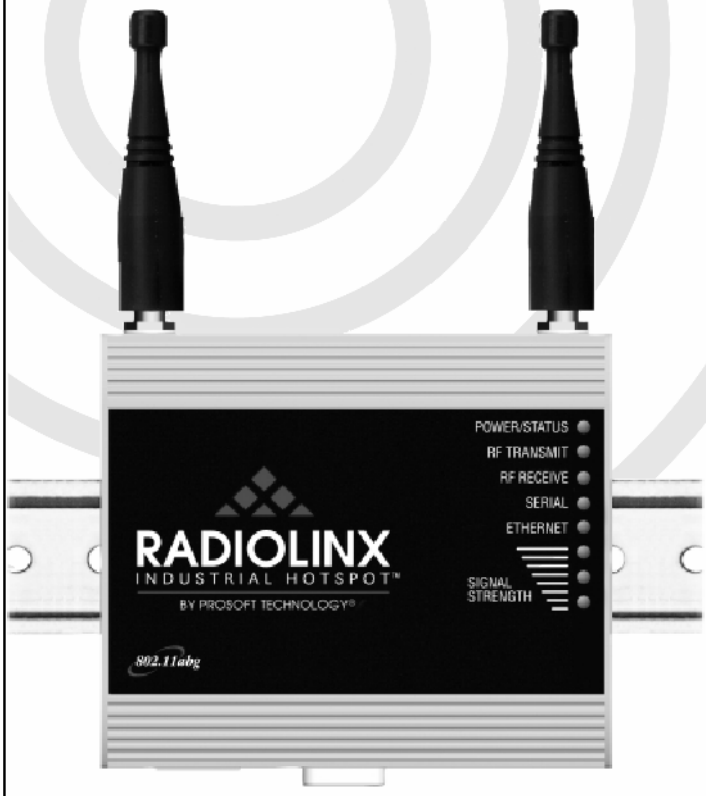
RADIOLINX®



RLX-IHW

Industrial Hotspot

802.11a, b, g

User Guide

September 05, 2007

ProSoft® TECHNOLOGY

Please Read This Notice

Successful application of this module requires a reasonable working knowledge of the RLX-IHW Module and the application in which it is to be used. For this reason, it is important that those responsible for implementation satisfy themselves that the combination will meet the needs of the application without exposing personnel or equipment to unsafe or inappropriate working conditions.

This manual is provided to assist the user. Every attempt has been made to assure that the information provided is accurate and a true reflection of the product's installation requirements. In order to assure a complete understanding of the operation of the product, the user should read all applicable documentation on the operation of the radio.

Under no conditions will ProSoft Technology be responsible or liable for indirect or consequential damages resulting from the use or application of the product.

Information in this manual is subject to change without notice and does not represent a commitment on the part of ProSoft Technology Improvements and/or changes in this manual or the product may be made at any time. These changes will be made periodically to correct technical inaccuracies or typographical errors.

Your Feedback Please

We always want you to feel that you made the right decision to use our products. If you have suggestions, comments, compliments or complaints about the product, documentation or support, please write or call us.

ProSoft Technology
1675 Chester Avenue, Fourth Floor
Bakersfield, CA 93301
+1 (661) 716-5100
+1 (661) 716-5101 (Fax)
http://www.prosoft-technology.com

RLX-IHW User Guide
September 05, 2007
PSFT.IHW.RLX.UM.07.09.05

Contents

1 Start Here

In This Chapter

For most applications, the installation and configuration steps described in the following topics will work without additional programming. ProSoft Technology strongly recommends that you complete the steps in this chapter before developing a custom application.

1.1 About the RadioLinx Industrial Hotspot

The RadioLinx Industrial Hotspot (RLX-IHW) provides high speed industrial wireless Ethernet communications between Ethernet devices such as PLCs, I/O, and operator interfaces while serving as a repeater/bridge for other hotspots, and an access point for wireless clients such as laptops and PDAs.

1.1.1 Features and Benefits

Conforms to IEEE 802.11a/b/g

- Open standard protects wireless network investment
- High speed (54 Mbps), low latency communications
- Radio-based IGMP snooping/querying to filter multicast industrial Ethernet maximizing bandwidth

Rugged and Powerful

- Metal enclosure, industrial operating temperatures, vibration and shock resistant
- Certification Pending for use in hazardous locations (UL1604 Class 1 Div 2, ATEX Zone 2)
- Transmit power and radio frequencies programmable for use globally

Data and Network Security

- Cryptographic strength security with WPA/802.11i-128/192/256 bit AES encryption and CCM integrity check
- Limit access to approved device MAC IDs
- Monitors RF environment for approved/rogue radios

Flexible and Reliable

- Single radio operates as an access point and repeater/bridge and client
- Automatic network configuration (can be prioritized or fixed) with self-healing network and master redundancy for reliable large networks (e.g., SCADA)

Easy to Configure and Monitor

- Built-in web server for browser-based configuration and remote diagnostics
- Included OPC Server for HMI-based RF network diagnostics

Backed by ProSoft Technology

- Industrial data communications experts who understand your protocols, devices, and applications
- Indoor/outdoor radio network design assistance – accessory selection, path studies, and site survey
- Three year standard warranty

1.1.2 Specifications

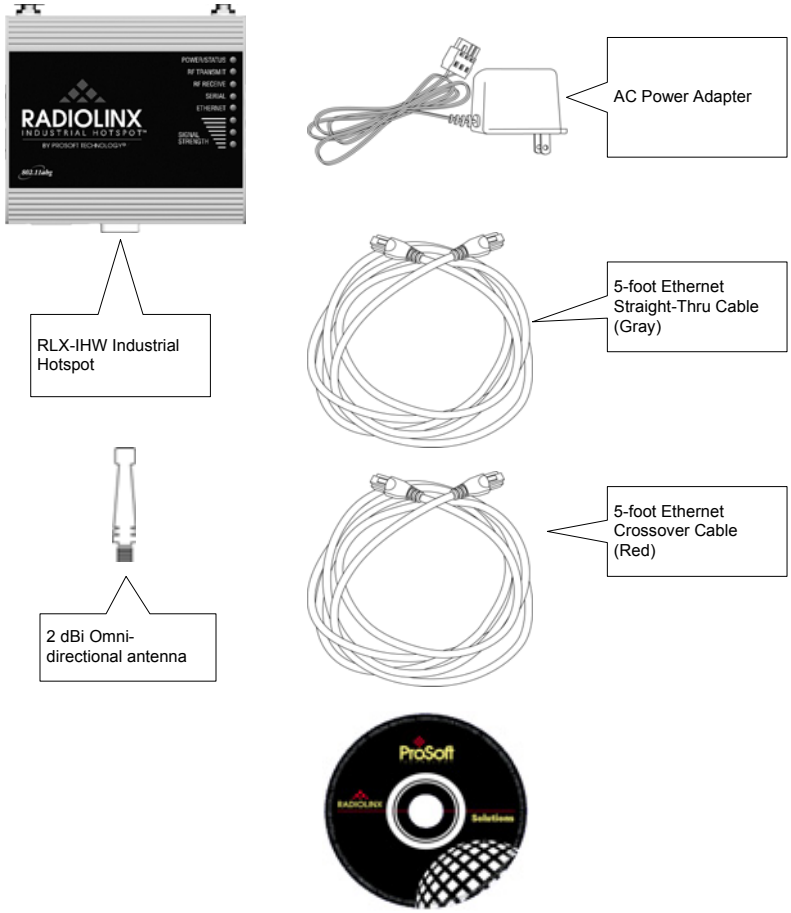
Radio

Frequency Band (Varies by country)	**802.11b/g:** 2.412 to 2.462 GHz (FCC) 2.412 to 2.472 GHz (ETSI) **802.11a:** 5.150 to 5.250 GHz (FCC/ETSI) 5.725 to 5.850 GHz (FCC)
Wireless Standards	802.11a, 802.11b, 802.11g, 802.11i
Transmit Power (Programmable)	Up to 50 mW without amplifier Up to 500 mW with optional amplifier
Channel data rates (Modulation)	802.11b: 11, 5.5, 2, 1 Mbps (DSSS - BPSK, QPSK, CCK) 802.11g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps (OFDM) 802.11a: 54, 48, 36, 24, 18, 12, 9, 6 Mbps (OFDM)
Receiver Sensitivity (Typical)	–95 dBm @ 1 Mbps –90 dBm @ 11 Mbps –82 dBm @ 24 Mbps –75 dBm @ 54 Mbps
Channels Selection	1 to 13 (802.11b/g) 36, 40, 44, 48, 149, 153, 157, 161, 165 (802.11a)
Security	WPA/802.11i with 128/192/256 bit AES-CCM Legacy WPA TKIP, WEP support MAC ID filter Admin password

Physical	
Enclosure	Extruded aluminum with DIN and panel mount
Size	101.6 × 63.5 × 56 mm (W × H × D) 4.0 × 3.5 × 2.2 inches
Ethernet Ports	One 10/100 Base-T connector, shielded RJ45 IEEE 802.3, 802.3u, 802.3x
Antenna Ports	(2) RP-SMA connectors
Weight	1.15 lbs (522g)
Environmental	
Operating Temperature	–30° C to +65° C
Humidity	To 90% RH, non-condensing
External Power	10 to 24 VDC
Average Power	<6W

1.2 Package Contents

Your new RadioLinx Industrial Hotspot radio includes the following components:



1.3 System Requirements

The RadioLinx IH Browser configuration tool is designed for Microsoft Windows XP, 2000 and 2003. Minimum hardware requirements are:

- Pentium® II 450 MHz minimum. Pentium III 733 MHz (or better) recommended
- Supported operating systems:
  - Microsoft Windows XP Professional with Service Pack 1 or 2
  - Microsoft Windows 2000 Professional with Service Pack 1, 2, or 3
  - Microsoft Windows Server 2003
  - Microsoft Windows Vista
- 128 Mbytes of RAM minimum, 256 Mbytes of RAM recommended
- CD-ROM drive
- 100 MB available hard drive space
- Available RS-232 serial port and null modem cable
- 256-color VGA graphics adapter, 800 x 600 minimum resolution (True Color 1024 x 768 recommended)
- Ethernet hub with standard RJ45 Ethernet cable
  or

  Ethernet port with RJ45 crossover cable for direct connection to module

- A web browser, for example Microsoft Internet Explorer or Firefox.

In addition, you will need

- A connection to an existing wired or wireless Ethernet network, with a Static or Dynamic IP address for your computer
- Static IP address, Subnet Mask and Gateway address for each RadioLinx device you plan to install. Obtain this information from your system administrator

1.4 Installing the IH Browser Configuration Tool

➢ ***To install the IH Browser application:***

1 Insert the ProSoft Solutions CD in your CD-ROM drive. On most computers, a menu screen will open automatically. If you do not see a menu within a few seconds, follow these steps:

a Click the Start button, and then choose Run.
b In the Run dialog box, click the Browse button.
c In the Browse dialog box, click "My Computer". In the list of drives, choose the CD-ROM drive where you inserted the ProSoft Solutions CD.
d Select the file **prosoft.exe**, and then click Open.
e On the Run dialog box, click OK.

2 On the CD-ROM menu, click Setup Software.

3 Follow the instructions on the installation wizard to install the program with its default location and settings.

When the installation finishes, you may be prompted to restart your computer if certain files were in use during installation. The updated files will be installed during the restart process.

1.5 Planning the Network

Before you configure and install the network, you should create a plan for it. The following points assume that you are creating a bridge network of masters and repeaters, but you can also set up clients to work with devices on existing wireless LANs. For information, see Set Up a Client.

To begin, determine where you need radios and then choose locations for them accordingly. For example, you might decide to install your master radio near a PC in a central plant location. (You can use the PC to configure the radios through the Radio Configuration / Diagnostic Utility.) If the plant is an oil refinery, for example, you might decide to install radios near the oil tanks.

The next important issue is how to link the radios. Unless the radios are very close together, you must make sure that each pair of radio antennas in the network has a line of sight between them. In other words, you must be able to see from one antenna to another, either with the naked eye or binoculars.

If a line of sight does not exist between antennas, you must choose a site for installing a repeater radio, which will create a bridge between the radio antennas.

Choose the appropriate antennas for the network. If an antenna will be connected to the radio by a long cable, you might need to purchase a power amplifier, which is available from ProSoft Technology. The more distance between an antenna and its radio, the more signal loss the radio will have. For more information, see Antennas.

Consider drawing up your network plans on paper. As part of the drawing, you should assign a logical name to each radio. You can use these names later when configuring the radios in the Radio Configuration / Diagnostic Utility.

As part of your planning, you might want to conduct a site survey. ProSoft Technology can perform this survey, you can do it yourself, or you can hire a surveyor.

Protect radios from direct exposure to weather, and provide an adequate, stable power source. Make sure that your plan complies with the radio's power requirements (page 86) and cable specifications (page 87).

Important: Radios and antennas must be located at least 8 inches (20 cm) away from personnel.

1.5.1 Installation Questions

Answer the following questions to make your installation easier, and to familiarize yourself with your system and what you want to do.

How many radios in your network?

Master ID	Repeater ID	Client ID

Locations

Is there a Line of Sight between them?

Selected the appropriate antennas for your network?

1.6 Configuring the Radios

To configure the network radios, follow these steps.

Use the RLX-IH Browser to display all radios on the network, and then use a Web browser or SNMP manager to view and change radio settings. The radio package includes the program CD, power supply, Ethernet cable, and a small antenna. You must install the antenna later, but it is not needed to get started.

IMPORTANT: If possible, you should configure all the radios side by side in an office setting and make sure they link before you try to install them in the field.

➢ ***To configure the radios in a network:***

1 Start the IH Browser (page 14) configuration application.
The PC or laptop must have a wired or wireless Ethernet connection configured with a static or dynamic IP address.

2 Plug in the power cable and Ethernet cable (page 15) to the RLX-IHW radio, wait a moment for the radio to power up, and then examine the radio's LED display to make sure the radio is working properly.

3 Assign a temporary IP address: (page 16, page 65) Double-click the radio listing in the RLX-IH Browser. In the next window, click OK to accept the temporary IP address, subnet mask, and default gateway.

4 Double-click the radio listing again in the RLX-IH Browser to open the Radio Configuration / Diagnostic Utility in your web browser. Enter "password" (lower case, no quotes) in the next window and then click Login.
If necessary, you can enter your own password later. For information, see Change Password (page 54).

5 Set up the master radio first, using the Radio Settings window in the Radio Configuration / Diagnostic Utility.

6 Click Apply Changes to save the master radio settings.
To cancel the settings and start over, click the Cancel Changes button before you click Apply Changes. After they are configured, master radios are preceded by an "M" in the utility window list.

Note: The text shown in yellow at the bottom of the window indicates the status of changes you have made to the configuration.
- If the text shows "Changes not saved", click Apply Changes to save your settings.
- If the text shows "Changes not saved; Will disrupt X s", you can click Apply Changes, however the network will be disrupted temporarily while the changes are applied. The value of "X" indicates the number of seconds the network will be offline.

7 Unplug the Ethernet cable from the radio and plug it into the next radio to be configured.

8 Set Up a Repeater. Return to the RLX-IH Browser. To be sure that you are seeing the latest status of the radio(s), go to the toolbar (page 74) and click the "Clear" icon (eraser) followed by the "Scan" icon (binoculars). Double-click the listing of the next radio to be configured, and configure it as a repeater radio.

9 Save the Radio Configuration. (page 20) Save the repeater radio settings by clicking Apply Changes at the bottom of the Radio Settings screen. Repeat steps 7 through 9 to configure each repeater in the network.

10 After configuring the network and its radios, physically label each radio. Labeling eliminates confusion about which radios correspond with which radio configurations in the software. You should identify the radio's name, network SSID, and IP address, if set.

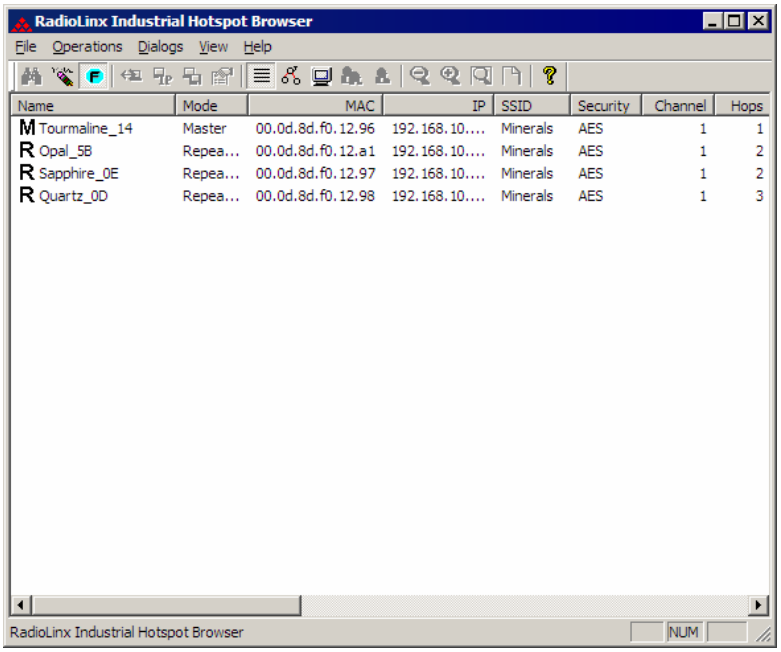
11 Install the radios and antennas (page 23).

The remainder of the topics in this section describe each of these steps in more detail.

1.6.1 Start IH-Browser

➢ ***To start IH Browser***

1. Click the Start button, and then choose Programs.
2. In the Program menu, navigate to ProSoft Technology.
3. In the ProSoft Technology menu, navigate to RadioLinx.
4. Click RadioLinx IH Browser.



The window lists all the radios your computer can access. The MAC ID number is essentially the serial number of the radio; this number is also printed on the side of the radio. If a radio listing does not appear in the window, select Scan from the File menu. If you still do not see a radio listing, see Troubleshooting.

1.6.2 Plug In the Cables

You can configure the RLX-IHW using the Ethernet port on the radio. On the underside are three ports; Ethernet, Serial and Power (10 to 24 VDC 6 W).

From left to right: Ethernet port, serial port and power connector.

- If you are connecting to the radio through an Ethernet hub or switch, use the gray (straight-through) cable.
- If you are connecting to the radio directly from your PC without going through an Ethernet hub or switch, you must use the red (crossover) cable.

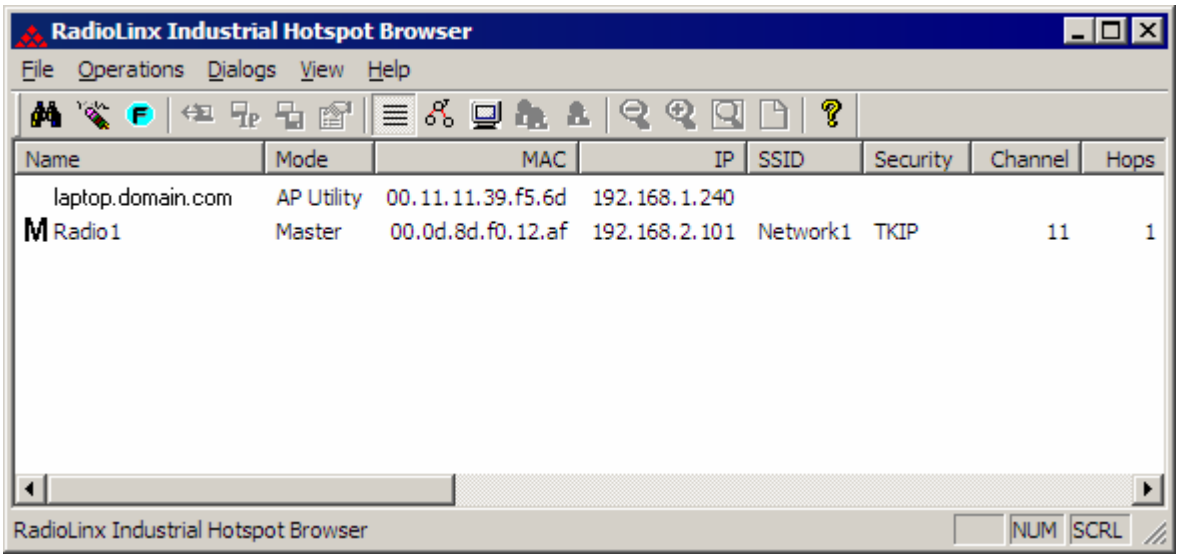
Note: After you plug in the power cable and Ethernet cable, the radio performs a startup procedure that includes a self-test, loading the main program, and initializing the radio. This startup procedure can take up to two minutes.

After the startup procedure has completed successfully, the Power/Status LED should be green, meaning that the radio has power. The Ethernet LED should also be green, meaning that the Ethernet connection is working. The RF Transmit and RF Receive LEDs should blink.

For information on making connections, see Radio power requirements (page 86) and Cable specifications (page 87).

1.6.3 Detecting the Radio

After the radio has completed its startup procedure, the radio will appear in the IH Browser window.



Tip: If a radio listing does not appear in the window, open the File menu and choose Scan. If you still do not see a radio listing, refer to Diagnostics and troubleshooting.

The next step is to assign a temporary IP address to the radio, so that you can configure the radio through its web interface.

1.6.4 Assign a Temporary IP Address

You need the IP address to log into the Radio Configuration/Diagnostic Utility and configure the radio settings. If the radio is connected to a network with a DHCP server, the radio may already have an IP address assigned to it.

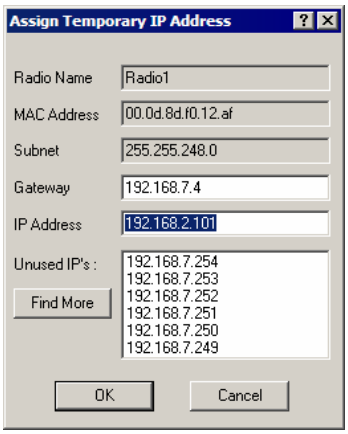
If a DHCP server is not available, or if you prefer to assign a static IP address, you can enter a temporary IP here. You will use the Radio Configuration / Diagnostic Utility (page 29) to assign a permanent IP address.

➢ ***To assign a temporary IP Address***

1 In IH Browser, click to select the radio.

Tip: If a radio listing does not appear in the window, open the File menu and choose Scan. If you still do not see a radio listing, refer to Diagnostics and troubleshooting.

2 Open the Operations menu, and choose Assign IP. This action opens the Assign Temporary IP Address dialog box.

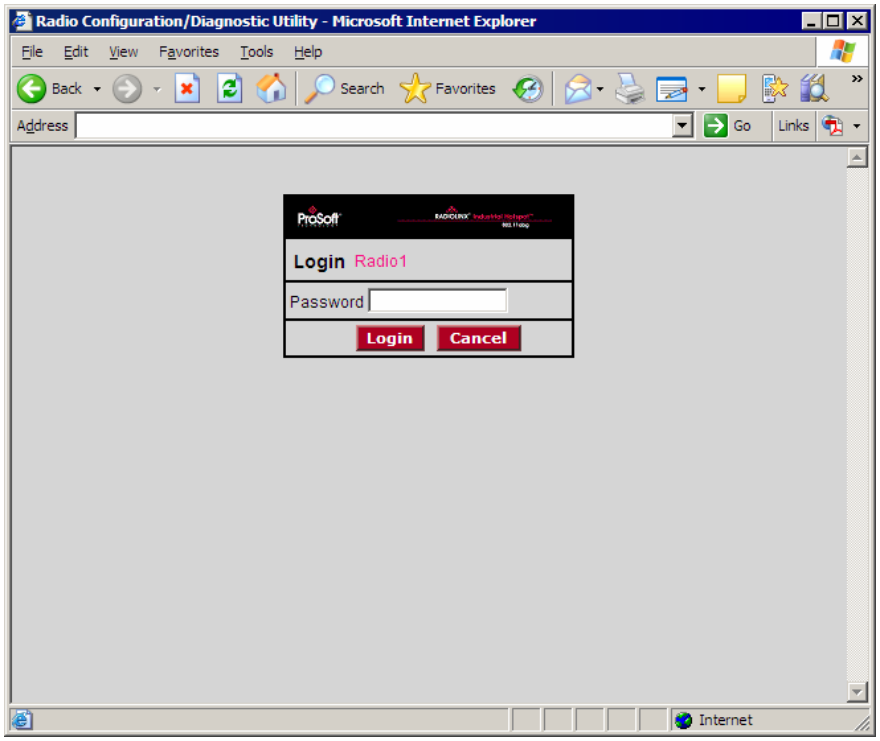


3 Accept the dynamically assigned address, and then click OK.

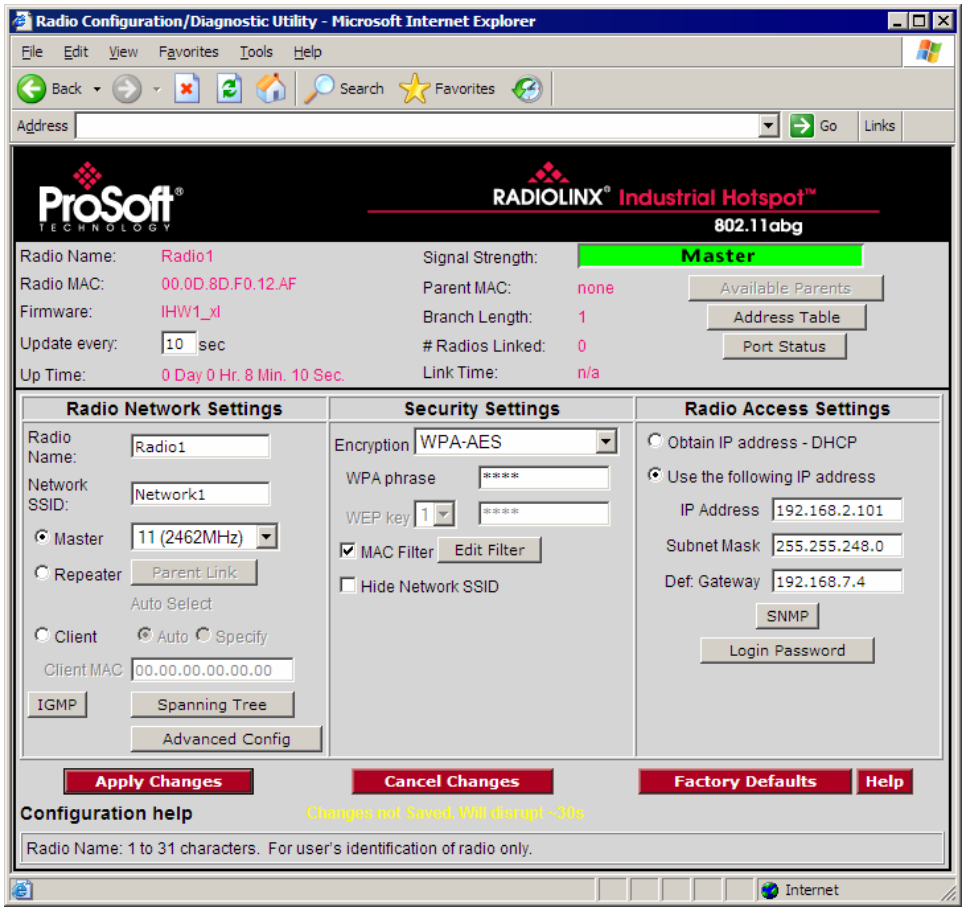
For information, see Radio Access settings (page 52).

1.6.5 Set Up the Master Radio

To configure the radio, double click on the radio (Radio1) in the IH Browser window. This action opens a web browser (for example Microsoft Internet Explorer or Firefox) and loads the IH Radio's web configuration interface.



Important: The radio configuration is protected by a login password. The default password for the radio is "password" (lower case, no quotes). To prevent unauthorized access to the radio configuration, you should change the password when you have finished the initial configuration.
Note: The master is the "root" or top-level radio in a network. You must have at least one master radio per network. For redundancy, you can assign more than one master to a network.



To configure a Master radio, make the following changes to the web configuration form:

➢ ***Radio Network Settings***

- **Radio Name:** Enter a unique name for the radio.
- Select **Master** as the radio mode.
- **Network SSID:** Assign a network name (SSID) of up to 32 characters. The radio uses this name in all network references. All radios in a network must have the same SSID.
- **Channel:** Select a channel and frequency range for the network or accept the default value. Network channels allow radios to avoid sharing a frequency with other networks in the same location. The channel list indicates the channel number as well as the frequency (2.4 gHz or 5 gHz).

Important: The RadioLinx IHW radio is supplied with a dual-band antenna that supports both frequency ranges. If you use a different antenna with the IHW radio, you must choose a channel and frequency range supported by the antenna.

➢ ***Security Settings***

- **Encryption Type:** Encryption scrambles data so that only intended viewers can decipher and understand it. Although "none" is an available encryption type, ProSoft Technology strongly recommends encrypting all data sent and received from every radio on your network, to help prevent your data from being intercepted and decoded.
- **WPA phrase:** To use WPA encryption on packets sent between the radios, select WPA in the Encryption Type field. Next, in the WPA phrase field, enter a pass phrase of between eight and 63 normal keyboard characters. This phrase automatically generates an encryption key of 128 hexadecimal characters. The default pass phrase is "passphrase" (lower case, no quotes). For more information on encryption, see Security settings.

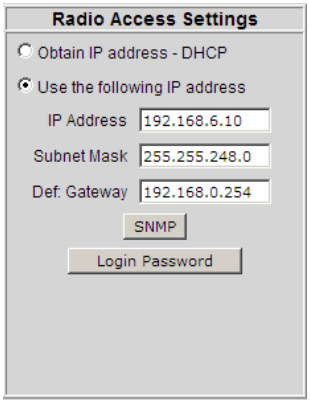
Because you must assign the same Network SSID and WPA phrase to the repeater radios later in this procedure, you should write down the settings.

Note: Network SSID and WPA phrase are both case-sensitive.

Network SSID:_____

WPA phrase:_____

➢ ***Radio Access Settings***



If a DHCP (Dynamic Host Control Protocol) server is configured on your local area network, the DHCP server can assign IP addresses automatically.

If you prefer to assign a Static (Fixed) IP address, select "Use the following IP address", and then enter the IP Address, Subnet Mask and Default Gateway in the Radio Access Settings area of the IH Radio web configuration form.

Important: If you intend to assign IP addresses manually, you must not duplicate an IP address that is already in use on your network. If you are not sure what IP addresses are available, ask your network administrator for assistance.

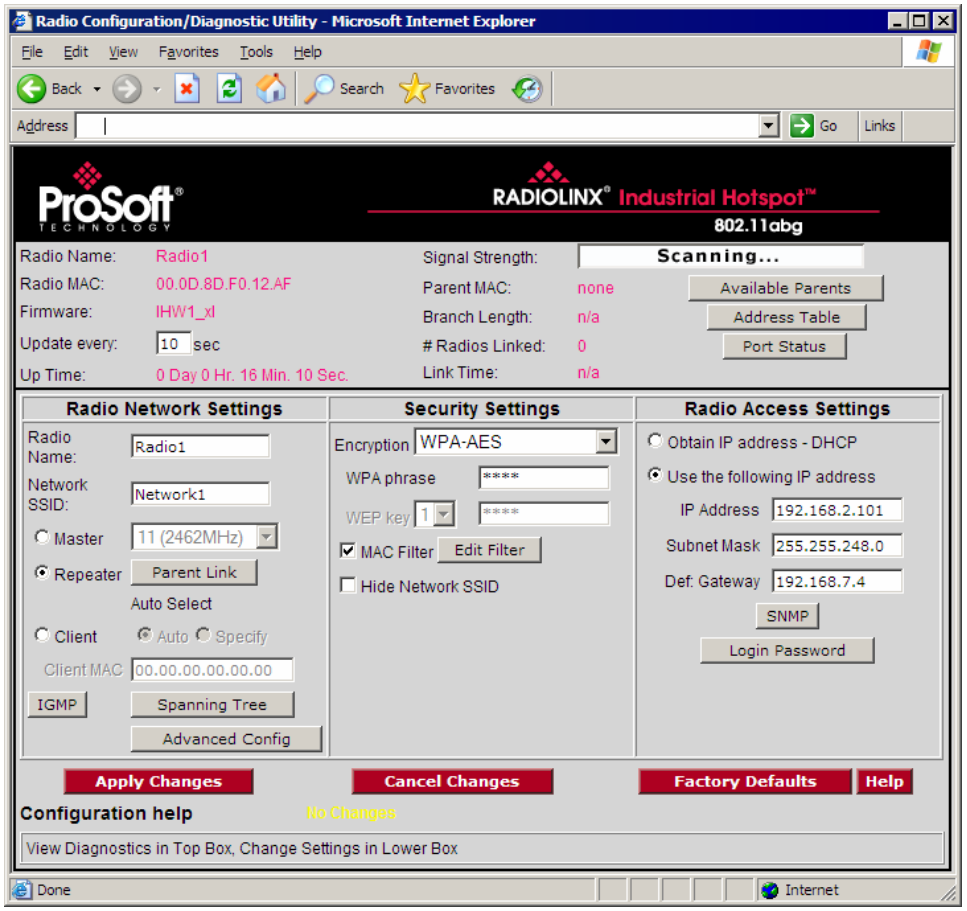
1.6.6 Save the Radio Configuration

Before closing the Radio Configuration window, you must apply your changes. Click Apply Changes to save your configuration and restart the radio.

Note: To discard your changes and start over, click Cancel Changes.

1.6.7 Set Up a Repeater

To configure a radio as a Repeater, make the following changes to the web configuration form:



➢ ***Radio Network Settings***

- **Radio Name:** Enter a unique name for the radio.
- Select **Repeater** as the radio mode.

- **Network SSID:** Enter the SSID you configured for the Master radio. All radios in a network must have the same SSID.

➢ ***Security Settings***

- **Encryption Type:** Encryption scrambles data so that only intended viewers can decipher and understand it. Choose the same encryption type you configured for the Master radio.
- **WPA phrase:** Enter the pass phrase you configured for the Master radio.

Important: The Network SSID and WPA phrase are case sensitive. Use *exactly* the same combination of upper case and lower case letters you entered for the Master radio, otherwise the Repeater radio will not be able to connect to the Master radio.

By default, a repeater connects automatically to the best available parent radio on the network. If necessary, however, you can click the Parent Link button and specify how repeater radios connect to the network. See Parent Link settings for information.

1.6.8 Set Up a Client

Client mode is a special mode in the radio that allows a user to connect an Ethernet device to a wireless network through any 802.11a, b or g access point. Any Ethernet device that has an RJ45 Ethernet port can, in effect, be transformed into an 802.11a, b or g wireless client by attaching the radio. Only a single device can be connected to the radio in client mode. Do not connect to more than one Ethernet device (using a switch or hub).

You only use client mode if you need to connect to another brand 802.11a, b or g access point. If you are using RLX-IHW radios, you should always use them as repeaters (and masters).

To connect a device to a radio in client mode, click the Client button for the radio and try programming the radio's client mode using the Auto setting. To test whether the Auto setting will work:

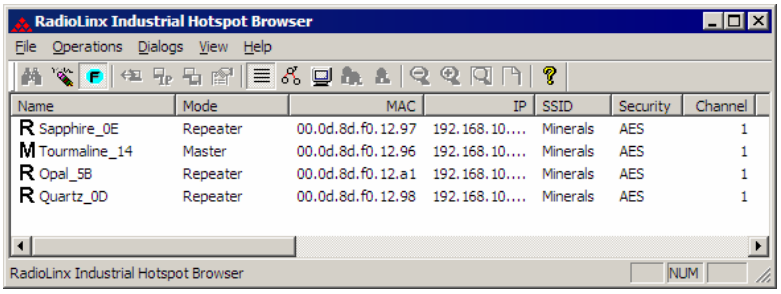
1. Connect the cable between the device and the radio.
2. Turn ON the radio power, or cycle the power if the radio is already on.
3. Turn ON the device. Watch the radio to see if it initializes. The Auto setting will work if the device advertises its MAC ID to the radio.

If the radio's RF LEDs do not show consistent activity after a few minutes, then you may need to modify the radio's client settings. Click the Specify radio button, determine the MAC ID of the Ethernet device, and type the ID into the Client MAC field.

Client radios are preceded by a 'C' in the list of radios in the RLX-IH Browser.

1.7 Verify Communication

When configured, the name of each radio is preceded by an M (for Master), an R (for Repeater), or a C (for Client) in the IH Browser window.



Look at the LEDs to ensure good link quality, as explained in LED display (page 26). After a repeater is configured, you can unplug the Ethernet cable from it.

2 Installing the Radios

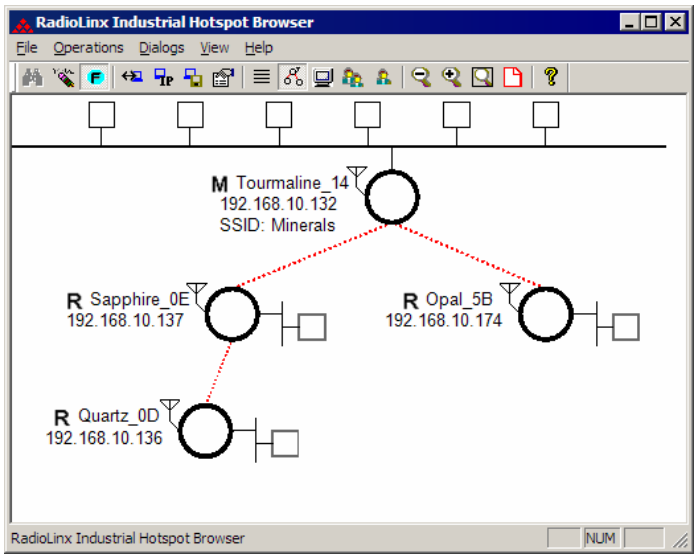
In This Chapter

If possible, you should configure all the radios side by side in an office setting and make sure they link before you install them in the field. If feasible, it would be even better if you could set up the entire system in the office and make sure your equipment communicates properly through the radio network.

Tip: To make it easier to physically identify the radios you are configuring, apply a label to each radio indicating the radio name and IP address.

After you have configured each radio using IH Browser and the web configuration form, you can install the radios and test their performance. Install the radios in their proposed permanent locations, then temporarily place each radio's antenna near its proposed mounting location. The temporary placement of the antenna can be by hand; however, with this testing method, one person must hold the antenna while another monitors the radio's signal strength.

To see how a radio is linked in the network, make sure that the radio is connected to a PC or laptop, and then select Topology View from the View menu in the RLX-IH Browser.



The Topology view shows a diagram of the network's wireless connections. Use this view to see whether all the radios are linked, and that you approve of the way the radios are linked. A radio that is not linked to a parent will show as a circle outlined by a flashing dashed red line. It may be near the bottom of the window, so scroll down to view all available radios. To change how radios link to the network, see Parent Link settings.

Refer to Improve Signal Quality (page 28) for more information on overcoming poor connectivity.

2.1 Connecting antennas

Each radio must have an antenna connected to the Main antenna port on the RLX-IHW radio; without an antenna for each radio, the network will not function.

All antennas for radios that communicate directly with each other should be mounted so they have the same antenna polarity. Small antennas with a reverse-polarity SMA connector can be mounted directly on the radio. Screw the antenna onto the antenna port connector until it is snug.

Larger antennas and antennas that do not have a reverse-gender SMA connector must be mounted separately and connected to the radio using a coaxial antenna cable. Because the antenna cable attenuates the RF signal, use an antenna cable length that is no longer than necessary to ensure optimum performance.

3 Diagnostics and Troubleshooting

In This Chapter

Use the program's diagnostic and signal strength settings at the top of the Radio Settings window to make sure the network is working properly.

- **Signal Strength graph:** This setting graphically shows the radio's signal strength. The graph will show the word Master if a master radio is selected. The graph will show the word Scanning if the radio is scanning to find another radio to which to connect. If the radio is not connected to a network and not currently scanning, the graph will show the words Not connected.
- **Update readings every:** If you want to update the diagnostic readings according to a particular interval, specify the interval (in seconds) in this field.
- **Read-only fields** that appear with the diagnostic settings .

You can perform the following troubleshooting routines:

- Check the Ethernet cable
- Check the serial cable
- Retrieve the default password

For more troubleshooting information, go to the ProSoft Technology web site at http://www.prosoft-technology.com

The Radio Configuration / Diagnostic Utility (the web configuration form for the radio) provides information that can help you troubleshoot problems with the radio.

Use the program's diagnostic and signal strength settings at the top of the Radio Settings window to make sure the network is working properly.

Signal Strength graph: This setting graphically shows the radio's signal strength.

- The graph will show the word **Master** if a master radio is selected.
- The graph will show the word **Scanning** if the radio is scanning to find another radio to which to connect.
- If the radio is not connected to a network and not currently scanning, the graph will show the words **Not connected.**

Update every: If you want to update the diagnostic readings according to a particular time interval, specify the interval (in seconds) in this field. After entering the new value, press Enter only if you want to save the new value; press Tab or click elsewhere to use the new value temporarily.

The following configuration forms in the Radio Configuration / Diagnostic Utility provide information about current radio operation:

- Address table (page 34)
- Port status (page 35)
- Available Parents

Read-only fields The following topics describe troubleshooting routines:

- Check the Ethernet cable (page 26)
- Retrieve the default password (page 27)
- Troubleshoot RLX-IH Browser error messages (page 27)
- Troubleshoot missing radios in the RLX-IH Browser (page 28)

For more troubleshooting information, visit the ProSoft web site at http://www.prosoft-technology.com

3.1 Check the Ethernet cable

If you connect a radio and the Ethernet LED does not light on the radio, you may have used the wrong cable type. In other words, you may have used a cross-over cable when you should have used a straight-through cable, or vice versa.

Use a straight-through cable when connecting the radio to an Ethernet hub or a 10/100 Base-T Ethernet switch. Straight-through cables are used in most cases.

Use a cross-over cable when connecting the Ethernet radio directly to any device that is NOT a switch or a hub (e.g., a direct connection to a PC, PLC, or printer).

3.2 LED display

The RLX-IHW front panel includes a set of LEDs that indicate the radio's status:

LED	Description
Power/Status	This green LED indicates that the radio has power.
RF Transmit	This yellow LED indicates RF transmission.
RF Receive	This green LED indicates RF reception.
Serial	If this green LED is lit, the serial cable is connected. If this LED is flashing, a serial packet is being transmitted or received. (The serial port is not available in the first release of the radio.)
Ethernet	If this green LED is lit, the Ethernet cable is connected. If this LED is flashing, an Ethernet packet is being transmitted or received.
Signal Strength	If only one of these three LEDs is lit, then the radio is linked. If two LEDs are lit, the radio's signal strength is fair. If all three LEDs are lit, the signal strength is good.

If a radio is configured as a master, the middle light of the three Signal Strength LEDs will always be on, and the bottom Signal Strength LED will always be off. The top LED on the master will flash if any radios are linked to this master.

After you first plug in the power cable and Ethernet cable to the radio, the Power/Status LED should be green, meaning that the radio has power. If the Ethernet LED is green, then the Ethernet connection is working. The RF Transmit and RF Receive LEDs should blink.

All three LEDs will blink just after the radio links to the Master's signal but before it has been fully authenticated. Normally you will see this last only a few seconds. If it lasts longer or never turns solid it usually means the encryption keys are not correct.

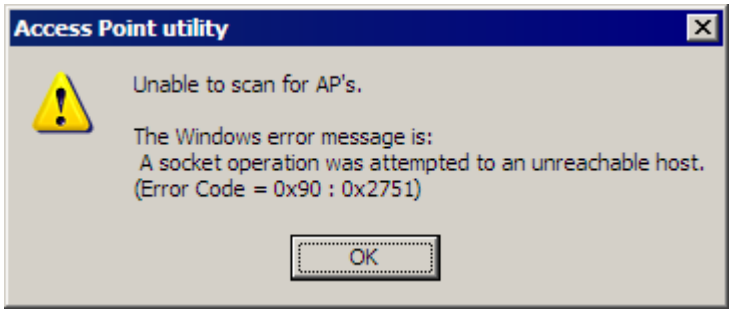
3.3 Retrieve the default password

If you forget your password, you will be unable to change the radio settings. You can retrieve the default password to use the software again, but you will lose all the settings you programmed before. To retrieve the default password and return the radio to its factory default settings:

1. Use a serial cable to connect the radio's serial port to an RS-232 serial port on the computer.
2. Run a terminal program such as HyperTerminal.
3. Set up the terminal program to communicate directly to the COM port you are connecting to by entering the following settings:
   - Baud rate: 38,400
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
4. Hold down the r (lower case R) key on the keyboard and turn on the radio power. Continue holding down the r key for more than 30 seconds until the radio initializes.
5. The radio will be reset to its factory default settings, including the password. You should now be able to log in using the default password, which is "password".

3.4 Troubleshoot RLX-IH Browser error messages

One error message commonly occurs when you use the RLX-IH Browser. You can easily remedy this error, which is shown in the following illustration:



This error occurs when the RLX-IH Browser attempts to scan for radios and no valid network connection exists on the PC, wired or wireless.

To correct this error, Confirm that your PC has at least one active network (LAN) connection; it could be a wired Ethernet connection or a wireless 802.11 connection. One way to determine if your network connections are active is to look in the system tray in the lower-right corner of your desktop. The two-PC icon indicates a connection and the icon with a red X indicates an inactive connection. If no connections are visible in the system tray, check Network Connections in the Control Panel.

Confirm that the network connection has a valid IP address. Your network connection might need to have a static IP address assigned to it. Check the IP address of your network connection to determine that one has been assigned.

3.5 Troubleshoot missing radios

If radios are not visible in the RLX-IH Browser, try the following:

- First, click the Scan button again. Scans are sent as broadcast messages, which can be dropped in RF connections, requiring the user to scan again.
- Second, make sure that the firewall is not activated on your PC. (This is most common in Windows XP). Open the Network connections folder in your Windows Control Panel, then open the Local Area Connection Properties window and verify that the check box under Internet Connection Firewall is not checked.
- If the preceding approaches do not help, the PC running the RLX-IH Browser and the radios are probably not connected to the same local network. Verify your connections.
- If you are in topological view, any unlinked radios may be at the bottom of the window. Scroll down to see all radios. If you still cannot see radios with the RLX-IH Browser, call technical support.

3.6 Improve signal quality

If you need to improve a radio's signal quality, try the following steps:

- Adjust the direction of the high-gain antennas.
- Increase the height of the antenna's placement.
- Use higher-gain antennas or external preamplifiers.
- Select a new location for the radio and/or its antenna.
- Decrease the length of the antenna cable.
- Determine and resolve sources of interfering electrical noise.
- Add a repeater between radios that are not communicating.

4 Radio Configuration / Diagnostic Utility

In This Chapter

The RadioLinx Industrial Hotspot radio has a built-in Radio Configuration / Diagnostic Utility (radio web configuration form) that allows you to configure the radio from any computer that can connect to the radio, through a wired Ethernet connection, or through a Wireless (WiFi) connection.

You can use a web browser such as Microsoft Internet Explorer or Firefox on your network-enabled desktop computer, laptop or Personal Data Assistant (PDA) to monitor and change the settings within the RadioLinx Industrial Hotspot radio.

➢ ***To open the Radio Configuration / Diagnostic Utility***

1. In the RadioLinx Industrial Hotspot Browser, select the radio to configure from the list view or topography view, and then click the right mouse button to open a shortcut menu.
2. On the shortcut menu, choose Connect. The Radio Configuration / Diagnostic Utility will open in your web browser.
   Or,
   Double-click the selected radio to launch the Radio Configuration / Diagnostic Utility.

You can also open the Radio Configuration / Diagnostic Utility directly from your web browser.

Important: Your desktop computer, laptop, or PDA must be connected to the same network as the RadioLinx Industrial Hotspot radio.

1. Open your web browser.
2. In the address bar, type "http://", followed by the IP address for the radio, and then click the "Go" button. For example,

http://192.168.6.10

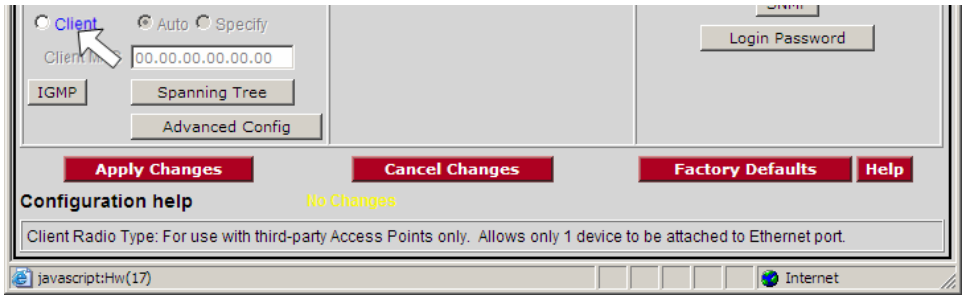
Read-Only fields

Some of the fields on the Radio Configuration / Diagnostic Utility form are read-only, meaning that the content of the field is provided for information only, and cannot be directly modified. Notice also that depending on the way the radio is configured, some fields and buttons may be unavailable because they do not affect the configuration you have selected. Review the topics in this section for more information on when and how to use each configuration option.

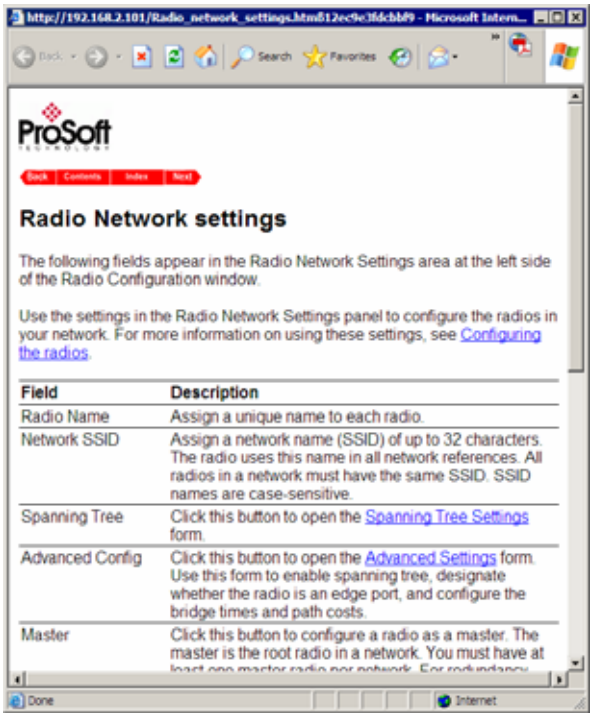
Configuration Help

Help is available for each item in the Radio Configuration / Diagnostic Utility.

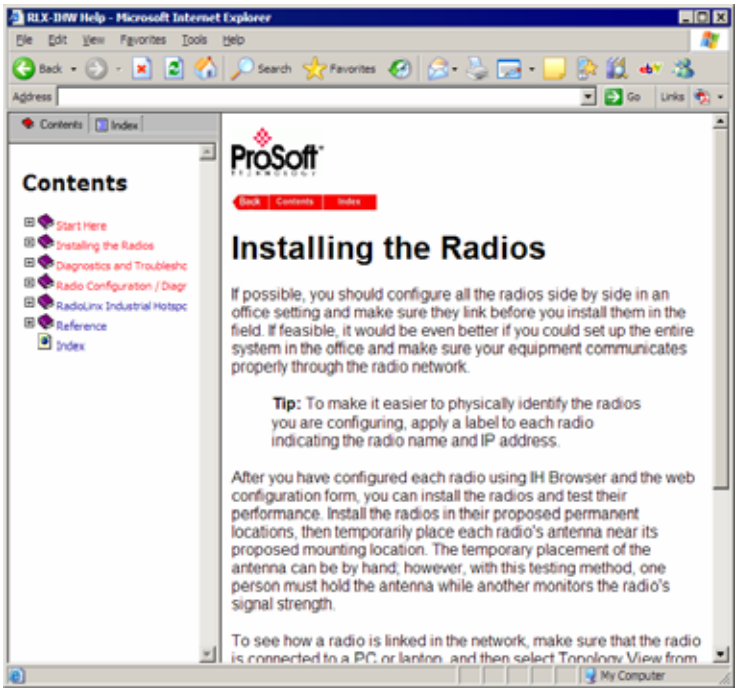
- To view a brief help message about any field on the screen, move your mouse pointer over the field, or use the **[Tab]** key, and refer to the text that appears at the bottom of the screen.



- To view more help about the selected field, click the field name. This action opens a help page in a new browser window.

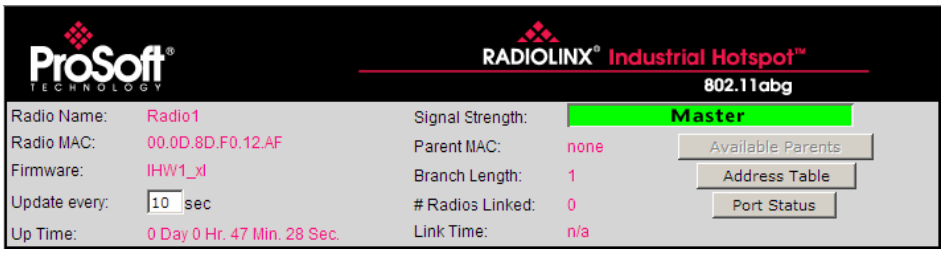


- To view the complete online documentation for your RadioLinx IH Radio, click the Help button. This action opens the online documentation in a new browser window. Use the Contents, Index and Search tabs in the left frame to navigate the help system.



4.1 Radio Status

The following fields appear in the status area at the top of the Radio Configuration window.



Use the settings in the Radio Status panel to view the current settings for this radio.

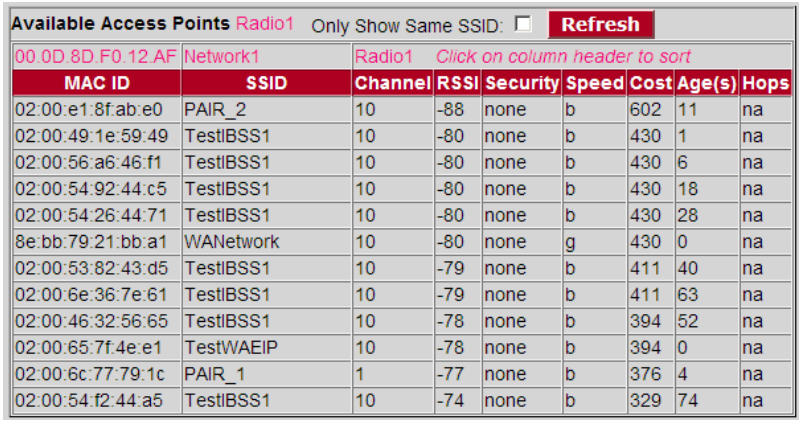
Field	Description
Radio Name	The name of the selected radio.
Radio MAC	The MAC address of the selected radio. The MAC ID is also printed on the side of the radio.

Field	Description
Firmware	The version of firmware currently installed. All radios on the network must have the same firmware versions installed. For more information on firmware versions, refer to Update firmware.
Update every	This value in seconds controls how often the web configuration form automatically refreshes. To change the value temporarily, enter the new value and press the [Tab] key. To change the value permanently, enter the new value and press the [Enter] key.
Up Time	The length of time the radio has operated since the last system power-up or last system reset.
Signal Strength	Strength of the signal from the Parent radio.
Parent MAC	The MAC address of the parent radio to which the selected radio is linked.
Branch Length	The number of RF links from the radio to the master radio.
# Radios Linked	The number of other radios that are linked to this radio.
Link Time	The length of time the radio has been continuously connected to a parent radio.
Available Parents	Click this button to view the list of Access Points (Parents) from which this radio can detect beacons. This button is only available when the radio type is Repeater.
Address Table	Click this button to view a list of MAC addresses for devices entered in the radio's address table.
Port Status	Click this button to view spanning tree status of each switch port, for RF ports and the RJ45 (Ethernet) port.

4.1.1 Available Parents

This page opens when you click the Available Parents button on the Radio Configuration Form.

Note: This form is not available when the radio type is Master.



MAC ID	SSID	Channel	RSSI	Security	Speed	Cost	Age(s)	Hops
02:00:e1:8f:ab:e0	PAIR_2	10	-88	none	b	602	11	na
02:00:49:1e:59:49	TestIBSS1	10	-80	none	b	430	1	na
02:00:56:a6:46:f1	TestIBSS1	10	-80	none	b	430	6	na
02:00:54:92:44:c5	TestIBSS1	10	-80	none	b	430	18	na
02:00:54:26:44:71	TestIBSS1	10	-80	none	b	430	28	na
8e:bb:79:21:bb:a1	WANetwork	10	-80	none	g	430	0	na
02:00:53:82:43:d5	TestIBSS1	10	-79	none	b	411	40	na
02:00:6e:36:7e:61	TestIBSS1	10	-79	none	b	411	63	na
02:00:46:32:56:65	TestIBSS1	10	-78	none	b	394	52	na
02:00:65:7f:4e:e1	TestWAEIP	10	-78	none	b	394	0	na
02:00:6c:77:79:1c	PAIR_1	1	-77	none	b	376	4	na
02:00:54:f2:44:a5	TestIBSS1	10	-74	none	b	329	74	na

This page is helpful for viewing:

- Possible parents for a repeater. The current parent should normally be the radio with the lowest cost and a matching SSID.

- Other 802.11 networks in the area.

Field	Description
Only Show Same SSID	Select (check) this box to restrict the list of available parents to those with the same SSID as the radio you are configuring.
Refresh	Click this button to re-scan the network and update the devices in the list.
Mac ID	A unique hexadecimal number that identifies any Ethernet device.
SSID	Network Name (Service Set Identifier).
Channel	The radio channel on which the device is transmitting. The channel list indicates the channel number as well as the frequency (2.4 gHz or 5 gHz). **Important:** The RadioLinx IHW radio is supplied with a dual-band antenna that supports both frequency ranges. If you use a different antenna with the IHW radio, you must choose a channel and frequency range supported by the antenna.
RSSI	Received Signal Strength Indication.
Security	The encryption type enabled for the device.
Speed	The IEEE 802.11 connection speed (a, b, or g). The RadioLinx IHW radio supports all three 802.11 connection speeds.
Cost	Parent selection cost.
Age	The length of time (in seconds) since the radio last saw a packet from this MAC address
Hops	The number of hops to the Master. A value of 0 (zero) is shown for non-ProSoft devices.

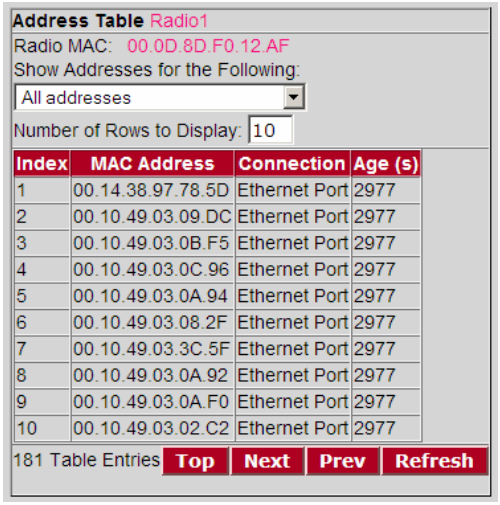
This list contains both 802.11 devices that are part of the same SSID as the IHW itself (for example, "Minerals") as well as devices that belong to different SSIDs (for example, "Network1" and "ProSoftInternal"). This list is updated continuously and can be used for many purposes.

The IH radio updates this list with each 802.11 packet that is received, whether from a radio of the same network or one that belongs to another SSID. It can also see radios from other vendors.

Once per second the IH radio evaluates the link it has to its parent to determine if this link is the best parent to use. A cost is calculated for each entry and can be seen in the column labeled "Cost" in the preceding table. The cost calculation is based not only on the strongest signal, but on several other factors to provide optimum network communication.

4.1.2 Address table

This configuration page opens when you click the Address Table button on the Radio Configuration form.



The Address Table shows the port through which each MAC address is connected, along with the age in seconds since the radio last saw a packet from this MAC address.

Field	Description
Radio MAC	The MAC address of the selected radio. The MAC ID is also printed on the side of the radio.
Show Addresses for the Following	Use this dropdown list to filter the address list. Options are: ▪ Devices Out Ethernet Port ▪ Directly Linked Radios/Clients ▪ Devices beyond Direct RF Links When the table is filtered to show only Directly linked radios/clients, an additional RSSI column is listed, showing the Received Signal Strength from each radio or client linked to the radio.
Number of Rows to Display	Use this field to choose how many MAC addresses to display on this page. Use the Next and Prev buttons to scroll through the available MAC addresses.
Index	Position in the list. Each page shows up to 10 devices. Use the Next and Previous buttons to move up and down through the table.
MAC Address	The MAC address for the device.
Connection	The connection type
Age (s)	The length of time (in seconds) since the radio last saw a packet from this MAC address
Top	Click the Top button to see the top of the table. The radio will display updated data in the table entries.
Next / Prev	If the table has more MAC addresses than it can display in the window, use the Next and Prev buttons to move up and down through the table.
Refresh	Click Refresh to update the table.

4.1.3 Port status

This configuration page opens when you click the Port Status button on the Radio Configuration form.

Port Status Amethyst_BD

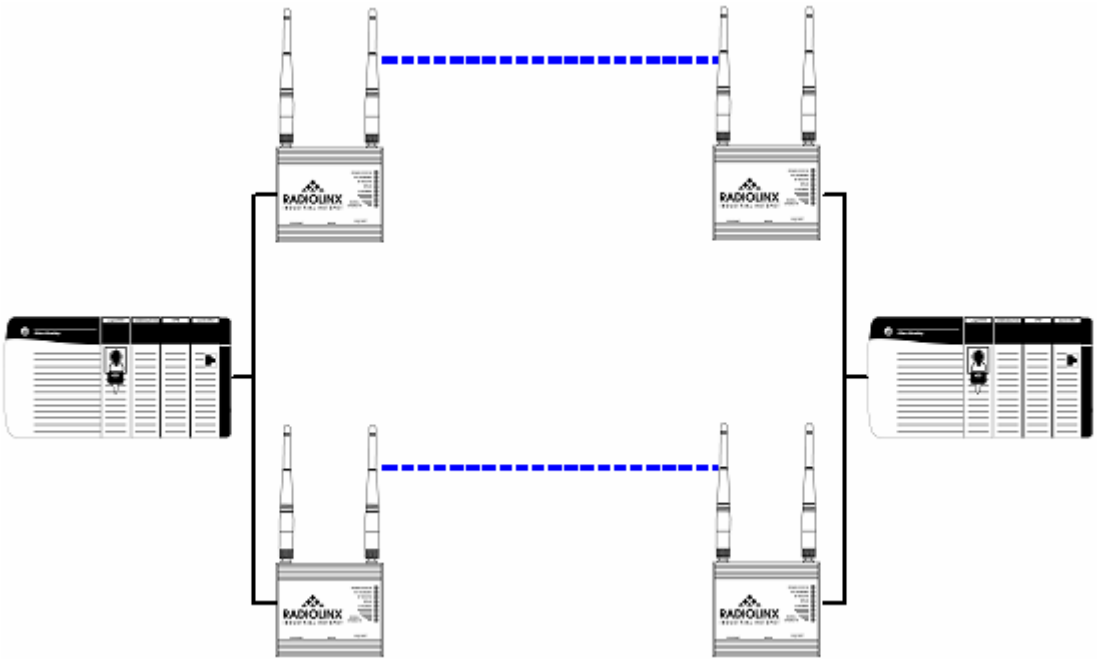
Spanning Tree Protocol: Wireless Ports Rapid STP Ethernet Port Rapid STP
Spanning Tree Root: MAC 00.15.C5.26.DA.1C
Priority 32768 Max Age 20s Hello Time 2s Forward Delay 15s

#	Connection	State	Designation	Path Cost	Designated Bridge
1	Ethernet-Disconnected	Forwarding	Designated	600	00.05.87.01.00.BD
2	RF Parent 00.05.87.01.01.14	Forwarding	Root	500	00.05.87.01.01.14
11	RF Child 00.05.87.01.01.5C	Forwarding	Designated	700	00.05.87.01.00.BD
12	RF Child 00.0D.8D.F0.00.4F	Forwarding	Designated	700	00.05.87.01.00.BD

Top | Next | Prev | Refresh

When you click the Port Status button, you can see information about all the active ports on the radio. Above the table, you can see information about the current Spanning Tree (page 45), including the MAC address of the "root" device, and the timing parameters that are set for the current Spanning Tree. Each radio can have up to 34 active ports—one Ethernet cable, one parent RF link, and up to 32 child RF links.

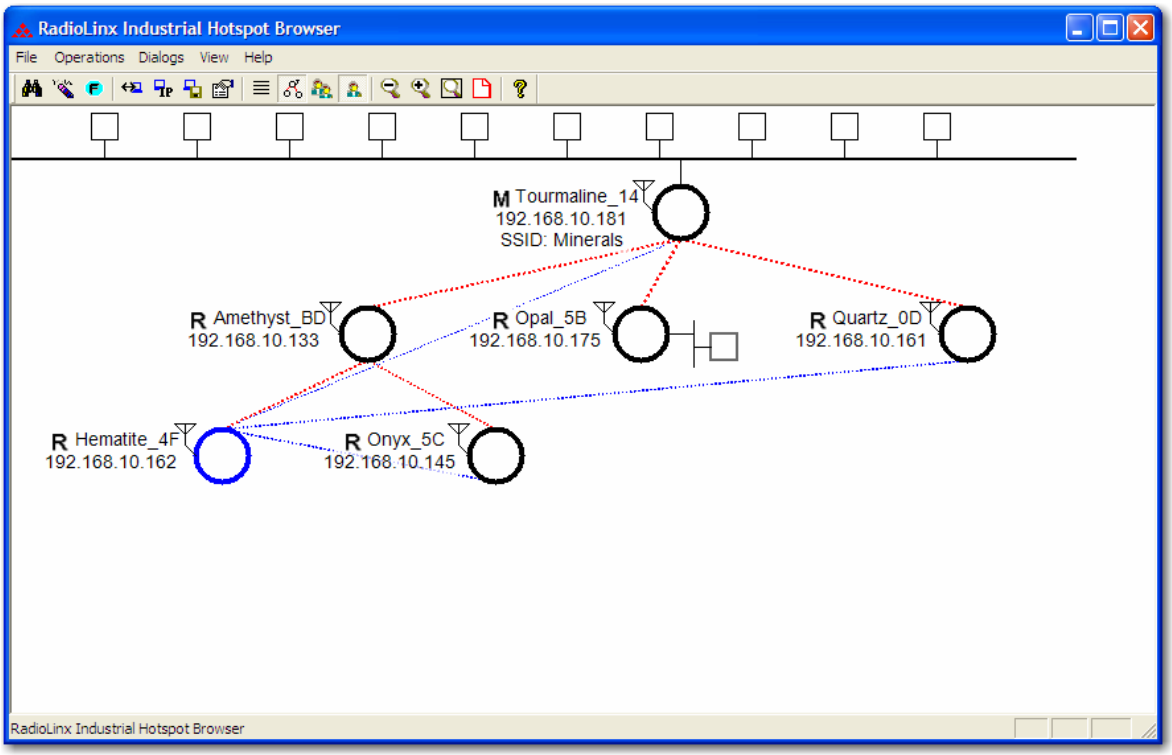
The primary reason for creating a Spanning Tree is that it allows you to create fully redundant paths. If any single radio in a redundant path loses its connection, another path still exists, and the connection will be updated and communication restored.



Field	Description
Spanning Tree Protocol: Wireless Ports	The Spanning Tree Protocol level for the wireless port. (Rapid STP or STP).
Ethernet Port	The Spanning Tree Protocol level for the Ethernet port. (Rapid STP or STP).
Spanning Tree Root MAC	The MAC ID of the root device in the spanning tree.
Priority	The Spanning Tree device with the lowest-priority value is elected the root of the tree
Max Age	The length of time a port can stay enabled without any new spanning updates.
Hello Time	The length of time between the transmission of spanning update packets.
Forward Delay	The length of time a port must listen for spanning information before being activated.
#	Position in the list. Each page shows up to 10 ports. Use the Next and Previous buttons to move up and down through the table.
Connection	This field indicates what the port represents: Ethernet, a parent radio, or a child radio.
State	The current Spanning Tree state of the port. Possible states are Blocking, Learning, Listening, and Forwarding. Forwarding packets can be transferred.
Designation	The Spanning Tree designation for the branch off the port. Possible designations are Root (ports going to the root), Designated (ports going to a branch), or Normal.
Path Cost	The cumulative cost of all wired and wireless links from the port to the Spanning Tree root.
Designated Bridge	The next bridge toward the Spanning Tree root for this port.
Top	Click the Top button to see the top of the table.
Next / Prev	If the table has more ports than it can display in the window, use the Next and Prev buttons to move up and down through the table.
Refresh	Click Refresh to update the table.

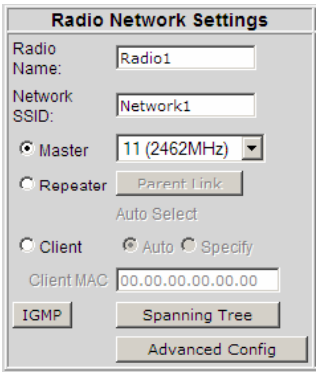
The following illustration shows the RadioLinx Industrial Hotspot Browser (page 57) application provided with the radios. Notice it shows the radio named Hermatite_4F, linked to Amethyst_BD. This link is shown with a red dotted line. Also visible is the level of redundancy in their network. Each of the blue lines represents an alternate parent. From this view, you can easily tell how much redundancy exists in their network.

To display the redundant paths, select the toolbar button denoting two "parents." To view the redundancy on a per-radio basis, select the single "parent" button, and then click on the radio to view its available redundancies.



4.2 Radio Network settings

The following fields appear in the Radio Network Settings area at the left side of the Radio Configuration window.

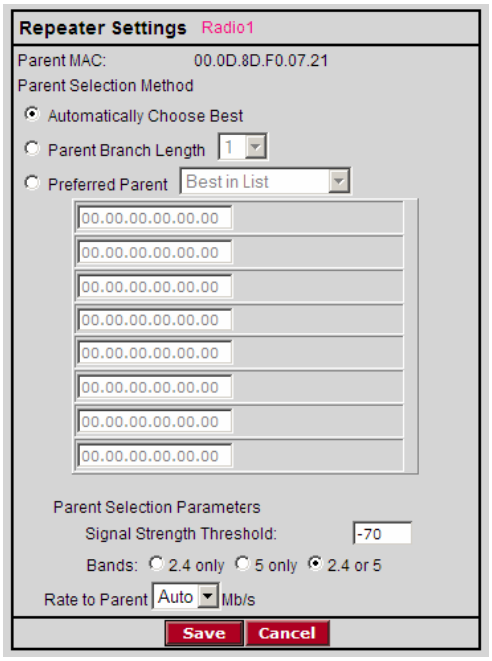


Use the settings in the Radio Network Settings panel to configure the radios in your network. For more information on using these settings, see Configuring the radios (page 12).

Field	Description
Radio Name	Assign a unique name to each radio.
Network SSID	Assign a network name (SSID) of up to 32 characters. The radio uses this name in all network references. All radios in a network must have the same SSID. SSID names are case-sensitive.
Master	Click this button to configure a radio as a master. The master is the root radio in a network. You must have at least one master radio per network. For redundancy, you can assign more than one master to a network. For information, see Redundancy (page 45).
Channel list (master radio)	The channel list indicates the channel number as well as the frequency (2.4 gHz or 5 gHz). **Important:** The RadioLinx IHW radio is supplied with a dual-band antenna that supports both frequency ranges. If you use a different antenna with the IHW radio, you must choose a channel and frequency range supported by the antenna.
Repeater	Click this button to configure a radio as a repeater. The repeater mode is the normal radio mode for the network, while the master mode is more of a special setting to establish the network channel and define the root of the network tree. Repeater radios help extend the range of a network and help create the signal "bridges" that allow networked radios to communicate. All RLX-IHW radios are capable of repeating.
Parent Link settings	Click this button to specify how a repeater radio connects to the network. For information, see Parent Link settings.
Client	This is a special mode that allows you to connect an Ethernet device to any 802.11 a, b or g access point. You would only use this mode in the special event that you wanted to connect a device to another brand access point. For information on setting up a client, see Configuring clients.
Auto / Specify	Only choose "specify" if device does not send out any unsolicited Ethernet packets. Try Auto first.
Client MAC	The MAC ID of the device connected to the radio, only if the device does not advertise its MAC address.
IGMP	Click this button to open the IGMP Settings (page 43) form. Use this form to enable (default) or disable IGMP, and to configure how the RLX-IHW radio will be have when IGMP is enabled.
Spanning Tree	Click this button to open the Spanning Tree Settings (page 45) form.
Advanced Config	Click this button to open the Advanced Settings form.

4.2.1 Parent Link Settings

This configuration page opens when you click the Parent Link button on the Radio Configuration form.

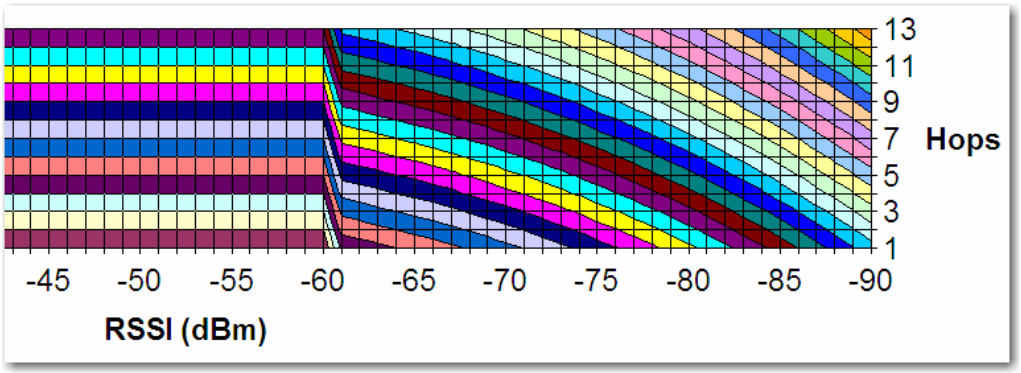


Field	Description
Parent MAC	The MAC Address of the radio's Parent node.
Parent Selection Method	
Automatically Choose Best	The Automatic Parent Selection algorithm uses a calculation to create a cost for each possible parent radio that it detects. In the calculation the radio includes, ▪ RSSI – Stronger signals receive a better cost. ▪ Hop Count – Fewer hops from the Master radio is given preference and therefore a lower cost Choose this setting to allow the radio to determine the best parent to select.
Parent Branch Length	With the branch length setting the IH will choose its parent strictly by the number of repeaters between it and the Master radio. If Branch Length of 1 is chosen, the IH will link only to the Master radio. If Branch Length of 2 is chosen, the IH will link only to an IH that is linked to the Master radio, and so on.

Field	Description
Preferred Parent	With the preferred parent setting the IH radio will select its parent from a list of possible parents specified by the user. The user can list up to eight radios to choose from. ▪ Best in List When Best in List is selected the IH will select its parent using the "Automatic Parent Selection" algorithm, but it will limit the selection to the list of radios in the list. Therefore, the radio in the list with the lowest cost according to the algorithm will be chosen as its parent. ▪ Follow List Priority When Follow List Priority is chosen the IH will select its parent from the list giving preference to the 1st entry followed by the 2nd entry and so on.
Parent Selection Parameters	
Signal Strength Threshold	When the signal from a parent reaches a high enough value, a stronger signal will not improve the quality of the link any further. For signals that are above that threshold, only fewer hops from the Master give preference. You can adjust that threshold here.
Bands	This setting controls which bands a Repeater will scan to look for a possible parent. It will scan the 2.4GHz band only, the 5GHz band only, or both 2.4GHz and 5GHz bands.
Rate to Parent	The default setting is auto which allows the radio to select the best rate to use to the parent radio, and adapt over time. You might specify a fixed rate rather than auto for example if the link to the parent has a low signal strength in which case fixing a lower rate can improve performance. The actual rate used between this radio and its parent is the lower value of this setting and the Max Data Rate setting in the parent (see Max Data Rate). So use these two controls in conjunction if desired to tailor the rate of each parent link.
Save	Saves your changes and updates the radio configuration.
Cancel	Discards your changes without updating the radio configuration.

When you save a selection and return to the Radio Network Settings panel, notice that your selection is indicated under the Parent Link button.

The Automatic Parent Selection algorithm uses a calculation to create a cost for each possible parent radio that it detects. The following graph describes how the cost is calculated when the signal strength threshold is set to –60 dBm.

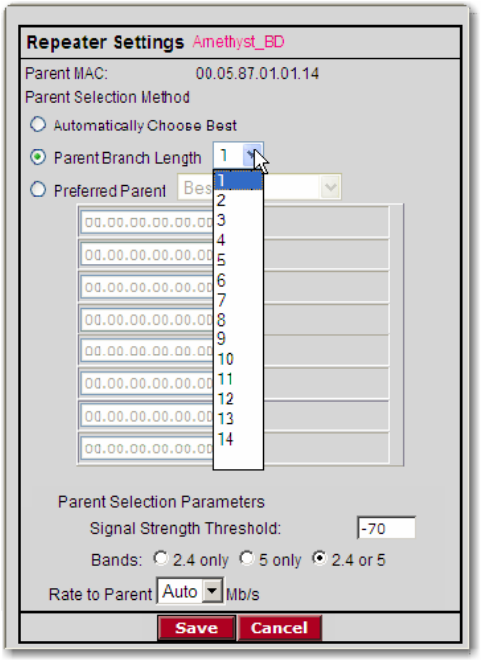


Once per second the IHW radio evaluates the link it has to its parent to determine if this link is the best parent to use. A cost is calculated for each entry and can be seen in the column labeled "Cost" in the preceding table. The cost calculation is based not only on the strongest signal, but on several other factors to provide optimum network communication.

Prioritized Parent Selection

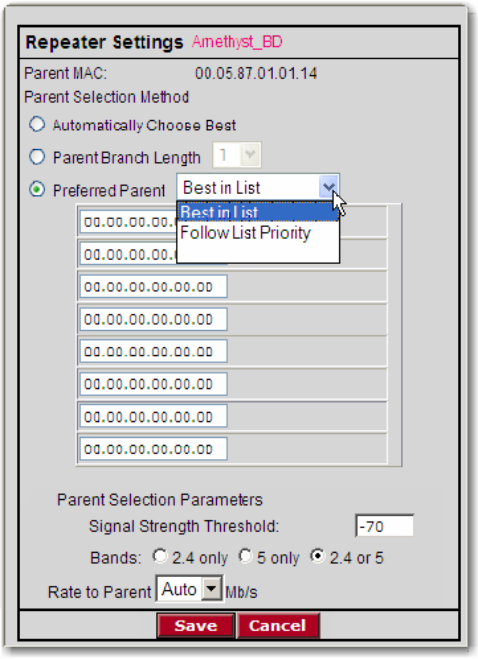
If you need more control than the automatic algorithm allows, you can also define a priority list of parents for the IH Radio to choose.

Prioritized Parent by Branch Length



With **Parent Branch Length,** the IH will choose its parent strictly by the number of repeaters between it and the Master radio. If Branch Length of 1 is chosen, the IH will link only to the Master radio. If Branch Length of 2 is chosen, the IH will link only to an IH that is linked to the Master radio, and so on.

Prioritized Parent by Preferred Parent List

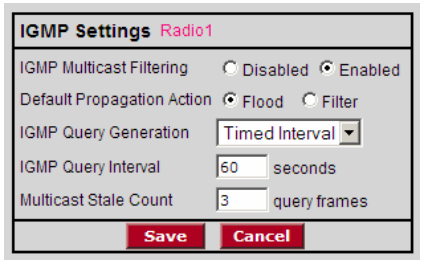


With **Preferred Parent,** the IH radio will select its parent from a list of possible parents that you specify. You can list up to eight radios to choose from.

- **Best in List**
  The IH will select its parent using the "Automatic Parent Selection" algorithm described above but it will limit the selection to the radios in the list. The radio in the list with the lowest cost according to the algorithm will be chosen as its parent.
- **Follow List Priority**
  The IH will select its parent from the list giving preference to the first entry, followed by the second entry, and so on.

4.2.2 IGMP Settings

This configuration page opens when you click the IGMP button on the Radio Configuration form.



RLX-IHW radios support IGMP v1 and v2. The default operation of the RLX-IHW radios is to have IGMP functionality enabled, although the user can disable IGMP entirely. Additionally, the user can specify settings associated with IGMP filtering and snooping. Unknown multicast addresses can be sent to all ports (flood) or to none (filtered) by changing the IGMP Multicast Filtering option. The user can specify whether or not the radio will generate IGMP queries, and configure the query interval time.

By RFC specification, only one device on a network should generate IGMP queries. As such, RLX-IHW radios will only send a query if another device has not sent a query within its Query Interval setting, even if Query Generation is enabled.

Field	Description
IGMP Multicast Filtering	Disabling filtering will cause the radio flood multicast packets to all ports.
Default Propagation Action	Determines how to handle multicast addresses that are not in the radio's address table.
IGMP Query Generation	Enables or disables query generation from this radio.
IGMP Query Interval	Number of seconds between queries (if not pre-emptied by another devices queries).
Multicast State Count	Number of queries generated before a device is removed from the multicast group on this radio if no response is received.
Save	Saves your changes and updates the radio configuration.
Cancel	Discards your changes without updating the radio configuration.

4.2.3 Rapid Spanning Tree Functionality

The software's built-in Rapid Spanning Tree (RSTP) functionality enables you to set up full redundancy between radios or other devices. Spanning Tree shuts off ports as necessary to prevent loops. If loops are created in an Ethernet network, packets can be circulated endlessly, consuming all the bandwidth and making the network unusable.

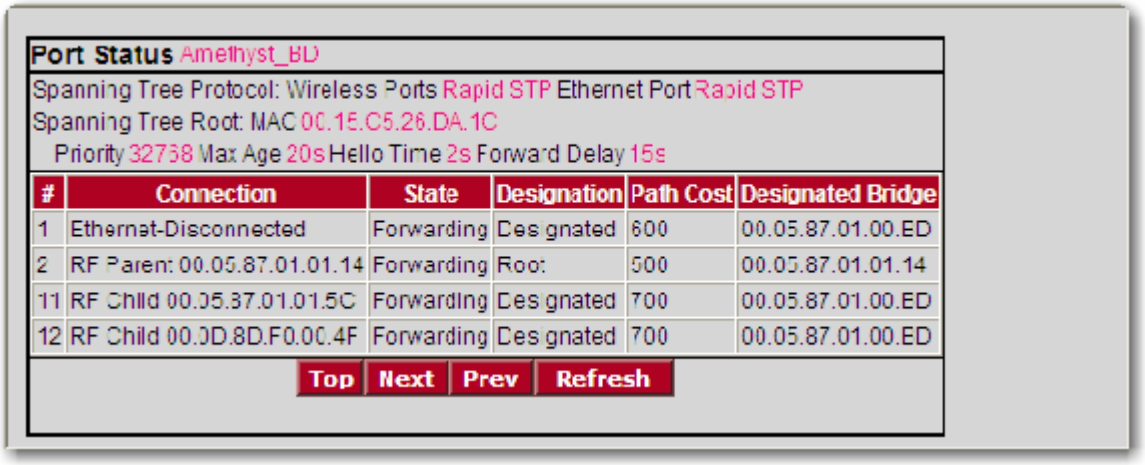
RSTP allows users to create truly redundant connections between any two points in the network. The radios detect the redundant paths and keep one connection alive for communications. If the primary connection fails for any reason, the secondary connection is quickly transitioned to a state to forward packets, allowing the network to adapt itself to handle problems without customer intervention.

RSTP uses active communications between network devices to propagate changes in the network and to cause transitions to occur much more quickly. Because RSTP is an IEEE standard, IH radios work in conjunction with wired Ethernet switches to form a redundant network.

Each RSTP device (IH radio or Ethernet switch) communicates with other RSTP devices in the network via packets called Bridge Protocol Data Units (BPDUs). BPDUs are sent out each of the devices ports. In a wired switch this would be from each of the Ethernet ports. In an IH radio, in addition to the Ethernet port, each wireless link is considered a port. These BPDUs are the communications means to allow each RSTP device in the network to make sure that the proper connections still exist.

In the following illustration, this IH radio has 4 RSTP "ports":

- Ethernet port (1)
- A port for its parent connection (2)
- A port for each of its two child connections (11 and 12).



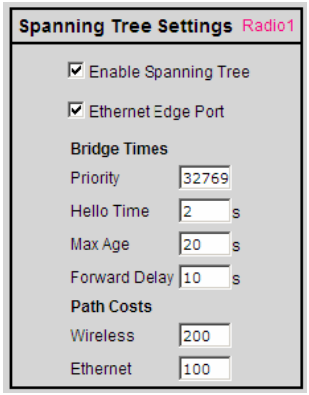
BPDUs are sent out the port at a rate called the "Hello Time". The accepted standard value for this is 2 seconds. If a radio (or any other RSTP device) does not get a BPDU for 2 Hello Times, it assumes the RSTP device that had been there is no longer available. It can then open an alternate path if one is available. This process is much like the STP process. If other devices on the network are not operating in rapid spanning tree mode, the radio will revert to normal spanning tree operation on a per-port basis.

RSTP provides a performance enhancement over STP operation. By comparison, the radio using the STP algorithm would revert its port to the listening state, and then to the learning state, before returning to the forwarding state. Each of these states takes at least 15 seconds, during which the STP devices are listening for BPDUs to re-negotiate the network topology. The advantage of using the RSTP functionality is that is uses active handshaking between adjacent RSTP devices to re-negotiate the network topology. This process takes one to two seconds.

Each IH radio contains a switch table, which tells it how to forward Ethernet packets to get them to their proper destination. When the network topology changes, the IH radio flushes its Ethernet switch table immediately. This allows it to pass traffic immediately over the new network topology and learn the configuration in the process. Until the learning is complete, the packets are broadcast to their destination. As each packet is seen and the switch table rebuilds, the radios return to directing packets to their destinations.

4.2.4 Spanning Tree Settings

This configuration page opens when you click the Spanning Tree button on the Radio Configuration form.



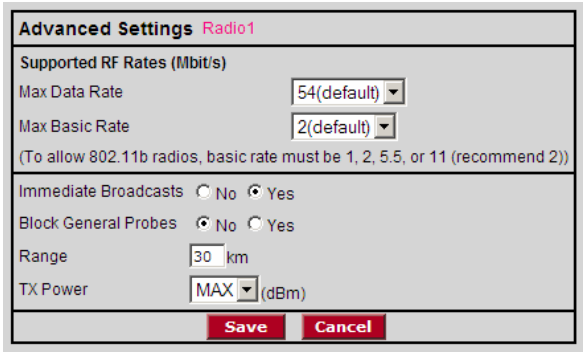
Field	Description
Enable Spanning Tree	Spanning Tree is enabled when this box is checked. Without spanning tree, redundant connections might exist if multiple radio links are created in parallel with each other. Redundant connections are blocked only if spanning tree is enabled. Additionally, spanning tree is used to flush the Ethernet switch table when the network topology changes as described in the section on Automatic Parent Selection. Firmware versions 2.5xx and above for RLX-IH, and all versions of RLX-IHW also support Rapid Spanning Tree (RSTP), and will default to this mode when enabled. The recommended setting for spanning tree is "Enabled".
Ethernet Edge Port	Because RSTP is an active protocol, it depends on communication between RSTP devices. If no RSTP device is connected to the radio's Ethernet port, the handshake cannot take place. In this case RSTP reverts to STP. This means that the Ethernet port will be forced to adhere to the timer based transition protocol of STP. Therefore on network transitions and power up, communications will not be allowed over the Ethernet port for 30 to 45 seconds. This setting is an indication that no redundant connections exist out this port and communication can immediately be allowed. If for some reason a BPDU is received on this port, the RSTP protocol will negotiate properly and handle any possible redundant paths. The recommended setting for Ethernet Edge Port is "Enabled".
Bridge Times	The values in this list configure the timing intervals to use.
Priority	This setting determines who should be the root of the RSTP. The RSTP device with the lowest priority becomes the root. The accepted standard value for this is 32768. If wired switches exist in the network that support RSTP, they should always be allowed to be the root. Set this value to 32769 to prevent the radio from being the root over a wired switch. Use this setting when a radio is configured to be a Master. Set this value to 32770 when the radio is configured to be a Repeater. In this way, if only IHs exist in the network, the Master radio will become the root.
Hello Time	The rate at which BPDUs are sent out. The industry standard is 2 seconds.
Max Age	Measures the age of the received protocol information recorded for a port and ensures that this information is discarded when its age limit exceeds the value to the maximum age parameter recorded by the switch. The timeout value for this timer is the maximum age parameter of the switches.
Forward Delay	Monitors the time spent by a port in the learning and listening states. The timeout value is the forward delay parameter of the switches.
Path Costs	The RSTP and STP algorithms use a cost to determine which connections should be used. The "spanning tree" is formed by determining the least cost paths from any RSTP device back to the root.
Wireless	To give preference to a wired connection, set the Wireless cost to 200.
Ethernet	To give preference to a wired Ethernet connection, set the Ethernet cost to 100.

You can define multiple master radios on the same network. Then, if one master radio goes down, any radios linked to it can switch over to the other master, so the networked radios remain connected and transmitting. In order to be redundant, the two masters should typically be on the same segment—in other words, they should be wired together into the same switch. These two masters can be assigned different channels to increase network bandwidth, but they must be assigned the same SSID.

Also, because all radios are repeaters, you can set up each radio to be able to reach a master radio via multiple repeater paths. Then, if a repeater goes down, the linked radios can use a different path to get back to a master radio.

4.2.5 Advanced Settings

This configuration page opens when you click the Advanced Configuration button on the Radio Configuration form.



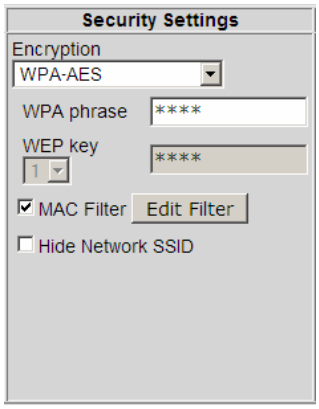
It is important to allow many industrial protocols to communicate properly over the RLX-IHW radios. The standard 802.11 AP operation for transmitting broadcast messages is to accumulate them and transmit them only on specific time intervals. This allows clients that are in power-save mode to wake up at the synchronized time interval and receive the broadcast packets. However, the power-save mode is rarely used in industrial networks. Additionally, many industrial protocols utilize multicast traffic, which is sent as broadcast messages over the wireless network. By enabling immediate broadcasting, these multicast messages are not delayed by the wait for the next time interval to occur before they can be transmitted. This results in improved network performance.

The settings on this form also allow you to configure the transmission rate and broadcast mode to optimize this radio's use on an industrial network.

Field	Description
Max Data Rate	The maximum data transmission rate, in megabits per second, for this radio. Available settings range from 1 to 54.
Max Basic Rate	In addition to the Data Rate setting which controls generic data traffic, the Basic Rate setting adjusts the rate at which control packets such as Beacons and Acks are sent at as well as packets that need to go to the whole network such as Broadcasts. Because these packets are intended for the whole network, the Max Basic Rate setting of the Master is advertised to each of the radios in the network through Beacons. Each of the radios other than the Master then inherit the Max Basic Rate setting of the Master. Therefore the setting only needs to be made in the Master radio. The setting in each of the other radios is disregarded.
Immediate Broadcasting	Forward multicast traffic immediately, rather than waiting for specific time intervals.
Block General Probe Requests	Do not respond to general probe requests that are not specific to the radio's SSID.
Range	The Range setting allows the radios to account for round trip delays. The Range settings should be the same in all radios in the network and should be at least large enough to account for the length of any links. However, increasing the Range beyond what is necessary can cause a slight decrease in throughput.
TX Power	This sets the output power of the radio.
Save	Saves your changes and updates the radio configuration.
Cancel	Discards your changes without updating the radio configuration.

4.3 Security settings

The following fields appear in the Security Settings area in the middle of the Radio Configuration window.



You can assign the following security settings:

Field	Description
Encryption type	WPA-AES is the preferred encryption method. It contains the latest updates to the 802.11 standards for best security. However, some legacy devices do not yet support these updates. Therefore, you can choose combinations of legacy methods. Available encryption types are: ▪ None (not recommended) ▪ WPA-AES – Latest security setting using WPA (pre-shared key) authentication and AES encryption. ▪ WPA-TKIP – Security setting using WPA (pre-shared key) authentication and TKIP encryption. ▪ WEP128 – Legacy security setting using a 128-bit key and WEP encryption. ▪ WEP64 – Legacy security setting using a 64-bit key and WEP encryption.
WPA phrase (page 50)	Enter a WPA pass phrase of between eight and 63 normal keyboard characters.
WEP key (page 50)	Enter five normal text characters in the WEP key field
MAC Filter (page 51)	Check (select) this field to restrict connections by MAC address.
Edit Filter	Opens the MAC filter (page 51) form, allowing you to specify the MAC addresses of devices to allow in the network.
Hide Network SSID (page 51)	Hides the Network SSID (Network Name) from other 802.11 users. You can still connect clients to the "hidden" network by typing the Network SSID.

The following topics describe each security setting in more detail.

4.3.1 Encryption type

The preferred encryption type is WPA (WiFi Protected Access). You should only select WEP (wired equivalency protocol) for use with an older client radio that only has WEP encryption. For compatibility with clients that do not support WPA, you can select WPA+WEP128 (bits) or WPA+WEP64 (bits) as the encryption type. Then the older clients can connect to an access point using the WEP setting, but new clients will use WPA and the RLX-IHW radios will still use WPA among themselves.

IMPORTANT: If WPA+WEP is selected, some clients using WPA might not be able to connect unless you use a WEP key other than number 1, due to limitations in these clients. In such cases, you should set a WEP key other than key 1 and set this same key in all clients that are using WEP. See WEP key (page 50).

WEP is the original security protocol used by 802.11 networks, but WPA offers better protection against attacks, for several reasons: WPA distances the encryption key from the actual data by performing several algorithms to the key before generating the encrypted data, it performs dynamic key management by changing keys frequently, and it performs message integrity checks to prevent forgery and replay.

You can also select WEP 128, WEP 64, or None (no encryption) as the encryption type, but none of these settings are recommended.

Note: If an RLX-IHW is set to use WPA+WEP, it will connect to other radios set to WPA only or WPA+WEP, but it will not communicate with radios set to WEP only. Likewise, an RLX-IHW in client mode with WPA+WEP selected will not connect to an access point with WEP only selected.

4.3.2 WPA phrase

To use WPA encryption on packets sent between the radios, enter a WPA pass phrase of between eight and 63 normal keyboard characters. This phrase automatically generates an encryption key of 128 hexadecimal characters. This field is only available if you select WPA as the encryption type.

The default WPA-AES Phrase when a module ships is 'passphrase'.

4.3.3 WEP key

A key is a set of hexadecimal (hex) or ASCII characters used to encrypt data. This field is only available if you select WEP as the encryption type. Write down your WEP encryption key as you create it, because you must enter the same key on your client.

To create a 64-bit WEP key, enter five normal text characters in the WEP key field, which converts the characters automatically to 10 hex digits. Alternatively, you can enter 10 hex digits (0 to 9, a to f, A to F) directly in the WEP key field. To create a 128-bit key, enter 13 normal text characters, which convert to 26 hex digits, or enter 26 hex digits (0 to 9, a to f, A to F) directly.

Note: Clients often support more than one WEP key. Packets received can be decrypted using any one of the keys if programmed, but packets are always transmitted with the "default" WEP key number. If you set a transmit key number on the RLX-IHW, make sure all other radios and clients have this key programmed. To set keys other than key 1 on some clients using Windows, you might have to use the Advanced settings.

Programming more than one key on the RLX-IHW requires setting the key number to the key you want to program, entering the key, and saving your changes. Repeat these steps for each key you want to program, saving after each one; finally, change to the desired transmit key number if necessary and save again. (If "****" remains in the key field, the previously programmed key will not be changed when changes are applied.)