Products International
- 0080D3 Shiva - AppleTalk-Ethernet interface
- 0080D4 Chase Limited
- 0080D7 Fantum Engineering Inc.
- 0080D8 Network Peripherals
- 0080DA Bruel & Kjaer
- 0080DD GMX Inc. / GIMIX
- 0080E0 XTP Systems Inc.
- 0080E7 Lynwood Scientific Dev Ltd.
- 0080EA The Fiber Company
- 0080F0 Kyushu Matsushita Electric Co.
- 0080F1 Opus
- 0080F3 Sun Electronics Corp.
- 0080F4 Telemecanique Electrique
- 0080F5 Quantel Ltd.
- 0080FB BVM Limited
- 0080FE Azure Technologies Inc.
- 00AA00 Intel
- 00B0D0 Computer Products International
- 00C000 Lanoptics Ltd.
- 00C001 Diatek Patient Managment
- 00C002 Sercomm Corporation
- 00C003 Globalnet Communications
- 00C004 Japan Business Computer Co. Ltd.
- 00808B Dacoll Limited
- 00808C Frontier Software Development
- 00808D Westcoast Technology B.V.
- 00808E Radstone Technology
- 008090 Microtek International Inc.
- 008092 Japan Computer Industry Inc.
- 008093 Xyron Corporation
- 008094 Sattcontrol AB
- 008096 HDS (Human Designed Systems) X-terminals
- 008098 TDK Corporation
- 00809A Novus Networks Ltd.
- 00809B Justsystem Corporation
- 00809D Datacraft Manufactur'g Pty. Ltd.
- 00809F Alcatel Business Systems
- 0080A1 Microtest
- 0080A3 Lantronix
- 0080A6 Republic Technology Inc.
- 0080A7 Measurex Corp.
- 0080AC Imlogix, Division of Genesys
- 0080AD Cnet Technology Inc.
- 0080AE Hughes Network Systems
- 00C005 Livingston Enterprise Inc.
- 00C006 Nippon Avionics Co. Ltd.

- 00C007 Pinnacle Data Systems Inc.
- 00C008 Seco SRL
- 00C009 KT Technology (S) Pte Ltd.
- 00C00A Micro Craft
- 00C00B Norcontrol A.S.
- 00C00D Advanced Logic Research Inc.
- 00C00E Psitech Inc.
- 00C00F Quantum Software Systems Ltd.
- 00C011 Interactive Computing Devices
- 00C012 Netspan Corporation
- 00C013 Netrix
- 00C014 Telematics Calabasas Int'l Inc.
- 00C015 New Media Corporation
- 00C016 Electronic Theatre Controls
- 00C018 Lanart Corporation
- 00C019 Leap Technology Inc.
- 00C01A Corometrics Medical Systems
- 00C01B Socket Communications Inc.
- 00C01C Systems Information
- 00C01D Grand Junction Networks Inc.
- 00C01F S.E.R.C.E.L.
- 00C020 Arco Electronic Control Ltd.
- 00C021 Netexpress
- 00C023 Tutankhamon Electronics
- 00C024 Eden Sistemas de Computacao SA
- 00C025 Dataproducts Corporation
- 00C027 Cipher Systems Inc.
- 00C028 Jasco Corporation
- 00C029 Kabel Rheydt AG
- 00C02A Ohkura Electric Co. Ltd.
- 00C02B Gerloff Gesellschaft
- 00C02C Centrum Communications Inc.
- 00C02D Fuji Photo Film Co. Ltd.
- 00C02E Netwiz
- 00C02F Okuma Corporation
- 00C030 Integrated Engineering B.V.
- 00C031 Design Research Systems Inc.
- 00C032 I-Cubed Limited
- 00C033 Telebit Communications APS
- 00C034 Dale Computer Corporation
- 00C035 Quintar Company
- 00C036 Raytech Electronic Corp.
- 00C039 Silicon Systems
- 00C03B Multiaccess Computing Corp.
- 00C03C Tower Tech S.R.L
- 00C03D Wiesemann & Theis GMBH
- 00C03E FA. Gebr. Heller GMBH
- 00C03F Stores Automated Systems Inc.
- 00C040 ECCI
- 00C041 Digital Transmission Systems
- 00C042 Datalux Crop.
- 00C057 Myco Electronics
- 00C058 Data Expert Corp.
- 00C03E FA. Gebr. Heller GMBH
- 00C03F Stores Automated Systems Inc.
- 00C059 Nippondenso Co. Ltd.
- 00C05B Networks Northwest Inc.
- 00C05C Elonex PLC
- 00C05D L&N Technologies
- 00C05E Vari-Lite Inc.
- 00C060 ID Scandinavia AS
- 00C061 Solectek Corporation
- 00C063 Morning Star Technologies Inc.
- 00C064 General Datacomm Ind Inc.
- 00C065 Scope Communications Inc.
- 00C066 Docupoint Inc.
- 00C067 United Barcode Industries
- 00C068 Philip Drake Electronics Ltd.
- 00C069 California Microwave Inc.
- 00C06A Zahner-Elektrik GMBH & Co. KG
- 00C06B OSI Plus Corporation
- 00C06C Svec Computer Corp.
- 00C06D Boca Research Inc.
- 00C06F Komatsu Ltd.
- 00C070 Sectra Secure Transmission AB
- 00C071 Areanex Communications Inc.

- 00C072 KNX Ltd.
- 00C073 Xedia Corporation
- 00C074 Toyoda Automatic Loom
- 00C075 Xante Corporation
- 00C076 I-Data International A S
- 00C077 Daewoo Telecom Ltd
- 00C078 Computer Systems Engineering
- 00C079 Fonsys Co. Ltd.
- 00C07A Priva B.V.
- 00C07D Risc Developments Ltd.
- 00C07F Nupon Computing Corp.
- 00C080 Netstar Inc.
- 00C081 Metrodata Ltd.
- 00C082 Moore Products Co.
- 00C084 Datalink Corp. Ltd.
- 00C043 Stratacom
- 00C044 Emcom Corporation
- 00C045 Isolation Systems Ltd.
- 00C046 Kemitron Ltd
- 00C047 Unimicro Systems Inc.
- 00C048 Bay Technical Associates
- 00C04B Creative Microsystems
- 00C04D Mitec Inc.
- 00C04E Comtrol Corporation
- 00C050 Toyo Denki Seizo K.K.
- 00C051 Advanced Integration Research
- 00C055 Modular Computing Technologies
- 00C056 Somelec
- 00C086 The Lynk Corporation
- 00C087 UUNET Technologies Inc.
- 00C089 Telindus Distribution
- 00C08A Lauterbach Datentechnik GMBH
- 00C08B Risq Modular Systems Inc.
- 00C08C Performance Technologies Inc.
- 00C08D Tronix Product Development
- 00C08E Network Information Technology
- 00C08F Matsushita Electric Works Ltd
- 00C090 Praim S.R.L.
- 00C091 Jabil Circuit Inc.
- 00C092 Mennen Medical Inc.
- 00C093 Alta Research Corp.
- 00C096 Tamura Corporation
- 00C097 Archipsel SA
- 00C098 Chuntex Electronic Co. Ltd.
- 00C099 Yoshiki Industrial Co. Ltd.
- 00C09B Reliance Comm/Tec R-Tec
- 00C09C TOA Electronic Ltd.
- 00C09D Distributed Systems Int'l Inc.
- 00C09F Quanta Computer Inc.
- 00C0A0 Advanced Micro Research Inc.
- 00C0A1 Tokyo Denshi Sekei Co.
- 00C0A2 Intermedium A/S
- 00C0A3 Dual Enterprises Corporation
- 00C0A4 Unigraf OY
- 00C0A7 Seel Ltd.
- 00C0A8 GVC Corporation
- 00C0A9 Barron McCann Ltd.
- 00C0AA Silicon Valley Computer
- 00C0AB Jupiter Technology Inc.
- 00C0AC Gambit Computer Communica tions
- 00C0AD Marben Communication Systems
- 00C0AE Towercom Co. Inc. (PC House)
- 00C0AF Teklogix Inc.
- 00C0B0 GCC Technologies Inc.
- 00C0B2 Norand Corporation
- 00C0B3 Comstat Datacomm Corpora tion
- 00C0B4 Myson Technology Inc.
- 00C0B5 Corporate Network Systems Inc.
- 00C0B6 Meridian Data Inc.
- 00C0B7 American Power Conversion Corp.
- 00C0B8 Fraser's Hill Ltd.
- 00C0B9 Funk Software Inc.
- 00C0BA Netvantage
- 00C0BB Forval Creative Inc.
- 00C0BD Inex Technologies Inc.
- 00C0BE Alcatel - Sel

- 00C0BF Technology Concepts Ltd.
- 00C0C0 Shore Microsystems Inc.
- 00C0C1 Quad/Graphics Inc.
- 00C0C2 Infinite Networks Ltd.
- 00C0C3 Acuson Computed Sonography
- 00C0CD Comelta S.A.
- 00C0D0 Ratoc System Inc.
- 00C0D1 Comtree Technology Corporation
- 00C0D2 Syntellect Inc.
- 00C0D4 Axon Networks Inc.
- 00C0D5 Quancom Electronic GMBH
- 00C0D6 J1 Systems Inc.
- 00C0D9 Quinte Network Confidentiality
- 00C0DB IPC Corporation (PTE) Ltd.
- 00C0DC EOS Technologies Inc.
- 00C0DE Zcomm Inc.
- 00C0DF KYE Systems Corp.
- 00C0E1 Sonic Solutions
- 00C0E2 Calcomp Inc.
- 00C0E3 Ositech Communications Inc.
- 00C0E4 Landis & GYR Powers Inc.
- 00C0E5 Gespac S.A.
- 00C0E6 Txport
- 00C0E7 Fiberdata
- 00C0E8 Plexcom Inc.
- 00C0E9 Oak Solutions Ltd
- 00C0EA Array Technology Ltd.
- 00C0EB SEH Comutertechnik GMBH
- 00C0EC Dauphin Technology
- 00C0ED US Army Electronic
- 00C0EE Kyocera Corporation
- 00C0EF Abit Corporation
- 00C0F0 Kingston Technology Corp.
- 00C0F1 Shinko Electric Co. Ltd.
- 00C0F2 Transition Engineering Inc.
- 00C0F3 Network Communications Corp.
- 00C0F4 Interlink System Co. Ltd.
- 00C0F5 Metacomp Inc.
- 00C0F6 Celan Technology Inc.
- 00C0F7 Engage Communication Inc.
- 00C0F8 About Computing Inc.
- 00C0F9 Harris and Jeffries Inc.
- 00C0FA Canary Communications Inc.
- 00C0FB Advanced Technology Labs.
- 00C0FC ASDG Inc.
- 00C0FD Prosum
- 00C0FF Box Hill Systems Corporation
- 00DD00 Ungermann-Bass - IBM RT
- 00DD01 Ungermann-Bass
- 00EFE5 IBM (3Com card) Micro Channel interface
- 020406 BBN internal usage (not registered)
- 00C0C4 Computer Operational
- 00C0C5 SID Informatica
- 00C0C6 Personal Media Corp.
- 00C0C8 Micro Byte Pty Ltd.
- 00C0C9 Bailey Controls Co.
- 00C0CA Alfa Inc.
- 00C0CB Control Technology Corporation
- 020701 Racal Datacom (Micom/Interlan)
- 026060 3Com
- 026086 Satelcom MegaPac (UK)
- 02608C 3Com IBM PC; Imagen; Valid; Cisco; Macintosh
- 02CF1F CMC Masscomp; Silicon Graphics; Prime EXL
- 02E6D3 BTI (Bus-Tech, Inc.) IBM Main frames
- 080001 Computer Vision
- 080002 3Com (formerly Bridge)
- 080003 ACC (Advanced Computer Communications)
- 080005 Symbolics LISP machines
- 080007 Apple Computer Inc.
- 080008 BBN
- 080009 Hewlett-Packard
- 08000A Nestar Systems
- 08000B Uniisys Corporation
- 08000D IInternational Computers Ltd.
- 08000E NCR/AT&T
- 08000F SMC (Standard Microsystems Corp.)

- 080010 AT&T [misrepresentation of]
- 080011 Tektronix, Inc.
- 080014 Excelan BBN Butterfly, Masscomp, Silicon Graphics
- 080017 NSC (National Semiconductor Corp.)
- 08001A Data General
- 08001B Data General
- 08001E Apollo
- 08001F Sharp Corporation
- 080020 Sun
- 080022 NBI (Nothing But Initials)
- 080023 Matsushita Denso
- 080025 CDC
- 080026 Norsk Data (Nord)
- 080027 PCS Computer Systems GmbH
- 080028 Texas Instruments
- 08002B DEC
- 08002E Metaphor
- 08002F Prime 50-Series LHC300
- 080030 CERN
- 080036 Intergraph CAE stations
- 080037 Fujitsu-Xerox
- 080038 Bull
- 080039 Spider Systems Ltd.
- 08003B Torus Systems
- 08003E Motorola VME bus processor modules
- 080041 DCA (Digital Comm. Assoc.)
- 080044 DSI (DAVID Systems, Inc.)
- 080046 Sony
- 080047 Sequent
- 080048 Eurotherm Gauging Systems
- 080049 Univation
- 08004C Encore
- 08004E BICC
- 080051 Experdata
- 080056 Stanford University
- 080057 Evans & Sutherland (?)
- 080058 DECsystem-20
- 08005A IBM
- 080067 Comdesign
- 080068 Ridge
- 080069 Silicon Graphics
- 08006A ATTst (?)
- 08006E Excelan
- 080070 Mitsubishi
- 080074 Casio Computer Co. Ltd.
- 080075 DDE (Danish Data Elektronik A/S)
- 080077 TSL (now Retix)
- 080079 Silicon Graphics
- 08007C Vitalink TransLAN III
- 080080 XIOS
- 080081 Crossfield Electronics
- 080083 Seiko Denshi
- 080086 Imagen/QMS
- 080087 Xyplex terminal servers
- 080089 Kinetics AppleTalk-Ethernet interface
- 08008B Pyramid
- 08008D XyVision machines
- 08008E Tandem
- 08008F Chipcom Corporation
- 080090 Retix Inc. Bridges
- 10005A IBM
- 1000D4 DEC
- 1000E0 Apple A/UX (modified addresses for licensing)
- 400003 NetWare (?)
- 475443 GTC (Not registered!) (This number is a multicast!)
- 484453 HDS ???
- 800010 AT&T (misrepresented as 080010?)
- AA0000 DEC obsolete
- AA0001 DEC obsolete
- AA0002 DEC obsolete

Common Ethernet Multicast Addresses

This table contains commonly used Ethernet Multicast Addresses and the Ethernet Protocols they use. They may be specified in the SPEEDLAN "Ethernet Address Menu".

- 01-00-1D-00-00-00 -802- Cabletron PC-OV PC discover
- 01-00-1D-42-00-00 -802- Cabletron PC-OV Bridge discover
- 01-00-1D-52-00-00 -802- Cabletron PC-OV MMAC discover
- 01-00-5E-00-00-00 0800 DoD Internet Multicast (RFC-1112) through 01-00-5E-7F-FF-FF
- 1-00-5E-80-00-00 DoD Internet reserved by IANA through 01-00-5E-FF-FF-FF
- 01-00-81-00-00-02 Synoptics Network Management
- 01-80-C2-00-00-00 -802- Spanning tree (for bridges)
- 01-80-C2-00-00-01 -802- 802.1 alternate Spanning multicast through 01-80-C2-00-00-0F
- 01-80-C2-00-00-14 -802- OSI Route level 1 (within area) IS hello?
- 01-80-C2-00-00-15 -802- OSI Route level 2 (between area) IS hello?
- 01-DD-00-FF-FF-FF 7002 Ungermann-Bass boot-me requests
- 01-DD-01-00-00-00 7005 Ungermann-Bass Spanning Tree
- 03-00-00-00-00-10 80D5 (OS/2 1.3 EE + Communications Manager)
- 03-00-00-00-00-40 80D5 (OS/2 1.3 EE + Communications Manager)
- 09-00-02-04-00-01? 8080? Vitalink printer messages
- 09-00-02-04-00-02? 8080? Vitalink bridge management
- 09-00-07-00-00-00 -802- AppleTalk Zone multicast addresses through 09-00-07-00-00-FC
- 09-00-07-FF-FF-FF -802- AppleTalk broadcast address
- 09-00-09-00-00-01 8005 HP Probe
- 09-00-09-00-00-01 -802- HP Probe
- 09-00-09-00-00-04 8005? HP DTC
- 09-00-0D-xx-xx-xx -802- ICL Oslan Multicast
- 09-00-0D-02-00-00 ICL Oslan Service discover on boot
- 09-00-0D-02-0A-38 ICL Oslan Service discover on boot
- 09-00-0D-02-0A-39 ICL Oslan Service discover on boot
- 09-00-0D-02-0A-3C ICL Oslan Service discover on boot
- 09-00-0D-02-FF-FF ICL Oslan Service discover on boot
- 09-00-0D-09-00-00 ICL Oslan Service discover as required
- 09-00-1E-00-00-00 8019? Apollo DOMAIN
- 09-00-26-01-00-01? 8038 Vitalink TransLAN bridge management
- 09-00-2B-00-00-00 6009? DEC MUMPS?
- 09-00-2B-00-00-01 8039 DEC DSM/DTP?
- 09-00-2B-00-00-02 803B? DEC VAXELN?
- 09-00-2B-00-00-03 8038 DEC Lanbridge Traffic Monitor (LTM)
- 09-00-2B-00-00-04 DEC MAP End System Hello?
- 09-00-2B-00-00-05 DEC MAP Intermediate System Hello?
- 09-00-2B-00-00-06 803D? DEC CSMA/CD Encryption?
- 09-00-2B-00-00-07 8040? DEC NetBios Emulator?
- 09-00-2B-00-00-0F 6004 DEC Local Area Transport (LAT)
- 9-00-2B-00-00-1x DEC Experimental
- 09-00-2B-01-00-00 8038 DEC LanBridge Copy packets
- 09-00-2B-01-00-01 8038 DEC LanBridge Hello packets
- (All local bridges) 1 packet per second, sent by the designated LanBridge
- 09-00-2B-02-00-00 DEC DNA Level 2 Routing Layer ?
- 09-00-2B-02-01-00 803C? DEC DNA Naming Service Advertise?
- 09-00-2B-02-01-01 803C? DEC DNA Naming Service Solicitation?
- 09-00-2B-02-01-02 803E? DEC DNA Time Service
- 09-00-2B-03-xx-xx DEC default filtering by bridges?
- 09-00-2B-04-00-00 8041? DEC Local Area SysTransport LAST?
- 09-00-2B-23-00-00 803A? DEC Argonaut Console?
- 09-00-39-00-70-00? Spider Systems Bridge Hello packet?
- 09-00-4C-00-00-00 -802- BICC 802.1 management
- 09-00-4C-00-00-02 -802- BICC 802.1 management
- 09-00-4C-00-00-06 -802- BICC Local bridge STA 802.1(D) Rev6
- 09-00-4C-00-00-0C -802- BICC Rem bridge STA 802.1(D) Rev8
- 09-00-4C-00-00-0F -802- BICC Remote bridge Adaptive Routing (e.g. to Retix)
- 09-00-4E-00-00-02? 8137? Novell IPX (BICC?)
- 09-00-56-00-00-00 Stanford reserved through 09-00-56-FE-FF-FF
- 09-00-56-FF-00-00 805C Stanford V Kernel, version 6.0 through 9-00-56-FF-FF-FF
- 09-00-77-00-00-00 -802- Retix Bridge Local Management System
- 09-00-77-00-00-01 -802- Retix spanning tree bridges
- 09-00-77-00-00-02 -802- Retix Bridge Adaptive routing
- 09-00-7C-01-00-01 Vitalink DLS Multicast 09-00-7C-01-00-03 Vitalink DLS
- 09-00-7C-01-00-04 Vitalink DLS and non DLS Multicast
- 09-00-7C-02-00-05 8080? Vitalink diagnostics
- 09-00-7C-05-00-01 8080? Vitalink gateway?
- 09-00-7C-05-00-02 Vitalink Network Validation Message
- 09-00-87-80-FF-FF 0889 Xyplex Terminal Servers

- 09-00-87-90-FF-FF 0889 Xyplex Terminal Servers
- 0D-1E-15-BA-DD-06 HP
- 80-01-43-00-00-00 -802- Bridge
- 80-01-43-00-00-08 -802- Bridge Management
- 80-01-43-00-00-28 -802- ISO 10589 level-1 Intermediate Stations
- 80-01-43-00-00-48 -802- Loadable Device
- 80-01-43-00-00-88 -802- Load Server
- 80-01-43-00-00-A8 -802- ISO 10589 level-2 Intermediate Stations
- 80-01-43-00-80-00 -802- FDDI RMT Directed Beacon
- 80-01-43-00-80-08 -802- FDDI status report frame
- 90-00-D4-00-00-20 -802- OSI Network Layer Intermediate Stations
- 90-00-D4-00-00-A0 -802- OSI Network Layer End Stations
- AB-00-00-01-00-00 6001 DEC Maintenance Operation Protocol (MOP) Dump/Load Assistance
- AB-00-00-02-00-00 6002 DEC Maintenance Operation Protocol (MOP) Remote Console 1 System ID packet every 8-10 minutes, by every: DEC DEUNA interface, DEC DELUA interface, and DEC DEQNA interface
- AB-00-00-03-00-00 6003 DECnet Phase IV end node Hello packets 1 packet every 15 seconds, sent by each DECnet host
- AB-00-00-04-00-00 6003 DECNET Phase IV Router Hello packets, 1 packet every 15 seconds, sent by the DECnet router
- AB-00-00-05-00-00 through Reserved DEC
- AB-00-03-FF-FF-FF
- AB-00-03-00-00-00 6004 DEC Local Area Transport (LAT) - old
- AB-00-04-00-xx-xx Reserved DEC customer private use
- AB-00-04-01-xx-yy 6007 DEC Local Area VAX Cluster groups System Communication Architecture
- C0-00-00-00-00-01 -802- Active Monitor
- C0-00-00-00-00-02 -802- Ring Parameter Monitor
- C0-00-00-00-00-04 -802- Network Server Heartbeat
- C0-00-00-00-00-08 -802- Ring Error Monitor
- C0-00-00-00-00-10 -802- Configuration Report Server
- C0-00-00-00-00-20 -802- Synchronous Bandwidth Manager
- C0-00-00-00-00-40 -802- Locate - Directory Server
- C0-00-00-00-00-80 -802- NETBIOS
- C0-00-00-00-01-00 -802- Bridge
- C0-00-00-00-02-00 -802- IMPL Server
- C0-00-00-00-04-00 -802- Ring Authorization Server
- C0-00-00-00-08-00 -802- LAN Gateway
- C0-00-00-00-10-00 -802- Ring Wiring Concentrator
- C0-00-00-00-20-00 -802- LAN Manager
- C0-00-00-00-80-00 -802- user-defined through C0-00-40-00-00-00 -802
- CF-00-00-00-00-00 9000 Ethernet Configuration Test protocol (Loopback)
- FF-FF-00-60-00-04 81D6 Lantastic
- FF-FF-00-40-00-01 81D6 Lantastic
- FF-FF-01-E0-00-04 81D6 Lantastic

Common Ethernet Broadcast Addresses

This table contains common uses for the Ethernet Broadcast Address and the Ethernet Protocols that use it. This table is for reference only.

- FF-FF-FF-FF-FF-FF 0600 XNS packets, Hello or gateway search?
- 6 packets every 15 seconds, per XNS station
- FF-FF-FF-FF-FF-FF 0800 IP (e.g. RWHOD via UDP) as needed
- FF-FF-FF-FF-FF-FF 0804 CHAOS
- FF-FF-FF-FF-FF-FF 0806 ARP (for IP and CHAOS) as needed
- FF-FF-FF-FF-FF-FF 0BAD Banyan
- FF-FF-FF-FF-FF-FF 1600 VALID packets, Hello or gateway search? 1 packet every 30 seconds, per VALID station
- FF-FF-FF-FF-FF-FF 8035 Reverse ARP
- FF-FF-FF-FF-FF-FF 807C Merit Internodal (INP)
- FF-FF-FF-FF-FF-FF 809B EtherTalk Phase I
- FF-FF-FF-FF-FF-FF 9001 3Com (ex Bridge) Name Service
- FF-FF-FF-FF-FF-FF 9002 3Com PCS/TCP Hello,approximately 1 per minute per workstation

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2nd year: 15% of published equipment list price
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*If all three years are purchased simultaneously, the cost will be 10% per year or 30% of list.
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All returns to Wave Wireless MUST have a valid RMA number written clearly on the outside of the box or the shipment will be refused. No returns for credit after 30 days will be approved. Products must be returned undamaged and in original packaging or they will be subject to a minimum 20% restocking/refurbishing fee. Return freight charges must be prepaid. At the option of Wave Wireless, products may be returned for repair or replaced provided the goods have not been modified or repair attempted by someone other than Wave Wireless.

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FCC Statement (For USA Only)

Federal Communications Commission

Radio Frequency Interference Statement for Spread Spectrum Devices

Warning:

This equipment generates, uses, and can radiate radio frequency energy. If it is not installed and used in accordance with the instruction manual, it may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area will probably cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

WARNING!

This is a 2.4 GHz point-to-point system. The conducted output is 30mW with Gant = 24 dBi. This system is used exclusively for fixed point-to-point operations. Its is prohibited to transmit the same information from multiple co-located antennas.

- This equipment must be professionally installed
- In order to comply with FCC RF Exposure requirements, this device must be installed in such that a minimum separation distance of 2 meters is always maintained between the antenna and all persons.
- The operator and professional installer are responsible for ensuring that the system is used exclusively for fixed point-to-point operations.

Electronic Emission Notices

All the spread spectrum devices sold in this catalog comply with Part 15 of the FCC rules.

Operation 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 operation.

If this equipment causes interference to radio reception (which can be determined by unplugging the power cord from the equipment) try these measures: (1) Re-orient the receiving antenna, (2) Relocate the equipment with respect to the receiver, (3) Plug the equipment and receiver into different branch circuits, or (4) Consult your dealer or an experienced technician for additional suggestions.

DANGER!!! Rooftop or tower antenna installations are extremely dangerous and incorrect installation may result in injury, damage, or death. Rooftop and tower installations must be performed by professional antenna installers only.