ProSoft TECHNOLOGY

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RadioLinx®

RLX2 Series

802.11a, b, g, n
Industrial Hotspots

November 29, 2012

USER MANUAL

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RLX2 Series User Manual

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Important Safety Information

The following Information and warnings pertaining to the radio module must be heeded:

WARNING – EXPLOSION HAZARD – DO NOT REPLACE ANTENNAS UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

"THIS DEVICE CONTAINS ONE OF THE FOLLOWING TRANSMITTER MODULES:

FCC ID: OQ7IHG, RYK-WMIA199NI, NKRDCMA82, SWX-XR5

PLEASE SEE FCC ID LABEL ON BACK OF DEVICE."

"THIS DEVICE USES AN INTERNAL COMPACT FLASH RADIO MODULE AS THE PRIMARY RADIO COMPONENT. THE COMPACT FLASH RADIO MODULE DOES NOT HAVE AN FCC ID LABEL. THE COMPACT FLASH RADIO MODULE HAS NO USER SERVICEABLE PARTS."

"THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION."

"CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE COULD VOID THE USER's AUTHORITY TO OPERATE THE EQUIPMENT."

"THIS DEVICE IS CONFIGURED FOR OPERATION IN THE USA DURING MANUFACTURING. THESE CONFIGURATION CONTROLS ARE NOT PRESENT IN THE SOFTWARE WITH WHICH THE UNIT IS SHIPPED; THEREFORE THE END USER CANNOT CHANGE THE MAX POWER SETTINGS OR THE COUNTRY/REGION. THE MODELS SOLD & SHIPPED WITHIN THE U.S. ARE IDENTIFIED WITHIN THE MODEL NUMBER WITH –A AS PART OF THE IDENTIFIER."

Industry Canada Requirements:

"THIS DEVICE HAS BEEN DESIGNED TO OPERATE WITH AN ANTENNA HAVING A MAXIMUM GAIN OF 24 dB. AN ANTENNA HAVING A HIGHER GAIN IS STRICTLY PROHIBITED PER REGULATIONS OF INDUSTRY CANADA. THE REQUIRED ANTENNA IMPEDANCE IS 50 OHMS."

"TO REDUCE POTENTIAL RADIO INTERFERENCE TO OTHER USERS, THE ANTENNA TYPE AND ITS GAIN SHOULD BE CHOSEN SUCH THAT THE EQUIVALENT ISOTROPICALLY RADIATED POWER (EIRP) IS NOT MORE THAN THAT REQUIRED FOR SUCCESSFUL COMMUNICATION."

"THE INSTALLER OF THIS RADIO EQUIPMENT MUST INSURE THAT THE ANTENNA IS LOCATED OR POINTED SUCH THAT IT DOES NOT EMIT RF FIELD IN EXCESS OF HEALTH CANADA LIMITS FOR THE GENERAL POPULATION; CONSULT SAFETY CODE 6, OBTAINABLE FROM HEALTH CANADA."

Recommended Antennas

ProSoft Part Number	Max Gain and Type
A2402S-OSLP	2 dBi Omni RP-SMA compact stub - 2.5" 2.4GHz
A2403NBH-OC	3 dBi Omni N-BH jack whipless 2.4GHz
A2403S-OM	3dBi Omni RP-SMA 10' LMR195 pigtail with magnetic base 2.4GHz
A2404NBHW-OC	4 dBi Omni N BH jack low profile 2.4GHz
A2404NJ-OC	4 dBi Omni N jack collinear with mounting hardware 2.4GHz
A2405S-OA	5 dBi Omni RP-SMA articulating 2.4GHz
A2405S-OM	5 dBi Omni RP-SMA straight w/magnetic base 2.4GHz
A2405S-OS	5 dBi Omni RP-SMA straight 2.4GHz
A2406NJ-OC	6 dBi Omni N jack collinear with mounting hardware 2.4GHz
A2406NJ-OCD	6dBi Omni N jack heavy duty collinear with mounting hardware 2.4GHz
A2406S3-DP	6dBi Panel RP-SMA MIMO antenna with 3 foot pigtail 2.4GHz
A2408NJ-DP	8 dBi Directional patch panel N jack with mounting hardware 2.4GHz
A2408NJ-OC	8 dBi Omni N jack collinear with mounting hardware 2.4GHz
A2409NJ-OCD	9 dBi Omni N jack heavy duty collinear with mounting hardware 2.4GHz
A2410NJ-DY	10 dBi Directional N jack Yagi with mounting hardware 2.4GHz

A2410NJ-OCM	10 dBi Omni N jack collinear for marine environment, 2.4GHz
A2412NJ3-DP	12dBi Panel N-Jack MIMO antenna 2.4GHz
A2413NJ-DP	13 dBi Directional patch panel N jack with mounting hardware 2.4GHz
A2415NJ-DY	15 dBi Directional N jack Yagi with mounting hardware 2.4GHz
A2415NJ-OC	15dBi Omni N jack collinear antenna with mounting hardware 2.4GHz
A2416NJ-DS	16 dBi Directional 120 degree sector N jack with mounting hardware 2.4GHz
A2419NJ-DB	19 dBi Directional N jack parabolic with mounting hardware 2.4GHz
A2419NJ-DP	19 dBi patch panel N jack with mounting hardware 2.4GHz
A2424NJ-DB	24 dBi Directional N jack parabolic with mounting hardware 2.4GHz
A2502S-OA	2dBi omni RP-SMA articulating 2.4/5GHz
A2506NJ-OC	6/8dBi omni N jack collinear with mounting hardware 2.4/5GHz
A2508NJ-DP	8/9 dBi directional N jack panel with mounting hardware 2.4/5GHz
A5003S-OBH	3dBi Omni RP-SMA bulkhead mount with 5' LMR195 pigtail 5GHz
A5004NBHW-OC	4 dBi Omni N BH low profile collinear antenna 5GHz
A5006NJ-OC	6dBi omni N jack collinear with mounting hardware 5GHz
A5007S3-DP	7dBi Panel RP-SMA MIMO antenna with 3 foot pigtail 5GHz
A5009NJ-OC	9dBi omni N jack collinear with mounting hardware 5GHz
A5017NJ3-DP	17dBi Panel N-Jack MIMO antenna 5GHz
A5019NJ-DP	19dBi directional N jack panel with mounting hardware 5GHz
A5024NJ-DP	24dBi directional N jack panel with mounting hardware 5GHz
A5812NJ-OC	12dBi omni N jack collinear with mounting hardware 5.8GHz
A5829NJ-DB	29dBi directional N jack parabolic with mounting hardware 5.8GHz
A2503S3-O	3/4dBi Omni RP-SMA MIMO antenna with 3 foot pigtail 2.4/5GHz
A2503S6-O	3/4dBi Omni RP-SMA Dual MIMO antenna with 3 foot pigtail 2.4/5GHz
A2506NJ3-O	6dBi Omni N-Jack Single MIMO antenna with 3 foot pigtail 2.4/5GHz
A2506NJ6-O	6dBi Omni N-Jack Dual MIMO antenna with 3 foot pigtail 2.4/5GHz

An adapter may be needed for some of the listed antennas to operate with certain radios

Antenna spacing requirements for user safety

It is important to keep the radio's antenna a safe distance from the user. To meet the requirements of FCC part 2.1091 for radio frequency radiation exposure, this radio must be used in such a way as to guarantee at least 20 cm between the antenna and users. Greater distances are required for high-gain antennas. The FCC requires a minimum distance of 1 mW *cm2 power density from the user (or 20 cm, whichever is greater).

If a specific application requires proximity of less than 20 cm, the application must be approved through the FCC for compliance to part 2.1093.

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1 Start Here

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

1.1 About this manual

This manual covers the entire RadioLinx® RLX2 Industrial Hotspot™ series of radio products. There are four products available in this product line:

Model	Standards	Maximum Output Power
RLX2-IHA	IEEE 802.11a	24 dBm (250 mW)
RLX2-IHG	IEEE 802.11b/g	24 dBm (250 mW)
RLX2-IHNF	IEEE 802.11a/b/g/n	17 dBm (50 mW)
RLX2-IHW	IEEE 802.11a/b/g	23 dBm (200 mW)

Except for different operating frequencies and output power levels, these radios all operate in a similar fashion. Different models operating on common frequencies can communicate with each other. Furthermore, all RLX2 series radios can communicate with ProSoft Technology's legacy RLXIB series of radios. Details on the specific differences between the RLX2 and RLXIB series products can be found in the ***Compatibility with ProSoft RLXIB Series Radios*** section on page 117.

When a feature is described in this manual that is unique to a specific RLX2 model, it will be highlighted like this:

RLX2-IHNF This features applies to the RLX2-IHNF only

1.2 About the RadioLinx® RLX2 Industrial Hotspot™ products

1.2.1 General Features

The RadioLinx® 802.11 Industrial Hotspots™ are high-speed wireless Ethernet radios, with Power Over Ethernet (PoE) and Serial Encapsulation. All radios operate at speeds up to 54 Mbps, and the RLX2-IHNF operates at speeds up to 300 Mbps. Designed for industrial installations, the RLX2 series offer many features including hazardous location certifications (pending), IGMP Snooping, OFDM for noise immunity, repeater mode to extend range, automatic parent selection for self-healing, OPC server diagnostics, extended temperature, high vibration/shock and DIN-rail mounting.

1.2.2 LED Indicators

All radios have LED indicators on the front panel that indicate the status of the radio while booting up and during operation. The LED states are summarized in the following table:

Power	● While booting up ● When fully operational
RF Transmit	● While transmitting over wireless
RF Receive	● While receiving over wireless
Serial	● When a serial cable is attached
Ethernet	● When Ethernet data is being transferred
Net	◗ Blinks if SD card with new configuration inserted
Mod	◗ Blinks if SD card with new configuration inserted
Signal Strength LEDs: SD card inserted	◗ ◗ ◗ Blinks if SD card with new configuration inserted
Signal Strength LEDs: running in Client or Repeater Modes	○ ○ ○ No Signal ● ○ ○ Radio linked, Poor Signal ● ● ○ Radio linked, Fair Signal ● ● ● Radio linked, Good Signal
Signal Strength LEDs: running in Master Mode	○ ● ○ No radios linked ○ ● ◗ One or more radios linked (right LED blinking). ◗ ◗ ◗ DFS Channel Availability Check in progress (all LEDs blinking Amber)

See section 5.3 for further details regarding the LED display for various conditions.

1.2.3 Antenna Ports

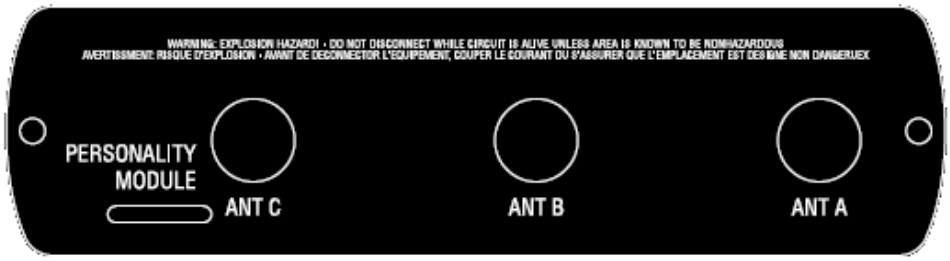
Each RLX2 series radio has three antenna connectors on the top, but not all ports are active on all products as noted below:

RLX2-IHA
RLX2-IHG

These radios have a single active antenna port:

RLX2-IHNF

This radio has three active antenna ports:



RLX2-IHW

This radio uses the right-side antenna port for transmit and receive. An optional receive-only antenna can be attached to the left-side antenna port for better performance. The middle antenna port is not used.

Models with inactive antenna ports are shipped with plastic caps on the inactive ports. To avoid the possibility of attaching an antenna to an inactive port, ProSoft recommends that users do not remove caps from inactive ports.

1.3 Package Contents

1.3.1 Standard Contents

The following components are included with standard RLX2 radio products:

Qty.	Part Name	Part Number	Part Description
1	RLX2 Series Radio	*Varies*	RadioLinx® RLX2 802.11 Industrial Hotspot
1	Personality Module	001-005700	MicroSD card with default factory configuration (installed in radio when shipped)
1	Power Connector	002-0116	Mating power connector for the RLX2 radios, for attachment to customer's power supply.
1	Power Connector Wiring Tool	357-0061	Tool to assist wiring the power connector.
1	Antenna	A2502S-OA	2 dBi Omni RP-SMA articulating, 2.4/5GHz. This antenna is suitable for all RLX2 radio products.
1	ProSoft Solutions DVD	DVD-001	Contains sample programs, utilities, firmware images, and documentation for RadioLinx® products.

1.3.2 Industrial Hotspot Bench Test Kit (RLX-IHBTK)

The standard radio products are intended for deployment into production systems and do not include accessory power supplies or cables. For bench testing of radios, an optional bench test kit provides these accessories:

Qty.	Part Name	Part Number	Part Description
1	Power Supply	RL-PS007-2	AC Power Adapter, 12V1.6A w/2 pin & 4 plug Set
1	Cable	RL-CBL025	5 foot Ethernet Straight-Thru Cable
1	Cable	085-1007	6 foot RS232 serial cable
1	Adapter	HRDNULL-DB9	RS232 null modem serial adapter

Important: Before installing, please verify all listed product items are present. If any of these components are missing, please contact ProSoft Technology Support for replacements.

1.4 The RadioLinx *Industrial Hotspot Browser* Configuration Tool

The *Industrial Hotspot Browser* configuration tool (hereafter called the *IH Browser*) is used for setup and configuration of the RLX2 radios. It is designed for personal computers running Microsoft Windows operating systems. The IH Browser can be installed from the product DVD shipped with the RLX2 radio product, or it can be downloaded from the ProSoft website.

1.4.1 System Requirements

- Pentium® II 450 MHz minimum. Pentium III 733 MHz (or better) recommended
- Supported operating systems:
  - Microsoft Windows XP Professional 32-bit with Service Pack 3
  - Microsoft Windows 7 Professional 32- or 64-bit, with Service Pack 1
  - Microsoft Windows 8 Release Preview 32- or 64-bit.
    Other Microsoft Windows operating system versions may work but have not been tested by ProSoft and are not officially supported.
- 128 Mbytes of RAM minimum, 256 Mbytes or more of RAM recommended
- 100 MB available hard drive space
- 256-color VGA graphics adapter, 800 x 600 minimum resolution (True Color 1024 x 768 resolution or better recommended)
- At least one 100BASET or 1000BASET network interface. A second interface is often useful to setup a small private network for initial configuration and testing.

In addition, these items may be needed:

- A DVD-ROM drive, if installing the RadioLinx IH Browser from optical media.
- An RS-232 port on the PC or a USB-to-serial convertor cable, to use serial encapsulation features or to access system debugging information.
- An internet connection may be useful to download updated product information from the ProSoft Technology website at http://www.ProSoft-Technology.com.

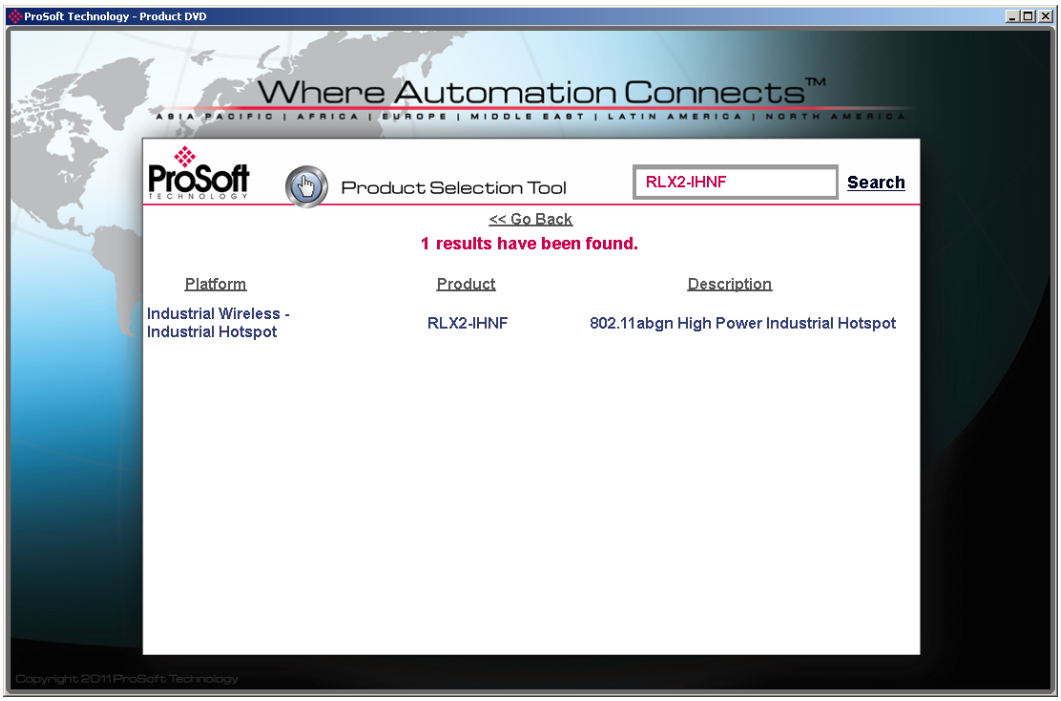
1.4.2 Install From DVD

1 Insert the *ProSoft Solutions* DVD in the DVD drive. On most computers, a menu screen will open automatically. If a menu does not appear within a few seconds, follow these steps:

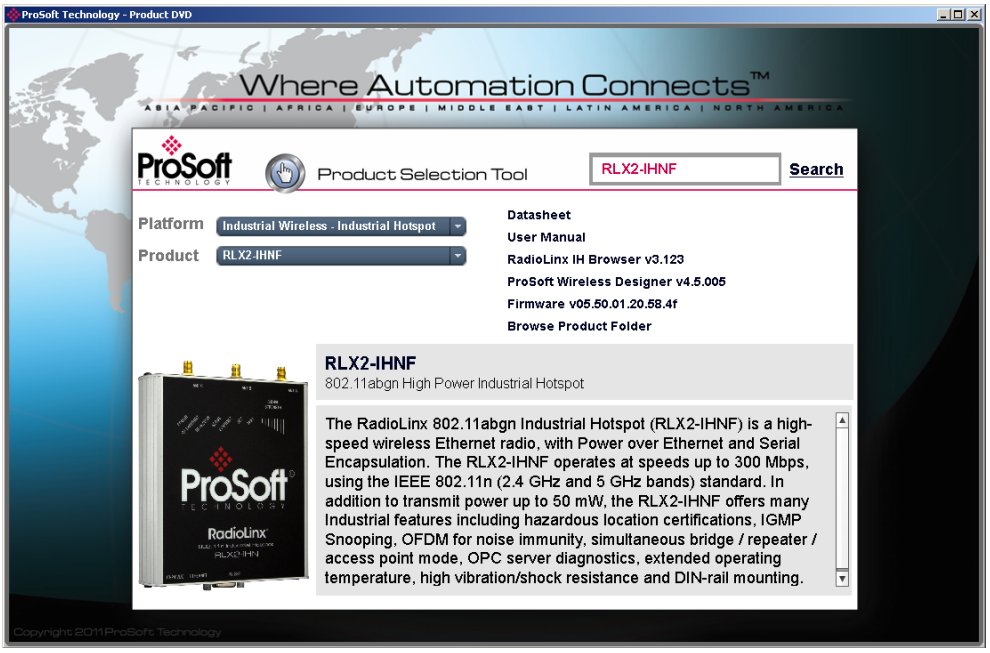
a Click the Start button, and then choose Run.
b In the Run dialog box, click the Browse button.
c In the Browse dialog box, click "My Computer". In the list of drives, choose the DVD drive where the ProSoft Solutions DVD was inserted.
d Open the DVD and double-click the **ProSoft_DVD.exe** file to run it.

2 The DVD should display a startup screen like this:

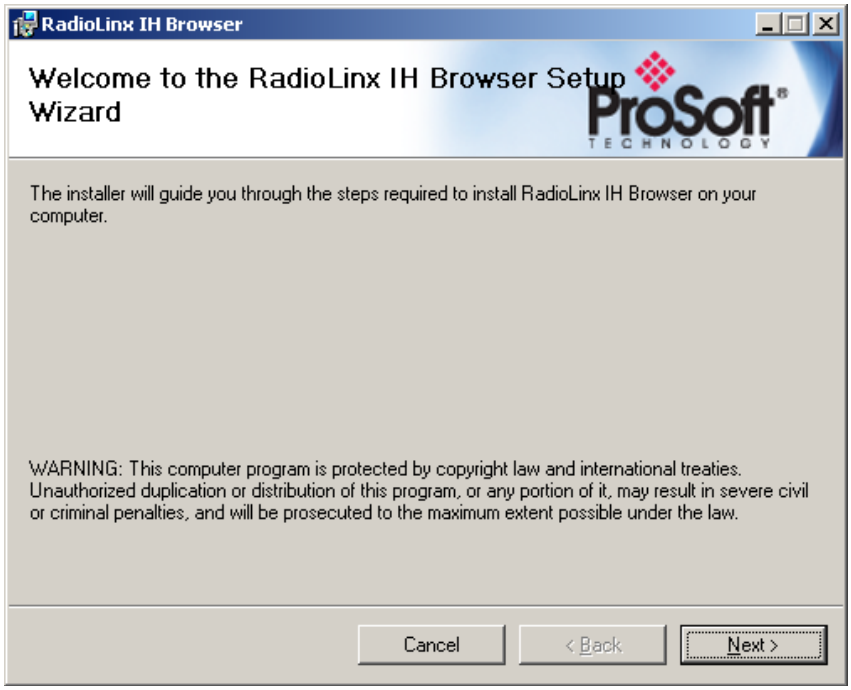
3 Type the product name into the search box and click *Search*. Here is an example of searching for the RLX2-IHNF:



4 Click on the product name. The screen will display the contents for this module.



5 Double-click on RadioLinx IH Browser v3.130 (or a newer version if available) and the installation wizard should launch:



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

7 When the installation finishes, a prompt to restart the computer may appear if certain files were in use during installation. The updated files will be installed during the restart process.

1.4.3 Install From Download File

If the RadioLinx IH Browser was downloaded from the ProSoft website, it will be packaged as a compressed zip file. Double–click the zip file after downloading, and the Windows extraction wizard will extract the installation file (**RadioLinx IH Browser 3.130.msi** or a newer version.) Then double-click the **.msi** file to install the IH Browser.

2 RLX2 Quick Setup

In This Chapter

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- Setup Repeater Radio 26
- Setup Client Radio 28

This section describes how to setup RLX2 radios in a minimal configuration before deploying them in the permanent installation. It will help verify the radios are operational along with getting familiar with basic configuration procedures.

Note that the procedures described in this section assume the radios are in their default configurations as shipped by ProSoft. If that is not the case, reset the radios to factory defaults as described in section 6.7 before attempting these procedures.

In any given network, there must be one radio acting as a *Master*, and the other radios will be configured as *Repeaters* or *Clients*. Generally there is only one Master radio per network.

Note: The RLX2 radios support the *Rapid Spanning Tree Protocol* (RSTP) which allows configuration of multiple Master radios on a single network in "hot standby" mode for redundancy. RSTP is described further in section 6.2.3

Because most wireless networks consist of one Master radio and multiple Repeaters, all RLX2 radios are shipped from ProSoft pre-configured as Repeaters. Hence our first task is to configure one radio as the network Master.

IMPORTANT: If a ProSoft Power adapter RL-PS007-2 (supplied with the RLX-IHBTK Bench Test Kit) is not present, see section 8.5.1 for instructions on wiring the power connector.

2.1 Setup Master Radio

The first step is to select the radio to use as a Master. Typically all RLX2 radios in a network will be the same model, although this is not necessary.

IMPORTANT: The only RLX2 radios that do not have any channels in common with each other are the RLX2-IHA and RLX2-IHG. The RLX2-IHW and RLX2-IHNF radios can communicate with each other and with the RLX2-IHA and RLX2-IHG radios.

If all the radios are present on the workbench, antennas are not needed for this configuration exercise. Radios without antennas will have sufficient signal strength to link over short distances, without radiating or receiving unnecessary RF energy in the surrounding environment. The connections needed are on the bottom of the radio:

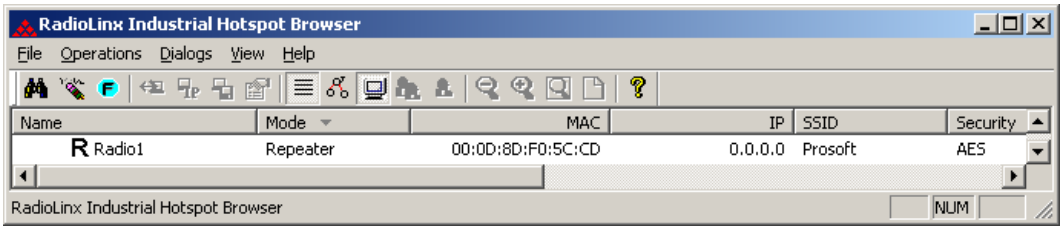
1. Attach an Ethernet cable to the designated master RLX2 radio. Make sure this network connection is on the same subnet as the PC running the IH Browser configuration software.

Note: The Ethernet DATA LED should come on when data is sent or received from the radio. The Ethernet SPEED LED indicates the speed of the Ethernet connection. The SPEED LED is off for 10 Base T, on for 100 Base T, and blinks about once every two seconds for 1000 Base T links.

2. Power up the radio. The power LED should illuminate with an amber color, then go out for a few seconds during initialization, then finally come back on green. This process will take 10 to 15 seconds. Once the power LED is green, the radio has booted and is operational. Other LEDs may become active as well.

3. Take note of the MAC address of the RLX2 radio. This is printed on a label attached to the front of the radio. The MAC address should be something like 00-0D-8D-*XX*-*YY*-*ZZ* (e.g. 00-0D-8D-F0-5C-8E.) This number uniquely identifies the radio on the network.

4. Run the IH Browser configuration software.



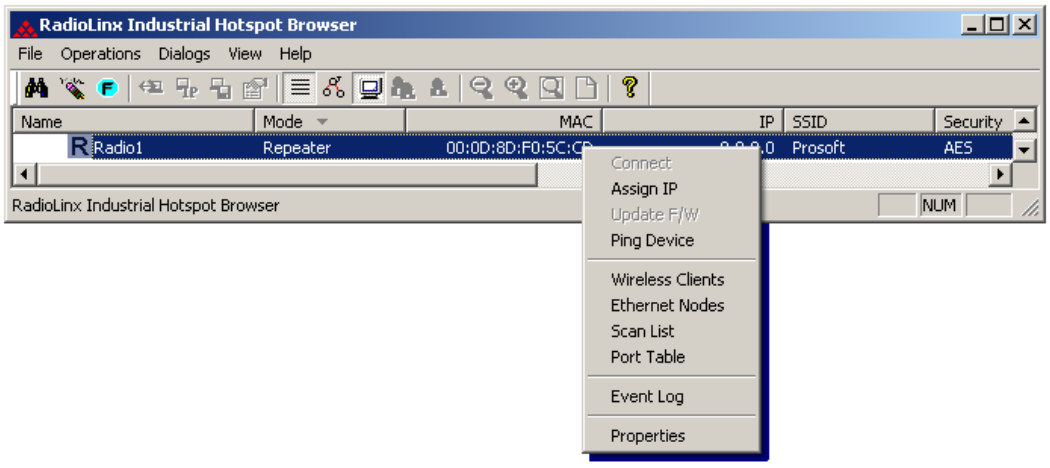
If the display is different than above, use the IH Browser toolbar controls to clear and refresh the display:

 The “erase” tool clears the display

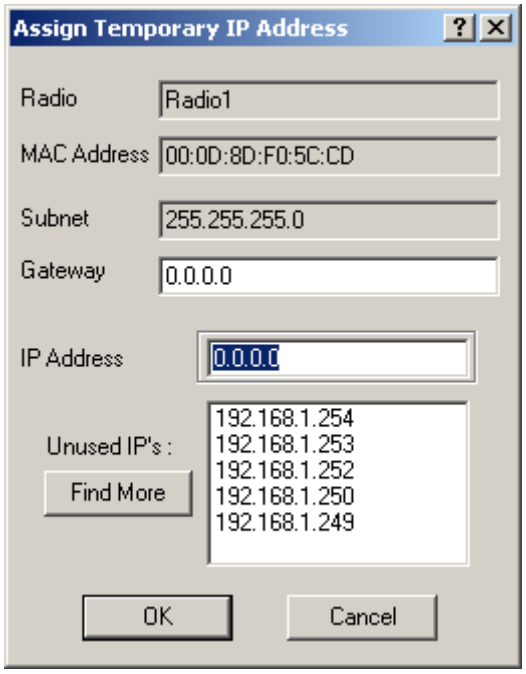
 The “search” tool rescans the network for RLX2 radios

If no radios appear in the list, see the section 5.6 on troubleshooting missing radios.

5. In particular, note the line listing the MAC address of the RLX2 radio. If the radio is on a network with a DHCP server, it will obtain an IP address via DHCP. If not, the radio will appear with an IP address of 0.0.0.0 as shown above.
6. Assign it a valid IP address for the network. Do this by right-clicking on the radio’s row in the IH Browser display and selecting *Assign IP* from the context menu.



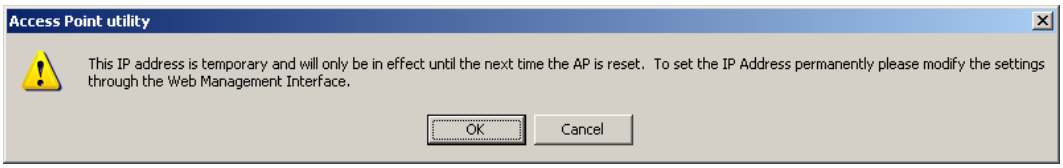
7. A dialog will appear:



The *Unused IP's:* box contains a number of IP addresses that have are currently available on the network. Select one of them, and click OK. (In this example,192.168.1.250 is used)

IMPORTANT: Be sure to click *OK* or the selected IP address will *not* be assigned to the radio.

8. A dialog will appear:

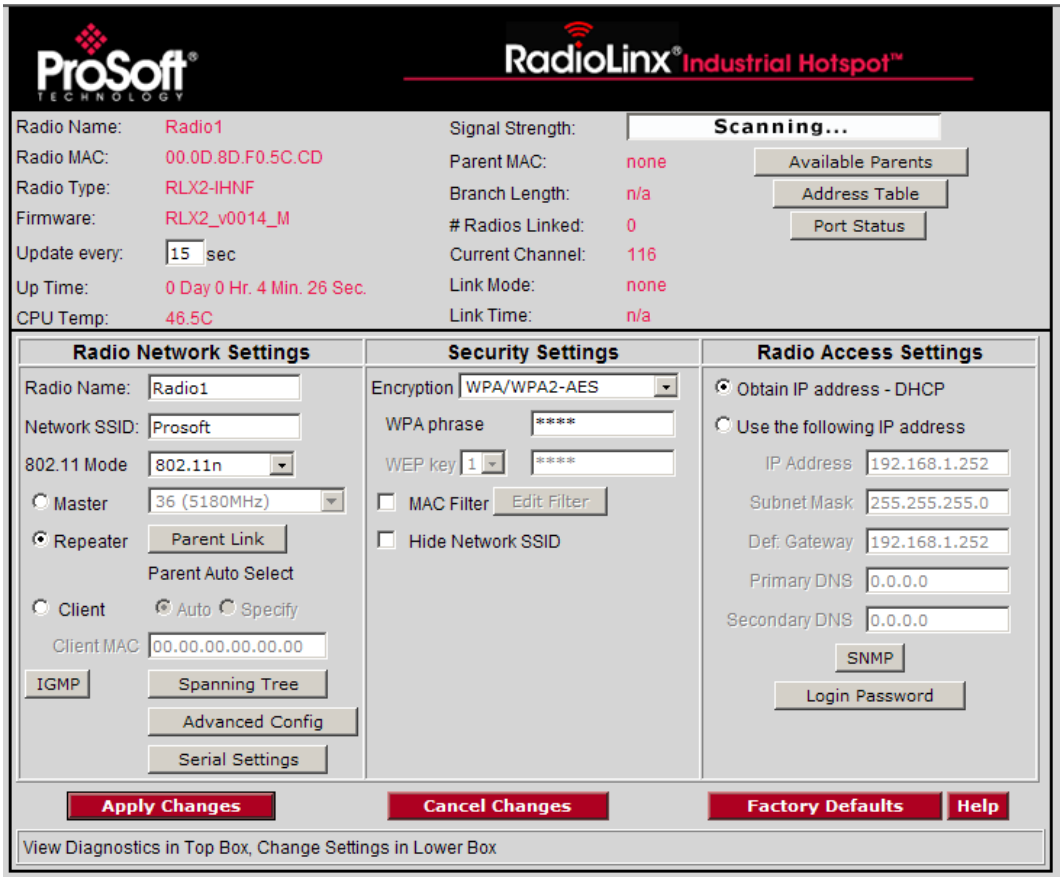


It is a reminder that this is only a temporary IP address.

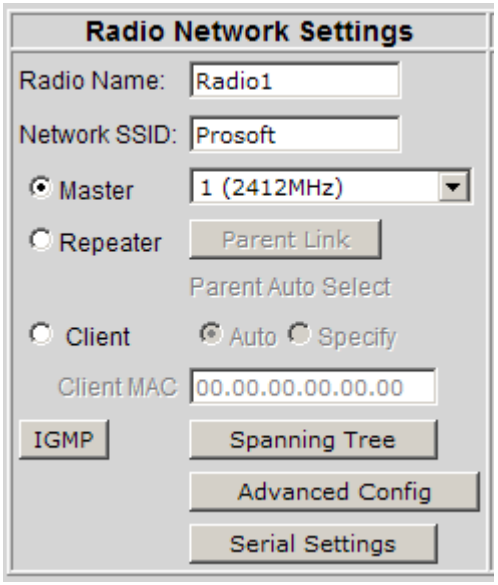
9. Open a web browser on the PC, and enter the IP address that was just assigned to the radio (e.g. http://192.168.1.250). A login screen will display:

The default password is *password*. Enter that in the text box and click *Login*.

10. The radio's main webpage will appear: (Some fields may be different depending on the specific radio model)

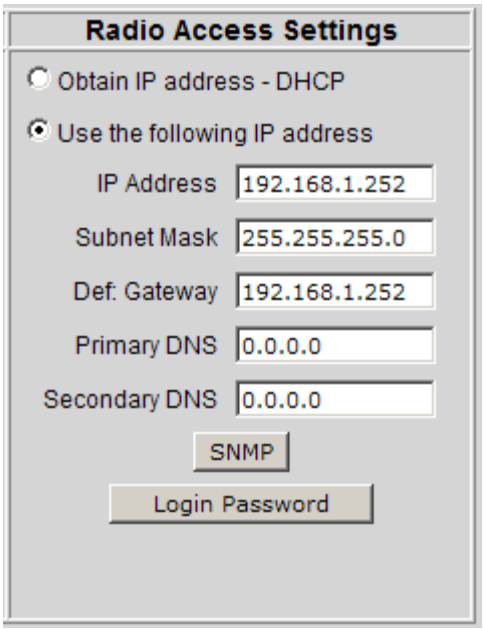


11. Select the *Master* radio button and select *Channel 1 (2412 MHz)* as shown below.



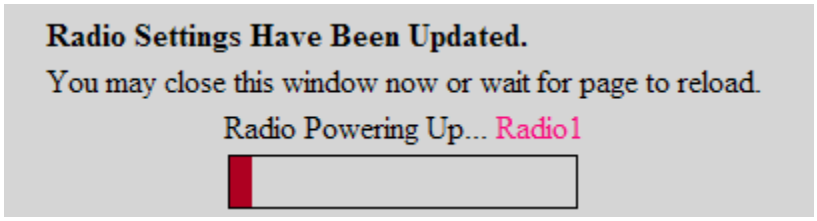
RLX2-IHA Note: If the Master radio is an RLX2-IHA, select *Channel 36 (5180 MHz)*.

12. If the IP address is manually set in steps five and six above, permanently set the IP address by selecting the *Use the following IP address* radio button:

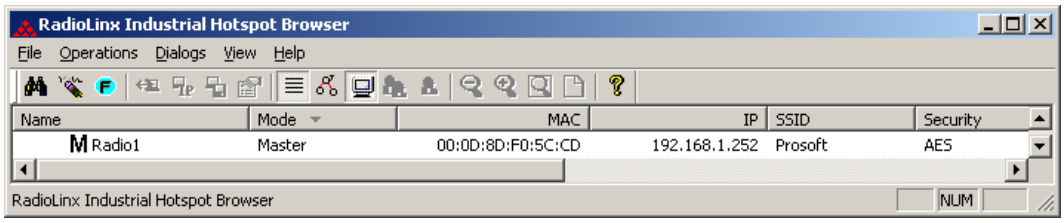


13. Click the *Apply Changes* button and the Radio will reboot

While rebooting, a progress will display:



After the radio has rebooted, it should be shown as a Master in the IH Browser window:

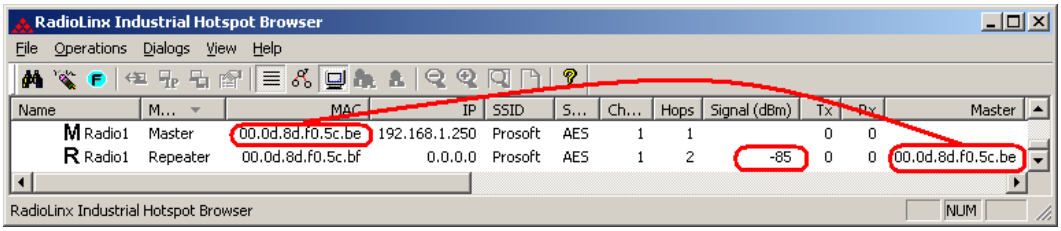


2.2 Setup Repeater Radio

Since we haven't changed any factory-default configuration parameters in the Master radio (other than to make it a Master), additional RLX2 radios in their default shipping configuration should link to it as soon as power is applied to them.

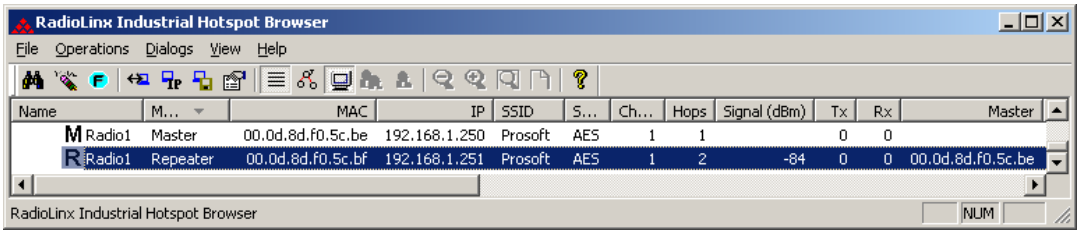
1. Attach power to another RLX2 radio. The Ethernet cable does not need to be attached to it at this time.

2. After the radio is booted, the radio should appear in the IH Browser:



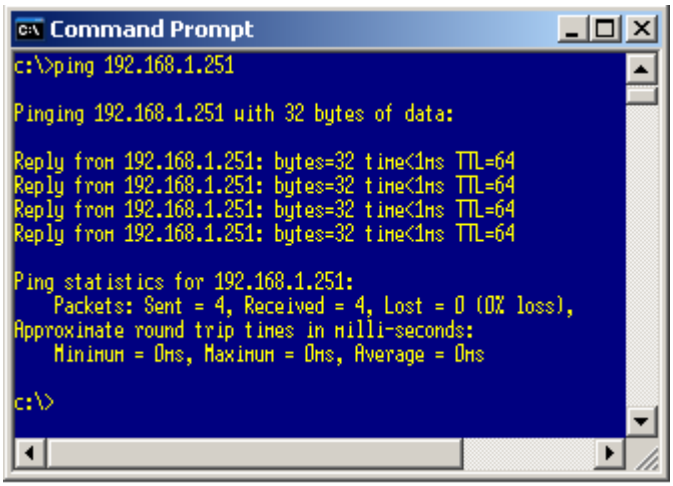
Note that the Repeater radio above (whose MAC address ends in BF in the above example) has linked to the Master (whose MAC address ends in BE) and there is a signal strength indication of –85 dBm.

3. Attach an Ethernet cable, and assign a unique IP address to the Repeater. In this example, the Repeater is assigned an IP address of 192.168.1.251:



After setting the Repeater's IP address, remove its Ethernet connection.

4. On the PC, open a command prompt window and attempt to ping the Repeater's IP address. The Master should ping the Repeater over the air:



5. Congratulations! The RLX2 wireless network is now configured. Additional Repeaters can be configured by repeating the steps listed above.

2.3 Setup Client Radio

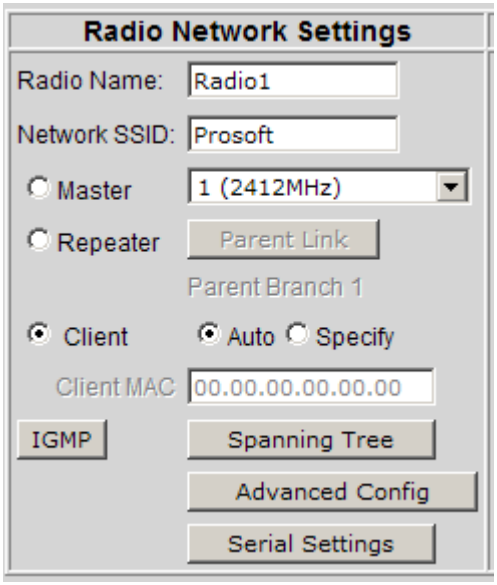
RLX2 radios can be configured in *Client* mode. Client mode radios only support one wired network device, but can connect to third-party 802.11 Access Points. The following table highlights the most significant differences between Repeater and Client modes on RLX2 radios:

	Repeater	**Client**
Number of attached Ethernet devices supported	Many (up to limits of network)	One
Can connect to other RLX2 Repeaters?	Yes	No
Can connect to non-ProSoft Access Points (Masters)?	No	Yes
MAC address seen on network	Repeater radio's MAC address	MAC address of connected device, or user-specified MAC address.

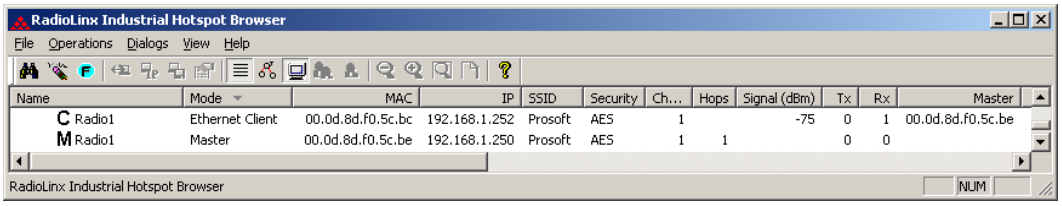
Client mode radios are not often necessary in Industrial network applications. If the need for a Client RLX2 radio in the system is not needed, this example configuration can be skipped.

The most straightforward way to test a Client mode radio configuration is with a second PC connected as the downstream network device from a Client radio. We will assume such a setup in the following example, and will connect to the Master radio we configured previously.

1. Connect the client radio to the same network as the configuration PC running the IH browser. Assign it an IP address as described above. Open the configuration webpage and change the radio to Client mode as shown:



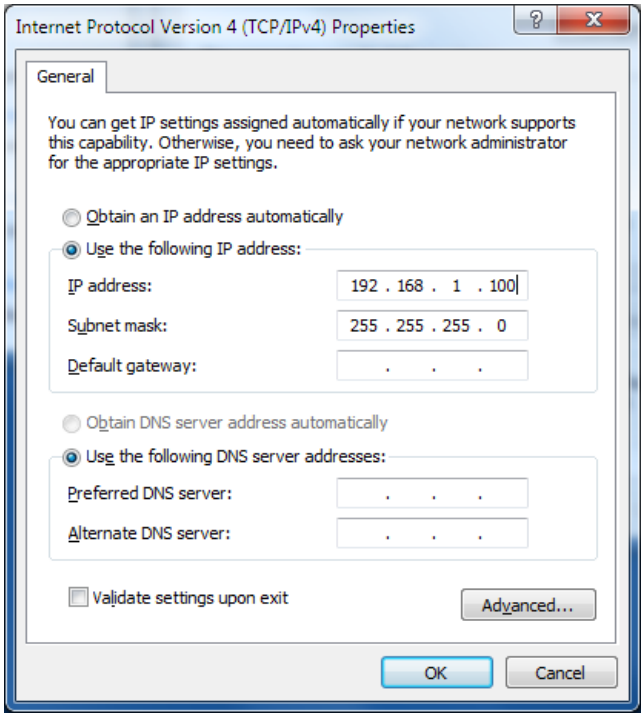
Click Apply Changes. When the radio reboots, the IH Browser will display:



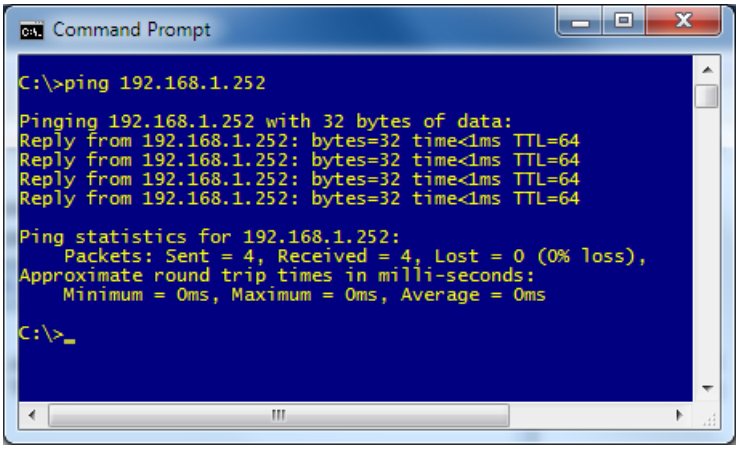
2. Power off the Client radio and disconnect the Ethernet cable from the configuration PC.

3. Connect the Ethernet cable to an Ethernet port on another PC, and power up the Client radio. (The radio must be powered up after attaching the Ethernet cable to the new PC so the radio will register the MAC address of the PCs network interface.)

Ensure the IP address of the Ethernet interface on the PC is on the same subnet as the network of the Client Radio. For this example, set the IP address of the PC interface to 192.168.1.100. Here is an example of doing so in Windows 7:



4. Open a command prompt on the client PC, and try to ping the IP address of the Master radio. It should respond as seen below:



3 Planning the Network

Before configuring and installing the wireless network, it may help to create a plan. The following points assume a bridge network of masters and repeaters. Clients can also be configured to work with devices on existing wireless LANs. For information, see Setup Client Radio (page 28).

The simplest way to design the physical network of radios, antennas, connectors, cables, amplifiers and other accessories, is to use *ProSoft Wireless Designer* (page 32). This is a freely-available software application that determines the hardware needs based on the user's answers to a few questions.

The software will generate a Bill of Materials specifying all the components needed for the installation. ProSoft Wireless Design is included on the optical media supplied with the RLX2 radio, and is also available for downloading from the ProSoft website.

- To begin, identify the potential radio locations. For example, the master radio may be installed near a PC in a central plant location (This PC can configure the radios through the Radio Configuration / Diagnostic Utility). If the plant is an oil refinery, for example, radios may need to be installed near the oil tanks.
- The next important issue is how to link the radios. Unless the radios are very close together, make sure that each pair of radio antennas in the network has a line of sight between them. In other words, visibility is needed from one antenna to another, either with the naked eye or with binoculars.
- If a line of sight does not exist between antennas, an additional site is needed for installing a repeater radio. This site 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, a power amplifier (available from ProSoft Technology) may be needed. The more distance between an antenna and its radio, the more signal loss the radio will have.
  ProSoft Wireless Designer can suggest suitable antennas for the application based on frequency band, data rate, distance, power output level, and other factors.
- Consider drawing up the network plans on paper. As part of the drawing, assign a logical name to each radio. These names can be assigned in the Radio Configuration / Diagnostic Utility.
- As part of the planning, a site survey may be helpful. ProSoft Technology can perform this survey, or hire a surveyor, or survey it on your own.
- Protect radios from direct exposure to weather, and provide an adequate, stable power source. Make sure the plan complies with the radio's power requirements and cable specifications.

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

3.1.1 Installation Questions

The following questions will help in getting familiar with the system.

How many radios are in the network?
Master ID:
Repeater ID:
Client ID:
Locations:
Is there a Line of Sight between them?
What type of antennas will be used in the network?

3.1.2 Planning the Physical Installation

A network's performance is affected by attributes specific to the installation site. Consider the following cautions, where possible, to optimize the network installation:

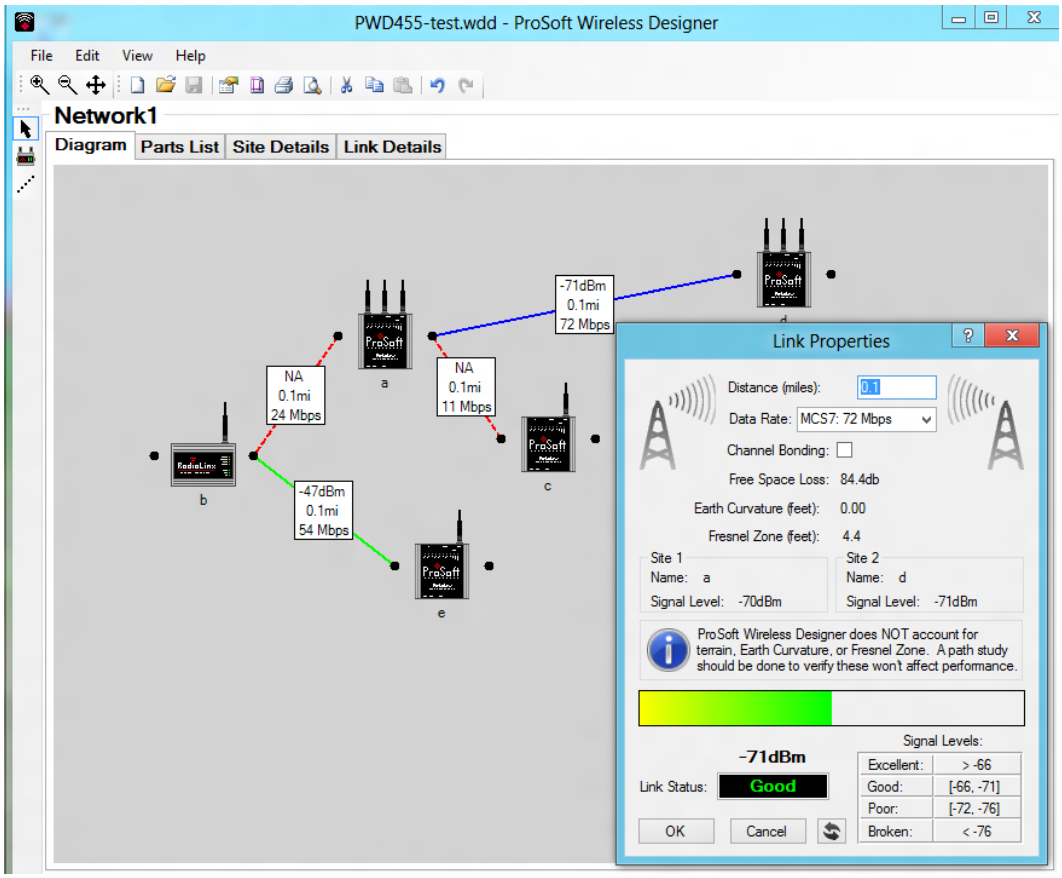
- Design the network to use less than 2048 radios (per network)
- Place radios within the specified 15 miles of each other
- Add repeater to extend distance or where line of sight is limited
- Radios or antennas CANNOT be placed within 8 inches (20 cm) of where people will be

Though radio frequency communication is reliable, sometimes its performance can be affected by intangibles. A good network installation plan includes **time** and **resources** for performance testing and installation changes.

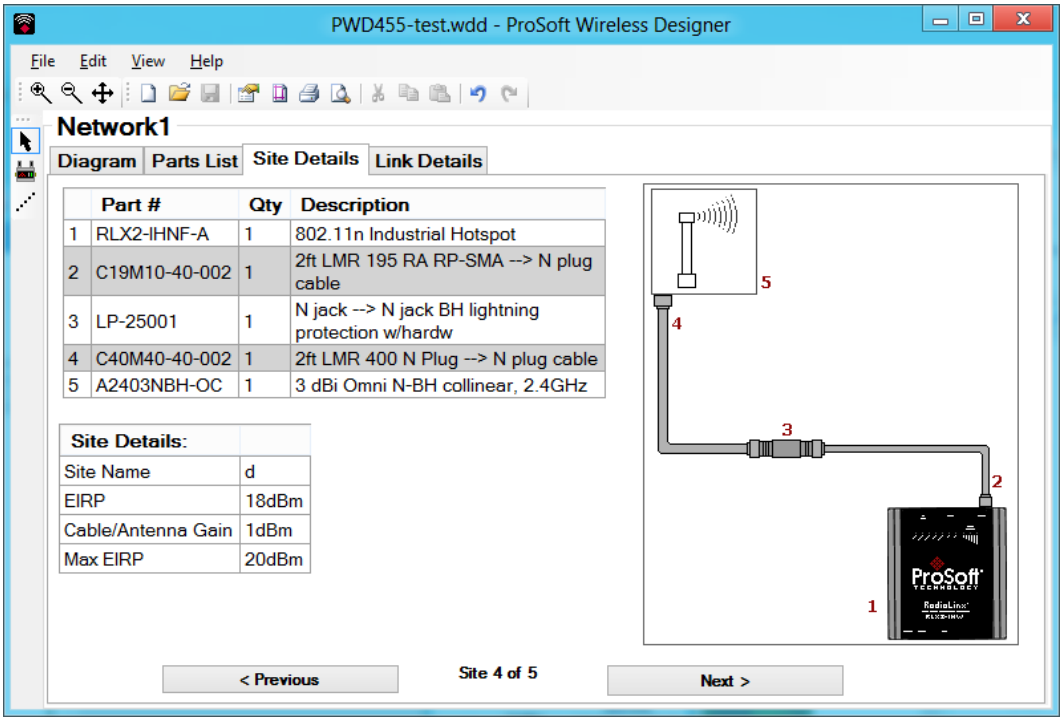
Test the installation plan (page 39) before the network installation is complete.

3.1.3 ProSoft Wireless Designer

ProSoft Wireless Designer is a freely-available software tool to simplify the task of specifying a ProSoft wireless installation. The following screenshot shows an example of configuring wireless links and estimates of signal quality:



ProSoft Wireless Designer can also compute a Bill Of Materials (BOM) for a complete radio installation, including antennas, cables, connectors and other required materials:



It is included on the DVD with the RLX2 radio, or it can be downloaded from the ProSoft website. ProSoft Wireless Designer provides a variety of views containing an accurate description of each site in a wireless network, including:

- Visual diagram of site layout
- Location (latitude/longitude, based on GPS coordinates)
- Radio type, frequency range, and country-specific channel and power requirements
- Length, type and estimated signal loss for cables
- Required accessories, including lightning protection, cable adaptors and antennas
- Complete parts list

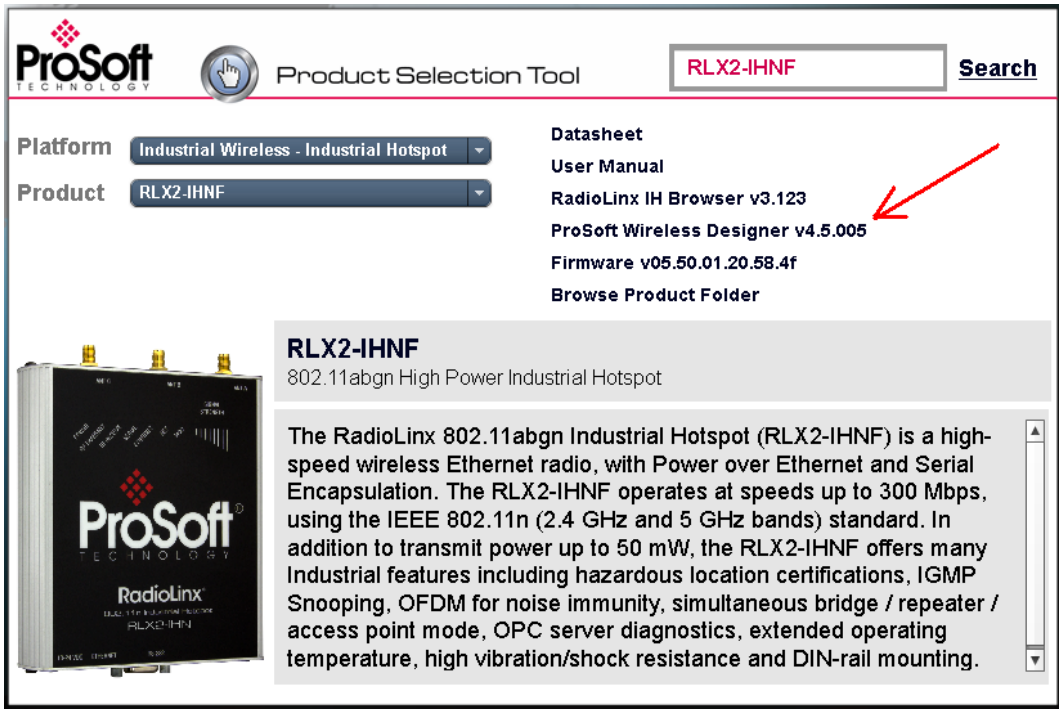
ProSoft technical personnel use *ProSoft Wireless Designer* when conducting site audits for customers, and then provide customers with a complete list of components and a detailed description for each site and link. Customers can use this information to understand and visualize their network, and provide necessary information for technical support and maintenance.

Functional Specifications:

- Contains a database of all currently available RadioLinx radios, antennas, cables, connectors and accessories
- Exports Parts List, Site and Link Details, and Wizard settings into a variety of common file formats, for import into applications such as spreadsheets, databases and word processors
- Checks wireless link feasibility based on path length and recommended accessories
- Predicts signal strength based on distance, local regulations and hardware choices
- Fully documents the ProSoft Wireless network plan

3.1.4 ProSoft Wireless Designer Installation

1 When installing from the product DVD, search for the product, then double-click on the ProSoft Wireless Designer item on the product menu (see the red arrow below). This action starts the installation wizard.



2 When using the downloaded application from the ProSoft website, it is packaged as a zip archive. Double-click the zip archive to extract the installation file **INSTALLER.MSI**, double-click it to start the installation.

3 The installer wizard should start and look like this:

4 Follow the instructions on the installation wizard to install the program.

5 Click **FINISH** to complete the installation. If prompted to restart the computer, save all work, close the applications, and allow the computer to restart.

6 Refer to the user manual for ProSoft Wireless Designer and its online help for detailed information.

4 Installing the Radios

In This Chapter

- Connecting antennas 39
- Test the Network Installation Plan 39

If possible, configure all the radios side by side in an office setting and make sure they link before installing them in the field. If feasible, test with the radios and end-device equipment together before they are installed in the field.

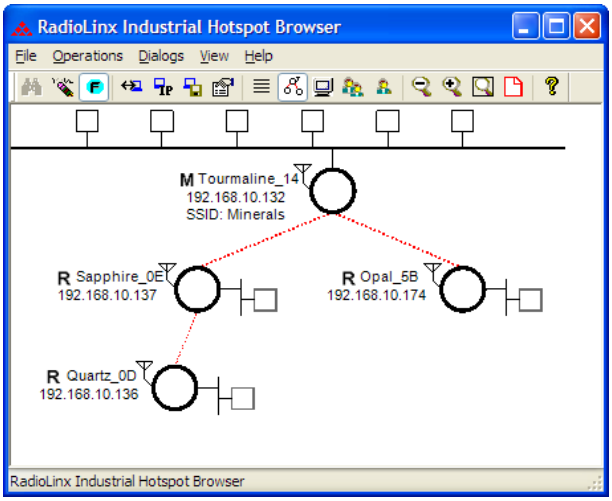
Important: If the radios are close enough to each other that their received signal strength is greater than -40dBm, performance may be degraded. Disconnect antennas from radios during bench testing, or move the radios further apart from each other.

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

After each radio is configured using the IH Browser and the web configuration form, install the radios and test their performance. Install the radios in their proposed permanent locations.

Temporarily place each radio's antenna near its proposed mounting location. The temporary placement of the antenna can be done by hand. Make sure to monitor 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, and select Topology View from the View menu in the 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 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. Scroll down to view all available radios. To change how radios link to the network, see Parent Link settings (page 61).

Refer to Improve Signal Quality (page 47) for more information on overcoming poor connectivity.

4.1 Connecting antennas

Each radio must have an antenna connected to the Main antenna port on the RLX2 radio; without an antenna for each radio, the network will not function if the radios are more than a few meters apart.

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.

Important: If the radio is to be used in a hazardous location, the radio must be mounted in an enclosure approved for hazardous locations. The radio requires a separate cable connection to the SMA connector that leads to an internal antenna.

4.2 Test the Network Installation Plan

Test proposed installations before finalizing the installation.

After the network and radios are configured:

- Install the Master radio in its proposed permanent location
- Cable the Configuration PC to the Master radio
- Place the Remote radios in their proposed locations
- Temporarily place each radio's antenna near its proposed mounting location. The temporary placement of the antenna can be by hand. However, one person must hold the antenna while the other person monitors the Remote radio's signal strength displayed on the Configuration PC.

To improve the signal quality of each Remote radio:

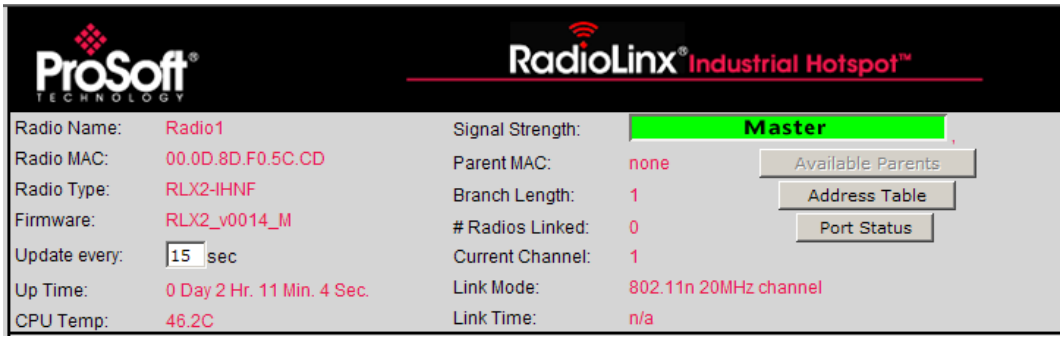
- Increase the height of the antenna's placement
- Use higher-gain antennas
- Increase the radio's transmission power, cable the radio to the Configuration PC, and reconfigure it
- Select a new location for the Remote radio and/or its antenna
- Decrease the length of antenna cable
- Determine and resolve sources of "electrical" noise which may be interfering with the radio transmission
- Add a repeater between the radios that are not communicating, or reconfigure an existing radio as a repeater if line of sight is available

5 Diagnostics and Troubleshooting

In This Chapter

- Diagnostics 42
- Check the Ethernet cable 43
- LED display 44
- Retrieve the default password 45
- Troubleshoot IH Browser error messages 46
- Troubleshoot missing radios 46
- Improve signal quality 47

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:** To update the diagnostic readings on a particular interval, specify the interval (in seconds) in this field. The default is 15 second updates.
- **Read-only fields** that appear with the diagnostic settings.

The following troubleshooting routines can be done:

- Check the Ethernet cable (page 43)
- Retrieve the default password (page 45)

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

5.1 Diagnostics

The Radio Configuration / Diagnostic Utility (Web configuration form for the radio) provides information that can help 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.**
- If the radio is configured as a Repeater and has linked to a Master, the Signal Strength graph will show a color-coded signal quality indication.

Update every: 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 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 55)
- Port status (page 56)
- Available Parents
- Read-only fields (page 52)

The following topics describe troubleshooting routines:

- Check the Ethernet cable (page 43)
- Retrieve the default password (page 45)
- Troubleshoot IH Browser error messages (page 46)
- Troubleshoot missing radios in the IH Browser (page 46)

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

5.2 Check the Ethernet cable

If the radio's Ethernet port is connected and the Ethernet LED does not light on the radio, there may be a problem with the Ethernet cable. Verify the cable is plugged into the radio at one end, and to an Ethernet hub or a 10/100/1000 Base-T Ethernet switch at the other end.

If using the PoE injector, verify that the M12 to RJ45 cable is connected between the radio and the injector and also that the Ethernet patch cable is connected between the injector and switch.

Note: The RLX2 radio auto-detects the Ethernet connection type, and does not require a crossover cable for direct connection to a PC.

5.3 LED display

The RLX2 radio front panel includes a set of LEDs that indicate the radio's status:

LED	Description
POWER	● While booting up ● When fully operational This bi-color LED comes up amber when power is first applied. After power is applied, this LED *will go out completely* for about four seconds while internal hardware is initialized. After initialization, the power LED comes on green, indicating the radio is fully operational.
RF TRANSMIT	● While transmitting data over the wireless interface
RF RECEIVE	● While receiving data over the wireless interface
SERIAL	● When a serial cable is attached The serial LED remains off until a serial cable is plugged into the RS-232 port.
ETHERNET	● When Ethernet data is being transferred over the wireless interface Note that the state of the front-panel ETHERNET LED may not necessarily correspond to the state of the DATA LED on the Ethernet connector. The DATA LED indicates any traffic over the wired link, while the ETHERNET LED indicates network data that will be sent (or has been received from) the wireless link. For example if the radio is pinged over the wired link, the DATA LED will blink but the ETHERNET LED will not (because the ping packet was not transmitted over the air)
NET	◗ Blinks if SD card with new configuration inserted Reserved for future additional use.
MOD	◗ Blinks if SD card with new configuration inserted Reserved for future additional use.
Signal Strength	◗ ◗ ◗ Blinks if SD card inserted with new configuration This is for all radio modes. Radios in Master mode: ○ ● ○ No radios linked ○ ● ◗ One or more radios linked (right LED blinking). ◗ ◗ ◗ DFS Channel Availability Check in progress (all LEDs blinking Amber) Radios in Repeater or Client mode: ○ ○ ○ No Signal ● ○ ○ Radio linked, Poor Signal ● ● ○ Radio linked, Fair Signal ● ● ● Radio linked, Good Signal

Once the power cable and Ethernet cable are connected to the radio, the Power/Status LED should illuminate green. The SPEED LED should indicate a valid wired link. The RF Transmit and RF Receive LEDs should start to blink occasionally.

For Repeater or Client mode radios, all three Signal Strength LEDs will blink just after the radio links to the Master's signal but before it has been fully authenticated. Normally this lasts only a few seconds. If it lasts longer or never turns solid it usually means the encryption keys are not correct.

5.4 Retrieve the default password

If the password is unknown, the user will be unable to change the radio settings. The user can retrieve the default password to use the software again, but will lose all the settings that were programmed before.

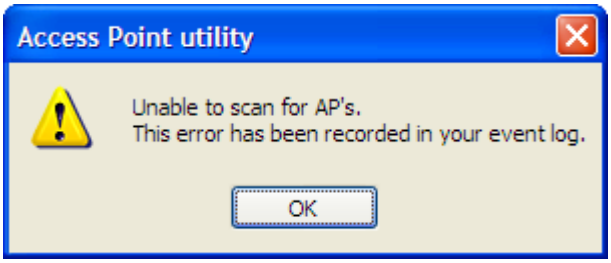
To retrieve the default password and return the radio to its default settings:

1 Turn off power to the radio.
2 Locate the reset button hole.

3 Insert the end of a paperclip or similar device into the hole to press the reset button.
4 While holding the reset button in with a paperclip, attach power to the radio, and continue to hold down the reset button for 30 seconds.
5 The radio will be reset to its default settings, including the password. The user should now be able to log in using the default password, which is *password*.

5.5 Troubleshoot IH Browser error messages

One error message commonly occurs when using the IH Browser, "Unable to scan for AP's".



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

To correct this error, Confirm the PC has at least one active network (LAN) connection. It could be a wired Ethernet connection or a wireless 802.11 connection.

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

5.6 Troubleshoot Missing Radios

If radios are not visible in the 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, disable any software firewall running on the PC (This is most common in Windows XP and newer). Open the **NETWORK CONNECTIONS** folder in the 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 IH Browser and the radios are probably not connected to the same local network. Verify the connections.
- In topological view, any unlinked radios may be at the bottom of the window. Scroll down to see all radios. If the radios still cannot be seen in the IH Browser, call technical support.

5.7 Improve signal quality

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.

6 Detailed Radio Configuration / Diagnostics

In This Chapter

- Radio Status 52
- Radio Network Settings 58
- Security settings 78
- Radio access settings 82
- Apply Changes 84
- Cancel Changes 85
- Factory Defaults 85
- DFS Support 85

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

A web browser such as Microsoft Internet Explorer or Firefox on a network-enabled desktop computer, laptop or Personal Data Assistant (PDA) can be used 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 the web browser.

   Or,
   Double-click the selected radio to launch the Radio Configuration / Diagnostic Utility.

Also, the Radio Configuration / Diagnostic Utility can be opened directly from the web browser.

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

1. Open a 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

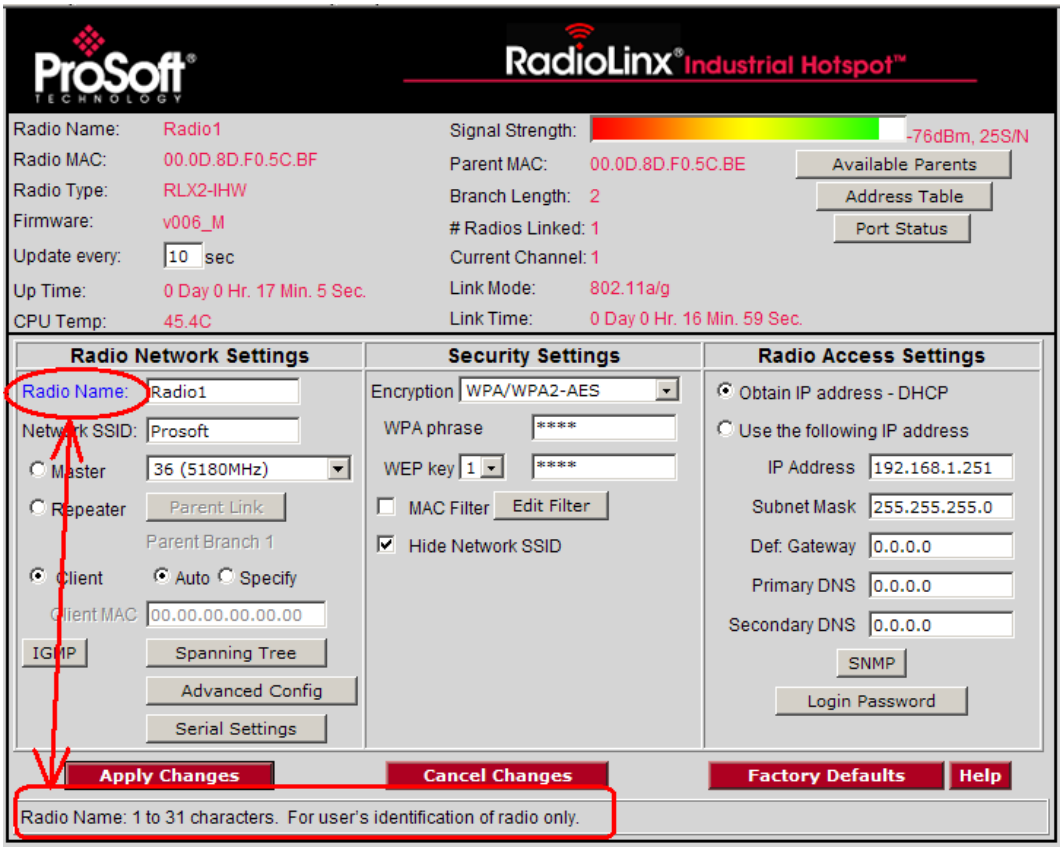
Some of the fields on the Radio Configuration / Diagnostic Utility form are read-only, meaning that the content of the field is provided for information only, and cannot be directly modified.

Depending on the way the radio is configured, some fields and buttons may be unavailable because they do not affect the configuration selected. Review the topics in this section for more information on when and how to use each configuration option.

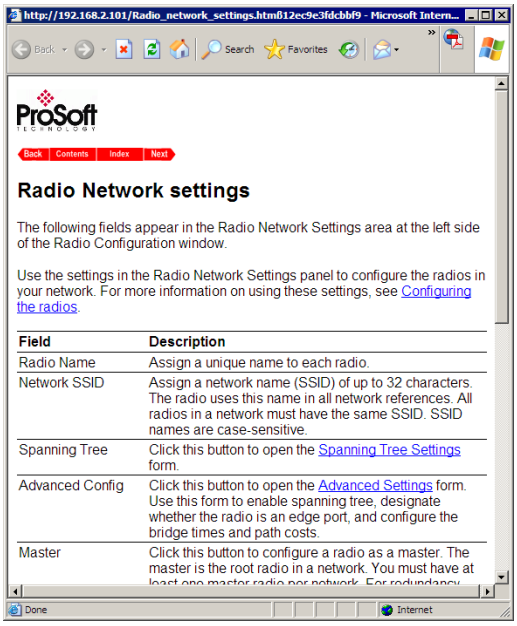
Configuration Help

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

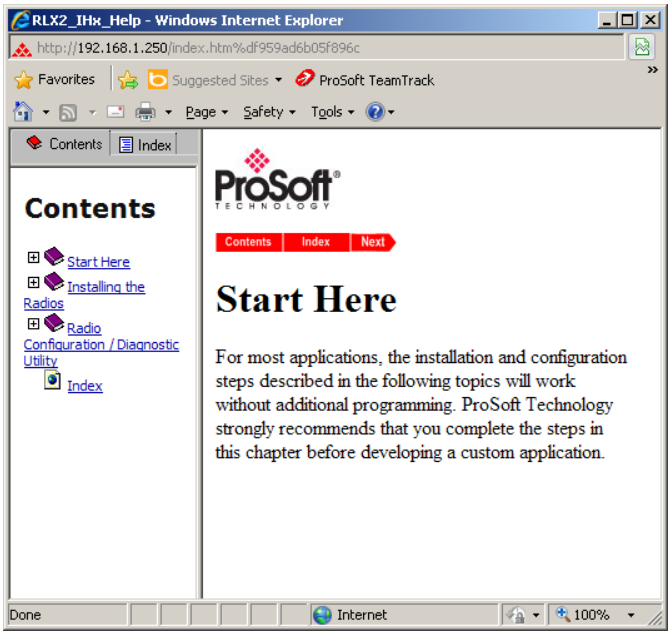
- To view a brief help message about any field on the screen, move the mouse pointer over the field (which turns blue), or use the **[Tab]** key, and refer to the text that appears at the bottom of the screen.



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

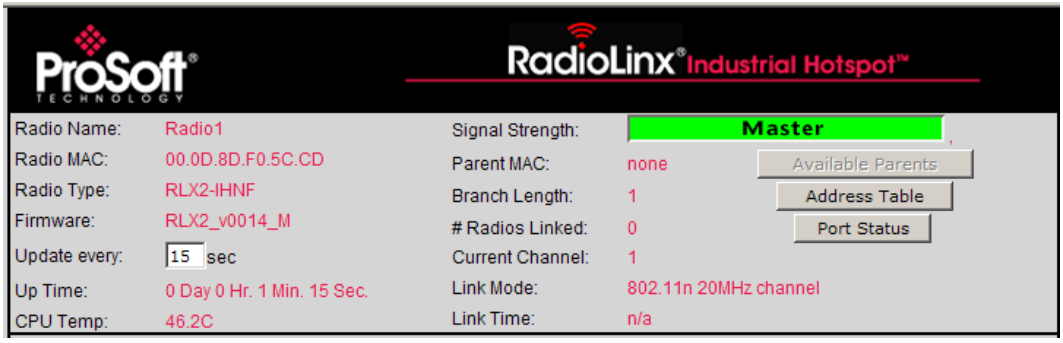


- To view the complete online documentation for the RLX2 radio, click the Help button. This action opens the online documentation in a new browser window. Use the Contents, Index and Search tabs in the left frame to navigate the help system.



6.1 Radio Status

The general radio status fields appear at the top of the Radio Configuration window.



Note: Different versions of the RLX2 Radios support different functionality. There may be more or fewer options on this page, depending on the version of the radio.

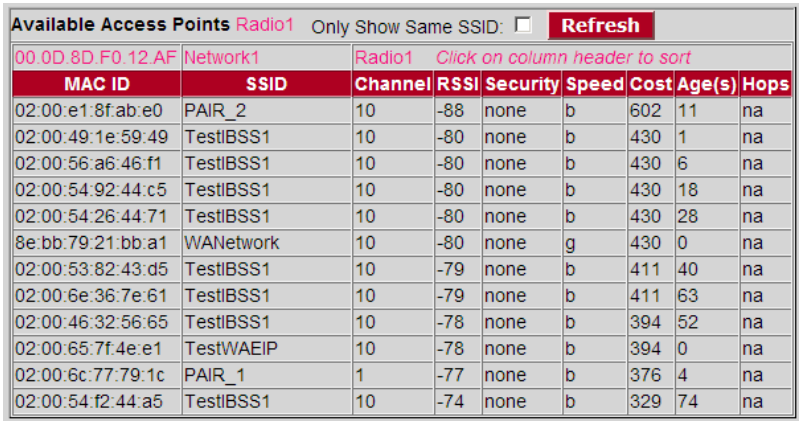
Use the settings in the Radio Status panel to view the current settings for this radio.

Field	Description
Radio Name	Name of the selected radio.
Radio MAC	MAC address of the selected radio. The MAC ID is also printed on the side of the radio.
Radio Type	Model of RLX2 radio –Examples: *RLX2-IHA*, *RLX2-IHG*, *RLX2-IHNF*, or *RLX2-IHW*.
Firmware	Version of firmware currently installed. All radios on the network must have the same firmware versions installed to guarantee proper operations. For more information on firmware versions, refer to Update firmware (page 93).
Update every	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	Length of time the radio has operated since the last system power-up or last system reset.
CPU Temp	Temperature of the CPU board inside the radio.
Signal Strength	Strength of the signal from the Parent radio.
Parent MAC	MAC address of the parent radio to which the selected radio is linked.
Branch Length	Number of RF links from the radio to the master radio.
# Radios Linked	Number of other radios that are linked to this radio.
Current Channel	Channel upon which the radio is currently operating. For Repeaters and Clients, this is the channel in use to communicate to their parent radio. For a Master radio, this may not match the channel selected by the user if the radio has changed channels because radar was detected. See section 6.8

Field	Description
Link Mode	This is the operating mode of the radio. For all radios other than the RLX2-IHNF, the Link Mode will always be *802.11a/g*. For the RLX2-IHNF, additional Link Modes possible are *802.11n* and *802.11n* wide. See section 6.2 for more info.
Link Time	Length of time the radio has been continuously connected to a parent radio.
Available Parents	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	List of MAC addresses for devices entered in the radio's address table.
Port Status	Spanning tree status of each switch port, for RF ports and the RJ45 (Ethernet) port.

6.1.1 Available Parents

Note: The Available Parents form is not available when the radio type is Master.



Available Access Points Radio1 Only Show Same SSID: ☐ **Refresh**

00:0D:8D:F0:12:AF | Network1 | Radio1 *Click on column header to sort*

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 being configured.
Refresh	Re-scans 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	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 bands). Important: The antenna must operate on the same channel (frequency range) that was selected.
RSSI	Received Signal Strength Indication.

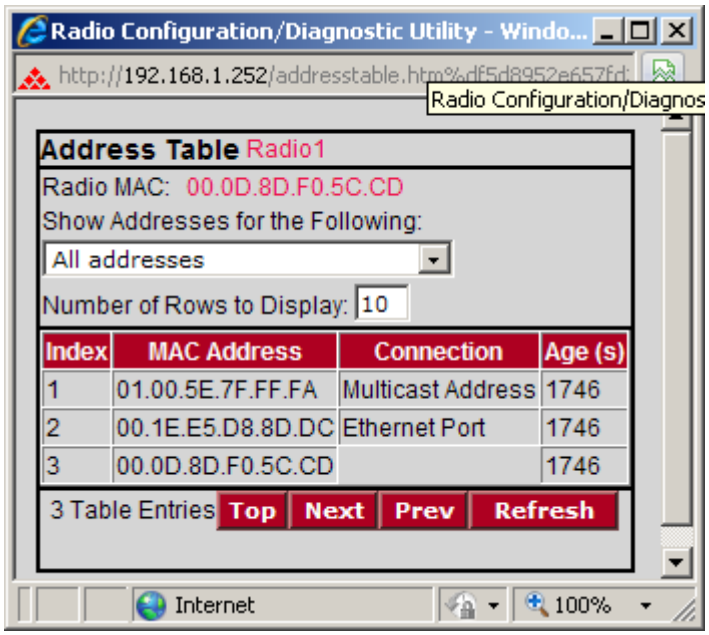
Field	Description
Security	Encryption type enabled for the device.
Speed	IEEE 802.11 connection speed (a, b, or g). The RadioLinx RLX2 radio supports all three 802.11 connection speeds.
Cost	Parent selection cost.
Age	Length of time (in seconds) since the radio last saw a packet from this MAC address
Hops	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 RLX2 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 RLX2 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 RLX2 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.

6.1.2 Address table

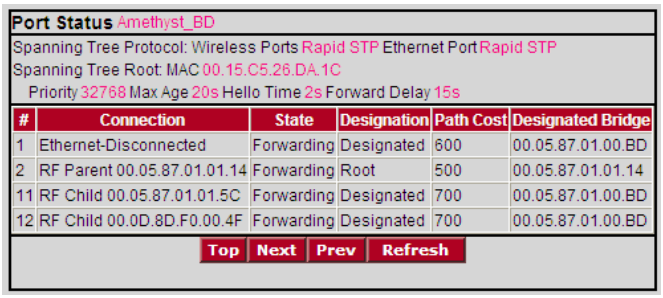


The Address Table shows the port through which each MAC address is connected, along with the age in seconds since the radio last saw a packet from this MAC address.

Field	Description
Radio MAC	MAC address of the selected radio. The MAC ID is also printed on the side of the radio.
Show Addresses for the Following	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	Selects the number of 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	MAC address for the device.
Connection	Connection type
Age (s)	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	Updates the table.

6.1.3 Port status

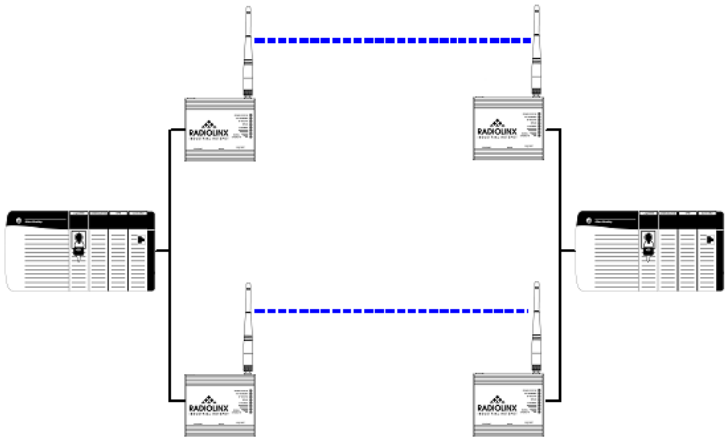
This configuration page opens when the *Port Status* button is clicked on the *Radio Configuration* form.



When the *Port Status* button is clicked, the information for all the active ports on the radio are displayed. Above the table, the information of the current Spanning Tree (page 69), 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 the creation of 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.

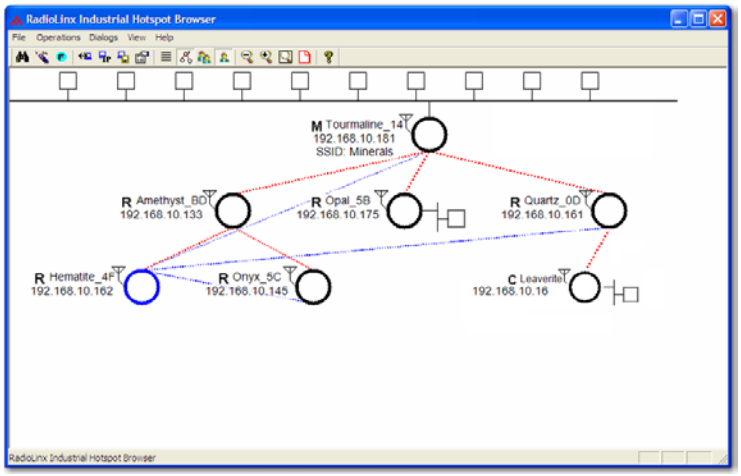


Field	Description
Spanning Tree Protocol: Wireless Ports	Spanning Tree Protocol level for the wireless port (Rapid STP or STP).
Ethernet Port	Spanning Tree Protocol level for the Ethernet port (Rapid STP or STP).
Edge Port	Displays *Active* or *Inactive* to based on the setting of *Ethernet Edge Port* in the *Spanning Tree* configuration dialog.
Spanning Tree Root MAC	MAC ID of the root device in the spanning tree.

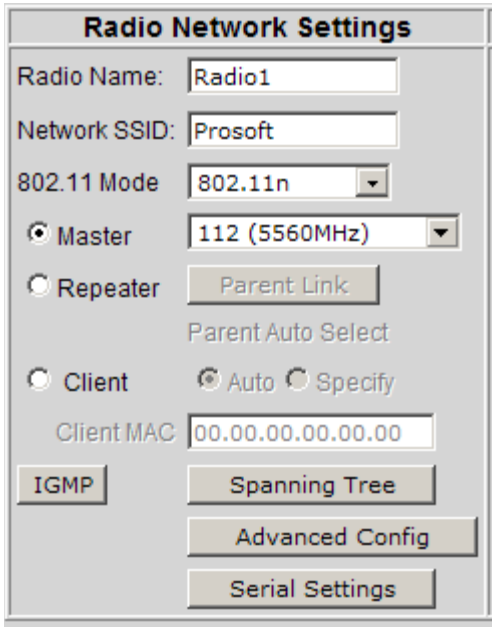
Field	Description
Priority	Spanning Tree device with the lowest-priority value is elected the root of the tree
Max Age	Length of time a port can stay enabled without any new spanning updates.
Hello Time	Length of time between the transmission of spanning update packets.
Forward Delay	Length of time a 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	Indicates what the port represents: Ethernet, a parent radio, or a child radio.
State	Current Spanning Tree state of the port. Possible states are Blocking, Learning, Listening, and Forwarding. Forwarding packets can be transferred.
Designation	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	Cumulative cost of all wired and wireless links from the port to the Spanning Tree root.
Designated Bridge	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	Updates the table.

The following illustration shows the RadioLinx Industrial Hotspot Browser (page 85) 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, it is easily shown 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.



6.2 Radio Network Settings



Note: Different versions of the RLX2 Radios support different functionality. The may be more or fewer options on this page, depending on the version of the radio.

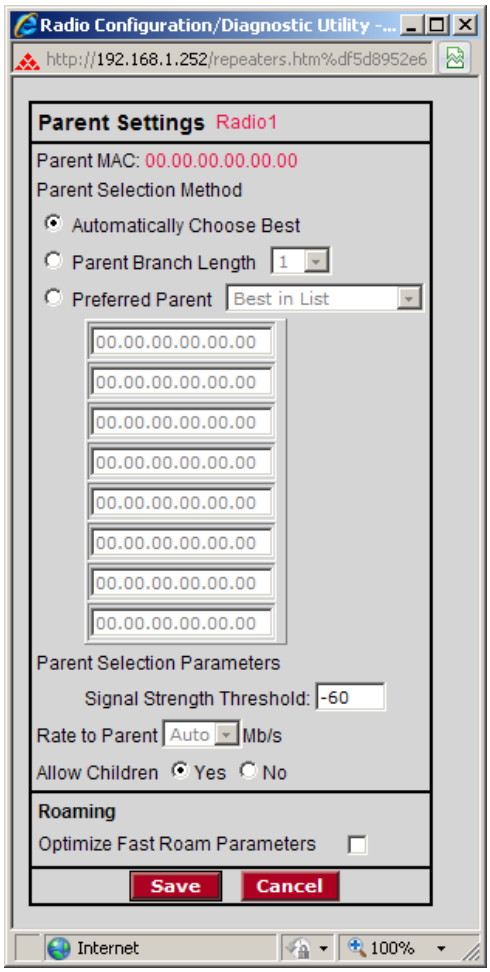
Use the settings in the Radio Network Settings panel to configure the radios in the network. For more information on using these settings, see Configuring the radios (page 37).

Field	Description
Radio Name	Unique name of radio on the network.
Network SSID	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.

Field	Description
802.11 Mode RLX2-IHNF	Present only on the RLX2-IHNF radio. There are three possible mode settings: **802.11a/g** The radio acts as an 802.11a radio on the 5 GHz band, and an 802.11g radio on the 2.4 GHz band. Data rates will be limited to the 802.11 a/g rates (54 mbps maximum). 802.11n operational features will be disabled. It is *not* necessary to select this mode for RLX2-IHNF radios to link to other RLX2 or RLXIB series radios; they will link their best possible speeds regardless of mode. This mode is not commonly used. It is mainly used to allow 802.11 a/b/g client devices that cannot link to 802.11n devices to work. One example of such a device is the ProSoft 1734-AENTR wireless I/O client. **802.11n** Default operational mode of the RLX2-IHNF radio. All 802.11n features are operational, and 20 MHz wide channels are used. **802.11.n wide** Utilizes adjacent pairs of 20 MHz-wide channels as a single 40 MHz-wide channel. This allows the fastest data throughput to other 802.11n devices. Only 802.11n devices can utilize this mode, but all RLX2 radios will link at their best speed regardless of mode. Channels in the 5 GHz band are 20 MHz apart, so *802.11n wide* mode occupies only two channels in that band. However, channels in the 2.4 GHz band are spaced only five MHz apart, so *802.11n wide* mode in the 2.4 GHz band occupies *eight adjacent channels*! Since there are at most 13 channels in the 2.4 GHz band, and only three channels do not overlap others, it is not recommended to enable wide mode on 2.4 GHz band channels.
Channel list (master radio)	Indicates the channel number as well as the frequency for operation in the 2.4 GHz or 5 GHz bands. The available channels in the radio will vary based on the model and country configuration. Please see section 0 for a comprehensive list of all frequencies for all RLX2 radio models. RLX2-IHNF RLX2-IHNF radios can operate on 5 GHz frequencies that are subject to *Dynamic Frequency Selection* regulations, and have a special channel selection called *DFS Auto Select*. See section 6.8.2 for further details **Important:** When choosing an antenna for use with the RLX2 radio, make sure it supports the frequency range set in the configuration for the radio.
Repeater	Configures 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 RLX2 radios are capable of repeating.
Parent Link settings	Specifies how a repeater radio connects to the network. For information, see Parent Link settings.

Field	Description
Client	Allows the connection of an Ethernet device to any 802.11 a, b or g access point. This mode is used in the special event of connecting a device to another brand access point. For information on setting up a client, see Configuring clients.
Auto / Specify	Use "specify" if device does not send out any unsolicited Ethernet packets. Try Auto first.
Client MAC	MAC ID of the device connected to the radio, only if the device does not advertise its MAC address.
IGMP	Opens the IGMP Settings form. Use this form to enable (default) or disable IGMP, and to configure how the RLX2 radio will behave when IGMP is enabled.
Spanning Tree	Opens the Spanning Tree Settings form.
Advanced Config	Opens the Advanced Settings form.
Serial Settings	Opens the Serial Settings form.

6.2.1 Parent Link Settings

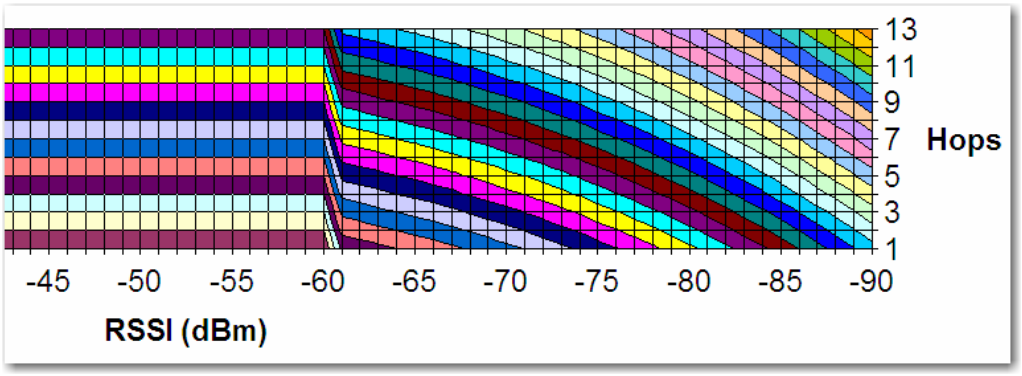


Field	Description
Parent MAC	MAC Address of the radio's Parent node. In the example above, the Repeater is not linked to a Master radio so the Parent MAC is shown as all zeroes.
Parent Selection Method	
Automatically Choose Best	The Automatic Parent Selection algorithm uses a calculation to create a "cost" metric for each possible parent radio that it detects. In the calculation the radio includes, ▪ RSSI - Stronger signals receive a lower 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	RLX2 radio will choose its parent strictly by the number of repeaters between it and the Master radio. If a Branch Length of 1 is chosen, the RLX2 radio will link only to the Master radio. If a Branch Length of 2 is chosen, the RLX2 radio will link only to another RLX2 radio that is linked to the Master radio, and so on.

Field	Description
Preferred Parent	RLX2 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 radio 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 radio 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. The threshold can be adjusted here.
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. 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.
Roaming Parameters	
Optimize Fast Roaming Parameters	In typical Fast Roam applications a Repeater is installed on a mobile pallet or platform and a set of Master units forms a backbone infrastructure network, through which the Repeater must roam. To obtain fast roam times, Spanning Tree must be disabled and SSID's not hidden on the Master. The Repeater should be configured to not allow child Repeaters and to use a Signal Strength Threshold set high enough such that RSSI is used to determine the link cost to a parent. Checking the checkbox in this section automatically sets these parameters accordingly along with a predetermined optimum value for the cost threshold. Unchecking it will revert the parameters to their previous values before the check box state was saved. Note: All *Spanning Tree* configurations and *Hide SSID* must be disabled manually on all Master units as this dialog box is only accessible when in Repeater mode. It is always possible to subsequently change any of these parameters if it is so desired, for example to set a different value for the Signal Strength Threshold. If this is done then the control will not display as checked as it will only display as checked if all three parameters have the preset values.
Save	Saves the changes and updates the radio configuration.
Cancel	Discards the changes without updating the radio configuration.

After a selection is saved and return to the Radio Network Settings panel, notice the 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.

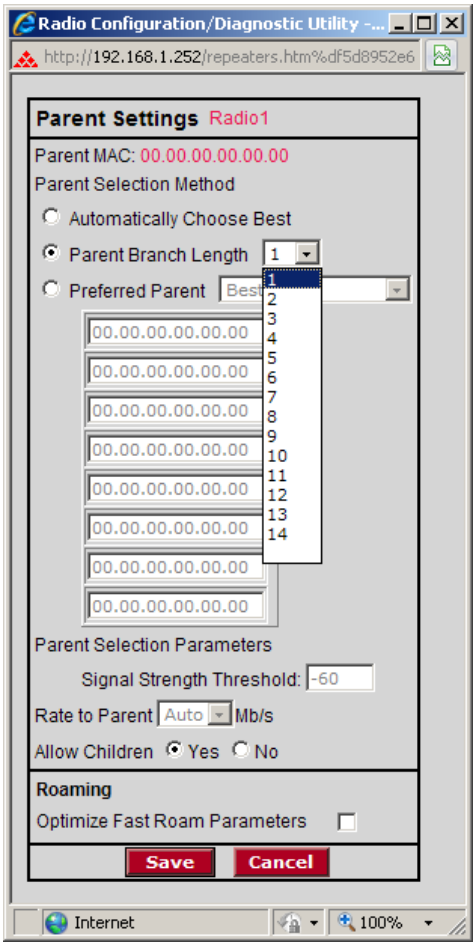


Once per second, the RLX2 radio evaluates the link it has to its parent to determine if this link is the best parent to use. A cost is calculated for each entry and can be seen in the column labeled "Cost" in the preceding table. The cost calculation is based not only on the strongest signal, but on several other factors to provide optimum network communication.

Prioritized Parent Selection

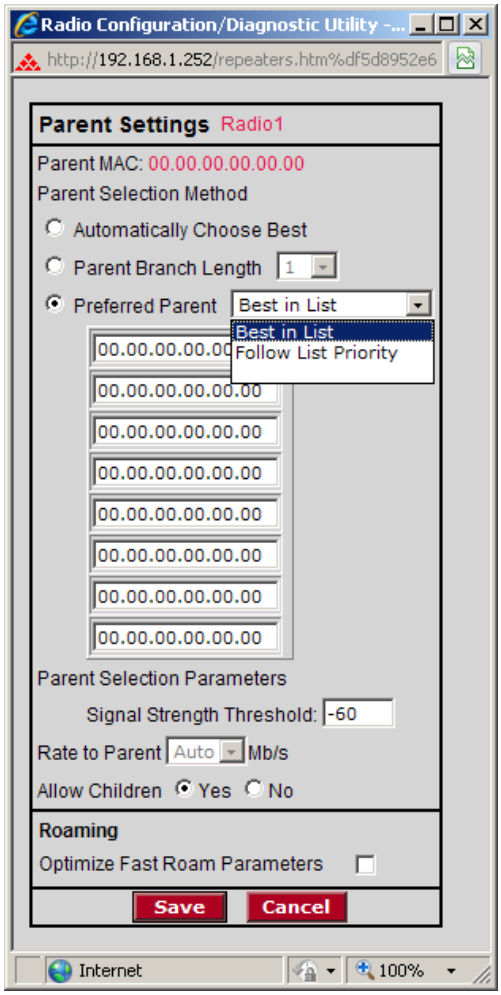
If more control is needed than the automatic algorithm allows, a priority list of parents for the RLX2 radio can be defined.

Prioritized Parent by Branch Length



With **Parent Branch Length,** the radio will choose its parent strictly by the number of repeaters between it and the Master radio. If Branch Length of 1 is chosen, the radio will link only to the Master radio. If Branch Length of 2 is chosen, the radio will link only to an RLX2 radio that is linked to the Master radio, and so on.

Prioritized Parent by Preferred Parent List



With **Preferred Parent,** the radio will select its parent from a list of user-specified parents. Up to eight radios can be defined.

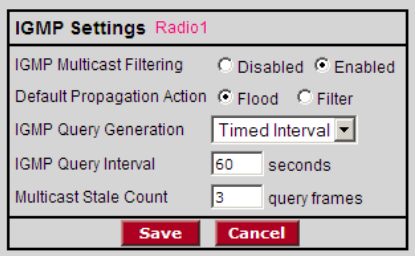
- **Best in List**

  The radio 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 radio will select its parent from the list giving preference to the first entry, followed by the second entry, and so on.

6.2.2 IGMP Settings



RLX2 radios support IGMP v1 and v2. The default operation of the RLX2 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 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, RLX2 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-empted by a query from another device).
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 the changes and updates the radio configuration.
Cancel	Discards the changes without updating the radio configuration.

6.2.3 Rapid Spanning Tree Functionality

The software's built-in Rapid Spanning Tree (RSTP) functionality enables the setup of 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.

Important: All radios in a network must have the same Spanning Tree configuration (enabled or disabled.) Radios will not link if some of them have Spanning Tree enabled while others do not.

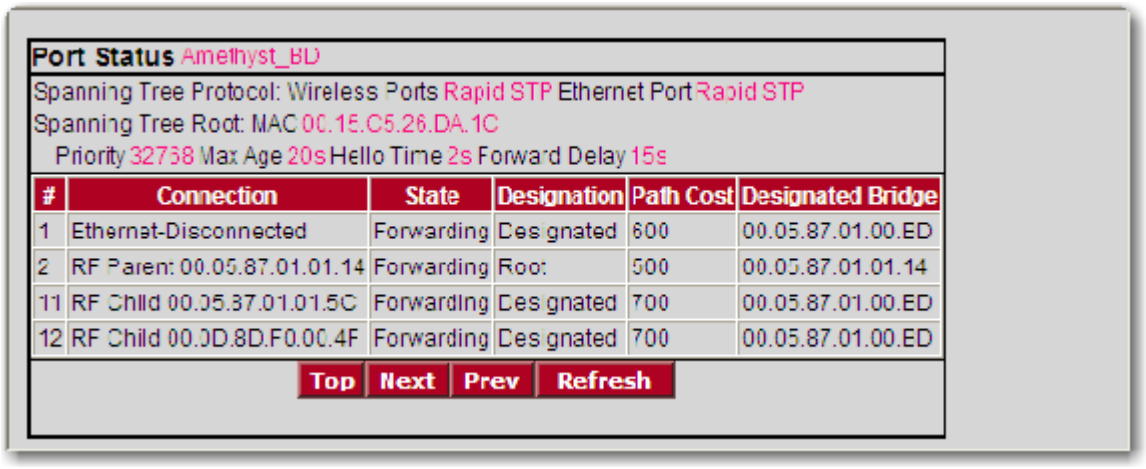
RSTP allows users to create truly redundant connections between any two points in the network. The radios detect the redundant paths and keep one connection alive for communications. If the primary connection fails for any reason, the secondary connection is quickly transitioned to a state to forward 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, RLX2 radios work in conjunction with wired Ethernet switches to form a redundant network. Spanning Tree details are described in the IEEE 802.1D series of specifications.

Each RSTP device (RLX2 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 RLX2 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, the RLX2 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).

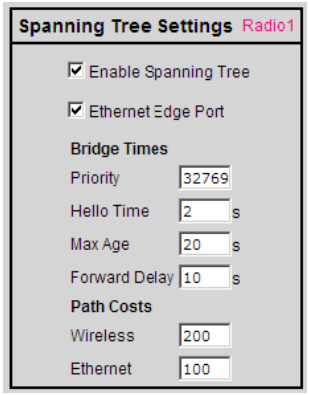


BPDUs are sent out the port at a rate called the "Hello Time". The accepted standard value for this is 2 seconds. If a radio (or any other RSTP device) does not get a BPDU for 2 Hello Times, it assumes the RSTP device that had been there is no longer available. It can then open an alternate path if one 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 RLX2 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 RLX2 Radio the Ethernet switch table is flushed 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.

6.2.4 Spanning Tree Settings



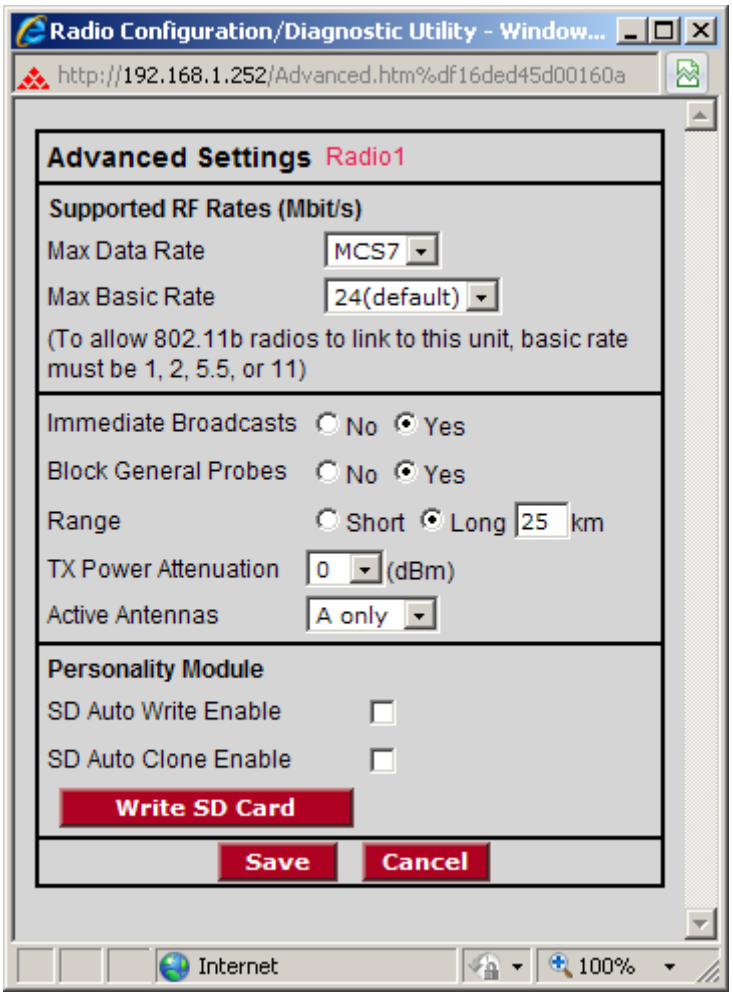
Field	Description
Enable Spanning Tree	Spanning Tree is enabled when this box is checked. Without spanning tree, redundant connections might exist if multiple radio links are created in parallel with each other. Redundant connections are blocked only if spanning tree is enabled. Additionally, spanning tree is used to flush the Ethernet switch table when the network topology changes as described in the section on Automatic Parent Selection. The default setting for *Enable Spanning Tree* is disabled. Note that many network switches implement spanning tree functionality themselves, which if enabled, will cause conflicts if Spanning Tree is also enables in the radio. Check the documentation and settings for the wired network equipment before enabling Spanning Tree in the radios.
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	Configures the timing intervals to use.
Priority	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 RLX2 radios exist in the network, the Master radio will become the root.
Hello Time	Rate at which BPDUs are sent out. The industry standard is 2 seconds.

Field	Description
Max Age	Measures the age of the received protocol information recorded for a port and ensures 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	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	Gives preference to a wired connection, set the Wireless cost to 200.
Ethernet	Gives preference to a wired Ethernet connection, set the Ethernet cost to 100.

Multiple master radios can be defined on the same network. 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, each radio can be configured to reach a master radio via multiple repeater paths. If a repeater goes down, the linked radios can use a different path to get back to a master radio.

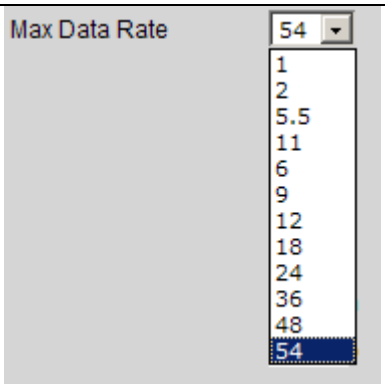
6.2.5 Advanced Settings

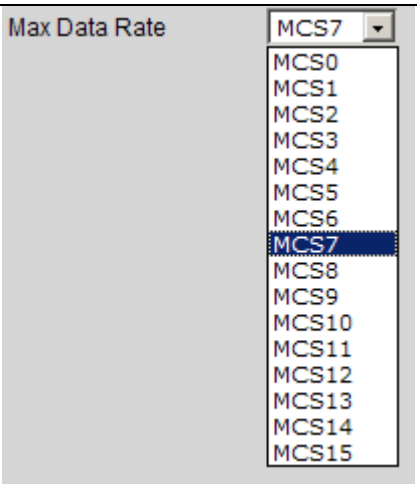


It is important to allow many industrial protocols to communicate properly over the RLX2 radios. The standard 802.11 AP operation for transmitting broadcast messages is to accumulate them and transmit them only on specific time intervals. This allows clients that are in power-save mode to wake up at 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 the configuration of the transmission rate and broadcast mode to optimize this radio's use on an industrial network.

Field	Description
Max Data Rate RLX2-IHA RLX2-IHG RLX2-IHW	 The maximum data rate for the RLX2-IHA, -IHG, and –IHW radios is specified in megabits per second. The allowed values are shown above. The default maximum is 54 Mbits/sec. Normally the Max Data Rate should be set to the maximum value. However under poor operating conditions, reliability may improve if the Max Data Rate is reduced.

Field	Description
Max Data Rate RLX2-IHNF	

The maximum data rate for the RLX2-IHNF radio is specified in terms of a *Modulation and Coding Scheme* (MCS) index value. This specification is unique to IEEE 802.11n devices. The actual maximum data rate depends on several factors as shown in the following table:

		802.11n mode, MBits/sec		802.11n wide mode, MBits/sec	
MCS Index	Active Antennas	800 ns GI	400 ns GI	800 ns GI	400 ns GI
0	1	6.50	7.20	13.50	15.00
1	1	13.00	14.40	27.00	30.00
2	1	19.50	21.70	40.50	45.00
3	1	26.00	28.90	54.00	60.00
4	1	39.00	43.30	81.00	90.00
5	1	52.00	57.80	108.00	120.00
6	1	58.50	65.00	121.50	135.00
7	1	65.00	72.20	135.00	150.00
8	2 or 3	13.00	14.40	27.00	30.00
9	2 or 3	26.00	28.90	54.00	60.00
10	2 or 3	39.00	43.30	81.00	90.00
11	2 or 3	52.00	57.80	108.00	120.00
12	2 or 3	78.00	86.70	162.00	180.00
13	2 or 3	104.00	115.60	216.00	240.00
14	2 or 3	117.00	130.00	243.00	270.00
15	2 or 3	130.00	144.40	270.00	300.00

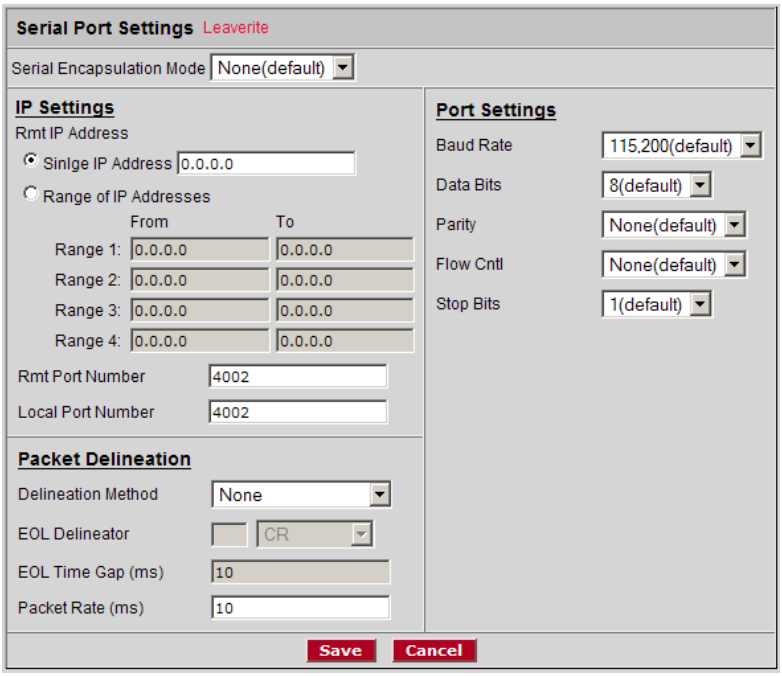
Only MCS rates from 0 through 7 are available with one antenna, which is the default configuration. To select MCS rates of 8 and above, configure the *Active Antennas* to be *A,C* or *A,B,C*. (See *Active Antennas* below.)
The maximum throughput also depends on the *802.11n Mode* as configured in the *Radio Network Settings* section of the main webpage. See section 6.2. Throughput in *802.11n wide mode* is approximately twice that of *802.11n mode*.
The radio will automatically select the *Guard Interval* (GI) based on

Field	Description
	current operating conditions. The system attempts to use a 400 microsecond Guard Interval, but will fall back to an 800 microsecond Guard Interval if excessive data corruption is detected. The radio will periodically attempt to resume using a 400 microsecond Guard Interval as conditions improve. A 400 microsecond Guard Interval results in about 11% more throughput than using a 800 microsecond guard interval. The user has no control of the Guard Interval. As seen in the table above, absolutely best throughput requires *802.11n wide* mode, more than one antenna, and a RF environment capable of supporting a 400 microsecond Guard Interval.
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 radio, other than the Master, then inherits 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	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. The default *Long* range is 25km, which is valid for all operating modes of all radios.
TX Power Attenuation	Allows reduction of the radio's output power.. The range of attenuation is from 0 to 18 dB. Radios are shipped from ProSoft configured for maximum output power. This is either the maximum output power of the radio itself, or the maximum power allowed by country for which the radio is configured. However, it is possible to attach an antenna with so much gain that the maximum legal allowed radiated power is exceeded. This control allows the reduction of power when using such antennas so that output power is still within legal limits. See section 8.4 for information on output power regulations by the FCC for the USA. Note that higher gain antennas provide better performance in both receive and transmit functions, while output power only increases transmit performance.

Field	Description
Active Antennas RLX2-IHNF	This control is only available on the RLX2-IHNF radios. The default is set to *A Only*. The other options are *A, C* (for two antennas) and *A, B, C* for three antennas. Note that if two antennas are used, they must be attached to the *ANT A* and *ANT C* antenna connectors. MIMO antennas generally will have three connections so all three antenna ports must be activated. In general, operation with three antenna ports will give best performance. When more than one antenna port is active, the radio will monitor the signal appearing at all antenna ports and dynamically select the port(s) with the best signal. However, there are situations where performance may improve if fewer antenna ports are active. If radios are very close together (typically a few feet), all three antenna ports will receive essentially identical signal strengths and the radio may continuously change antenna ports, resulting in degraded performance.
SD Auto Write Enable	Enables the unit to write a copy of its Configuration to the SD Card whenever new settings are saved from any pages of the unit's web interface. Previous Configuration files are renamed with a unique file name which allows auditing of changes made to the unit's settings.
SD Auto Clone Enable	Enables the unit's Clone function. On power up if an SD Card is present that has a Configuration file different from the unit's current Configuration the unit will adopt the settings from the SD Card. If the Configuration matches or there is no Configuration file on the SD Card then no action is taken. On inserting an SD Card into a running unit, if the Configuration file found on the SD Card will result in the unit's settings being changed on Powerup or Reset, a warning is indicated by flashing the Signal Strength, MOD and NET LEDs. In order to save this control as enabled, either an SD Card must not be present, or the *SD Auto Write Enable* control must also be checked when saving. If these conditions are not present the control will be disabled before saving, to prevent the unit from reverting back to a Configuration file on the SD Card after reset. To adopt the Configuration file on an SD Card when this control is already enabled, simply insert the SD Card and power cycle the unit. If this control is not enabled, first enable and save the setting without the SD Card inserted and then insert the SD Card and power cycle the unit. NOTE: Do not enable Auto Write if you do not want the active Configuration file on the SD Card to be replaced when the unit adopts and saves the SD Card's current Configuration file.
Write SD Card	Immediately writes a copy of the unit's Configuration file to the SD Card, independent of the Auto Write check box setting. Note that the configuration files are in a binary format so sensitive data (e.g. passwords, encryption keys) cannot be easily read from the files.
Save	Saves the changes and updates the radio configuration.
Cancel	Discards the changes without updating the radio configuration.

6.2.6 Serial Port Settings

This configuration page opens when the *Serial Port Settings* button is clicked on the Radio Configuration form.

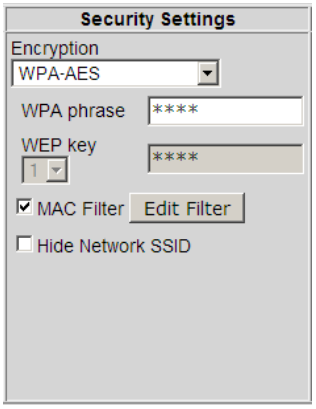


Use this page to configure the way serial data packets are encapsulated and transmitted over an Ethernet network.

Field	Description
Serial Encapsulation Mode	**None:** No serial data encapsulation. **UDP:** In UDP mode, programs on networked computers can be used to send short messages or Datagrams. Once enabled, the serial port will be used to transmit and receive packets. **NOTE:** In UDP mode if a multicast group address is entered in this field then packets are sent to that address. **TCP Server:** In TCP Server mode, only connections from this address will be accepted. Once the session is established, the serial port is enabled to transmit and receive packets. **NOTE:** To accept connections from any IP address the field should be set to 0.0.0.0. **TCP Client:** In TCP Client mode, a TCP connection will be established with this address. When the session is established, the serial port is enabled to transmit and receive packets.
Single IP Address	IP Address or URL of the radio that should receive encapsulated serial protocol packets.
Range of IP Addresses	Up to 4 IP Address ranges for radios that should receive encapsulated serial protocol packets.
Remote Port Number	Remote UDP port number to use for encapsulated serial data transmission.
Local Port Number	Local UDP port number to use for encapsulated serial data transmission.

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>Delineation Method</td><td>None: All data received between packet delineation events is sent to the remote node in a single network frame.
Time Gap: The minimum time gap between characters that is to be interpreted as a delineator for a packet. Configure this value in the EOL Time Gap field.
Character: The particular character sequence in the stream of characters that indicates the delineator for the packet. Configure this value in the EOL Delineator field.</td></tr>
<tr><td>EOL Delineator</td><td>Available when the selected Delineation Method is Character. Choose the type of delineator to use from the dropdown list:
Available delineation types are:
<table>
<tr><th>Type</th><th>Decimal</th><th>Hex</th><th>Description</th></tr>
<tr><td>Use Text</td><td></td><td></td><td>Any string of characters</td></tr>
<tr><td>CR</td><td>13</td><td>0D</td><td>Carriage Return</td></tr>
<tr><td>ESC</td><td>27</td><td>1B</td><td>Escape</td></tr>
<tr><td>LF</td><td>10</td><td>0A</td><td>Line Feed (New Line / nl)</td></tr>
<tr><td>Null</td><td>00</td><td>00</td><td>Null</td></tr>
<tr><td>Spacebar</td><td>32</td><td>20</td><td>Space</td></tr>
<tr><td>Tab</td><td>09</td><td>09</td><td>Horizontal Tab</td></tr>
</table></td></tr>
<tr><td>EOL Time Gap</td><td>Available when the selected Delineation Method is Time Gap; This value configures the length of time in milliseconds that must elapse after a character is received (from the local attached device) before that character marks the end of a packet.
NOTE: the smallest value this field can be set to will be limited by the device and is platform dependent.</td></tr>
<tr><td>Packet Rate (milliseconds)</td><td>Sets the minimum time gap that will be interpreted as an inter-packet space. When detected the characters received up to that point will constitute a single packet and will be sent to the remote node. Units: microseconds. Values: 1,000 to 500,000.</td></tr>
<tr><td>Baud Rate</td><td>Baud rate on the radio must match the baud rate on the connected serial device.</td></tr>
<tr><td>Data Bits</td><td>Number of data bits (5, 6, 7 or 8). The data bits on the radio must match the data bits on the connected serial device.</td></tr>
<tr><td>Parity</td><td>Parity (None, Even, Odd, 1 or 0). The parity on the radio must match the parity on the connected serial device.</td></tr>
<tr><td>Flow Control</td><td>Flow control (handshaking) mode (None or Hardware). The handshaking mode on the radio must match the handshaking mode on the connected serial device.</td></tr>
<tr><td>Stop Bits</td><td>Stop bits (1 or 2). The stop bits on the radio must match the stop bits on the connected serial device.</td></tr>
<tr><td>Save</td><td>Saves the changes and updates the radio configuration.</td></tr>
<tr><td>Cancel</td><td>Discards the changes without updating the radio configuration.</td></tr>
</table>

6.3 Security settings



The following security settings can be configured:

Field	Description
Encryption type (page 79)	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, a few combinations of legacy methods can be selected. 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 79)	WPA pass phrase of between eight and 63 normal keyboard characters.
WEP key (page 80)	Five normal text characters in the WEP key field
MAC Filter (page 81)	Restricts connections by MAC address.
Edit Filter	Opens the MAC filter (page 81) form, allowing the specification of the MAC addresses of devices to allow in the network.
Hide Network SSID (page 81)	Hides the Network SSID (Network Name) from other 802.11 users. Clients can connect to the "hidden" network by typing the Network SSID.

The following topics describe each security setting in more detail.

6.3.1 Encryption type

The preferred encryption type is WPA (WiFi Protected Access). 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, select WPA+WEP128 (bits) or WPA+WEP64 (bits) as the encryption type. The older clients can connect to an access point using the WEP setting, but new clients will use WPA and the RLX2 radios will still use WPA among themselves.

IMPORTANT: If WPA+WEP is selected, some clients using WPA might not be able to connect unless a WEP key other than number 1 is used, due to limitations in these clients. In such cases, set a WEP key other than key 1 and set this same key in all clients that are using WEP. See WEP key (page 80).

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.

Selecting WEP 128, WEP 64, or None (no encryption) as the encryption type is possible, but none of these settings are recommended.

Note: If an RLX2 radio 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 RLX2 radio in client mode with WPA+WEP selected will not connect to an access point with WEP only selected.

6.3.2 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 WPA encryption type is selected.

The default WPA-AES Phrase is 'passphrase'.

6.3.3 WEP key

A key is a set of hexadecimal (hex) or ASCII characters used to encrypt data. This field is only available when using WEP encryption type. Be sure to record the WEP encryption key to retrieve if needed.

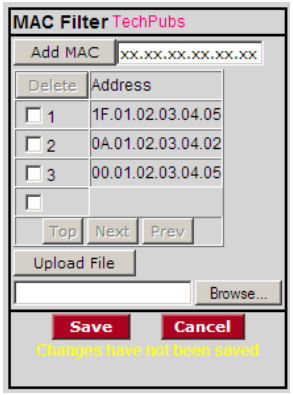
To create a 64-bit WEP key, enter five normal text characters in the WEP key field, which converts the characters automatically to 10 hex digits. Alternatively, enter 10 hex digits (0 to 9, a to f, A to F) directly in the WEP key field.

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 a transmit key number is set on the RLX2 radio, make sure all other radios and clients have this key programmed. To set keys other than key 1 on some clients using Windows, Advanced settings may be used.

Programming more than one key on the RLX2 radio requires setting the key number to the key, entering the key, and saving the changes. Repeat these steps for each key 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)

6.3.4 MAC filter



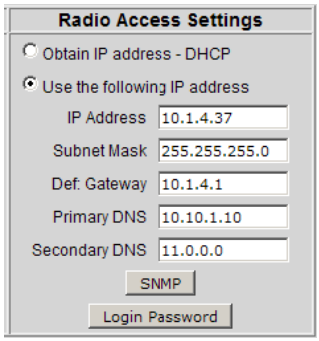
Field	Description
Add MAC	Enter the MAC address to add.
Delete	Deletes the selected MAC address from the list.
Address	List of MAC addresses configured.
Top	Displays the top of the list.
Next / Prev	Navigates up and down through the address list.
Upload File	To assign the same list of MAC addresses to several radios conveniently, open a text editor such as Notepad.exe. Enter addresses in hexadecimal format, one MAC address per line, including periods. When finished, save the document. In the MAC Filter window, click Browse to select the text file, click Upload File to upload the list of MAC addresses.
Browse	Navigates to a prepared text file of MAC addresses on the appropriate drive and folder, and click the Upload File button.
Save	Saves the changes and updates the radio configuration.
Cancel	Discards the changes without updating the radio configuration.

6.3.5 Hide Network SSID

If the radio network is to be hidden from other 802.11 users, click the Hide Network SSID check box in each radio to be hidden. With the SSID hidden, the network does not show up when other clients scan for an access point. Clients can still connect to the "hidden" network by typing the Network SSID.

6.4 Radio access settings

The following fields appear in the Security Settings area on the right side of the Radio Configuration window.



In order to configure or diagnose a radio using its built-in Web server or SNMP agent, both the computer and the radio must have IP addresses. These IP addresses must be on the same subnetwork. An IP address is only needed to configure the radio and view its diagnostic settings. Otherwise, the address is unnecessary.

Field	Description
Obtain IP address - DHCP	Allows the radio to obtain its IP address from a DHCP server.
Use the following IP address	Specifies a Static IP address to the radio. Enter the IP address information in the following fields.
IP Address	Use an IP address that will not interfere with any other devices on the network. Request a block of IP addresses to use from the Network Administrator.
Subnet Mask	Subnet Mask provided by the Network Administrator.
Default Gateway	Default Gateway address provided by the Network Administrator.
Primary DNS	Primary DNS address provided by the Network Administrator.
Secondary DNS	Secondary DNS address provided by the Network Administrator.
SNMP button	Opens the SNMP (Simple Network Management Protocol) Agent settings form. Use this form to configure access to radio network settings through an SNMP agent.
Login Password button	Configures the Login Password for the radio. The default password is "password". Change this password and keep a record of it in a safe place, to protect the radio from being reconfigured by unauthorized users.

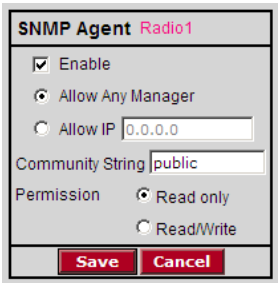
DHCP (Dynamic Host Control Protocol) is a service provided by a server (typically a router or a firewall) on a local area network. Devices on a network that supports DHCP can request and receive an IP address from the DHCP server. RLX2 radios support DHCP; by default, they attempt to obtain an IP address from a DHCP server.

If a DHCP server is not available, the radio will not be able to acquire an IP address automatically. Therefore, assign an IP address, subnet mask and default gateway to the radio so that it can communicate on the network.

Assign a Static (fixed or permanent) IP address to the radio to make it easier to identify and configure the radio. Static IP addresses are particularly useful when configuring radios to serve as Access Points, or for radios that must be accessible through a firewall.

A detailed discussion of TCP/IP networking is beyond the scope of this manual. Refer to the following Microsoft knowledgebase article for more information: http://support.microsoft.com/kb/164015

6.4.1 SNMP Agent settings



SNMP is a network management protocol that is often used with TCP/IP and Ethernet. As an alternative to using the Radio Configuration / Diagnostic Utility, changing radio settings and viewing diagnostics can be done in an SNMP manager application.

Field	Description
Enable	Enables the following SNMP Agent settings.
Allow Any Manager	Allows any user to change the radio settings from any computer using SNMP.
Allow IP	Restricts access to an SNMP manager with a particular IP address. Enter the IP address in the Allow IP field.
Community String	Enter a "community string" (essentially a password) that a manager must use to access the radio's SNMP agent.
Permission	Select the permission level to assign to this radio.
Read only	An SNMP Agent can view but cannot modify radio settings.
Read/Write	An SNMP Agent can view and modify radio settings.
Save	Saves the changes and updates the radio configuration.
Cancel	Discards the changes without updating the radio configuration.

The RLX2 SNMP agent supports SNMP protocol version 1.4 and 2 MIBs:

RFC12133-MIB (partial; internet.mgmt.MIB-2.system, .interfaces, .snmp)

ROMAP-MIB (included on the DVD; internet.private.enterprises.romap)

It also supports a selection of standard SNMP traps, including Cold Start, which is sent when the radio initializes.

6.4.2 Change password

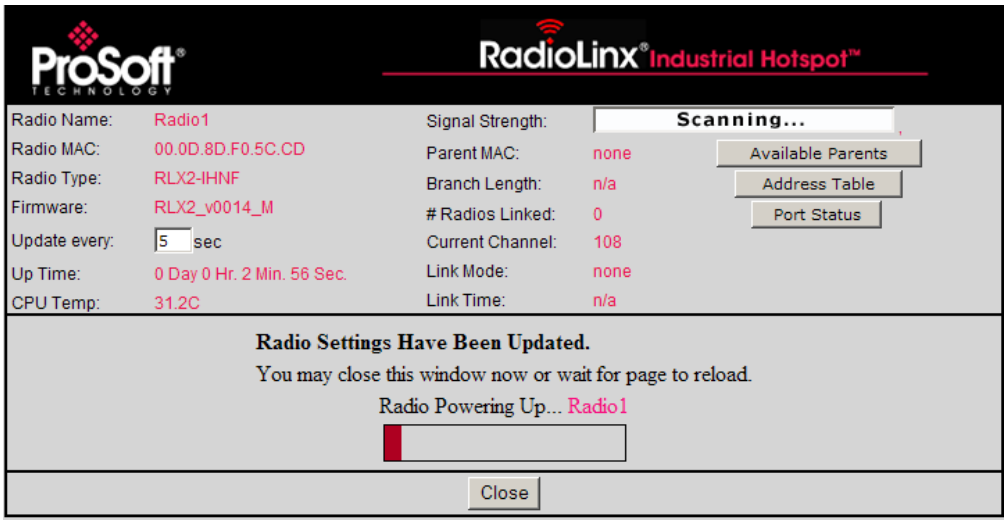
Field	Description
Old	Enter the current password in this field. The default password is "password" (lower case, no quotes). This entry must exactly match the current password, otherwise the change will be rejected.
New	Enter the new password in this field. Passwords are case sensitive.
Repeat	Confirm the new password in this field. This entry must exactly match the password entered in the "New" field, otherwise the change will be rejected.
Save	Saves the changes and updates the radio configuration.
Cancel	Discards the changes without updating the radio configuration.

Any alphanumeric value between one and 31 characters can be entered. The password is case-sensitive.

If the password cannot be found, changes the radio settings cannot be done. To revert back to the default password, see the Troubleshooting section.

6.5 Apply Changes

Click the Apply Changes button to save the changes after editing radio configuration in order for those changes to take effect. When changes are applied, the radio will shut down and restart using the new settings.



6.6 Cancel Changes

Click *Cancel Changes* to discard any settings made during this session.

Note: This button only applies to changes made in the Radio Configuration / Diagnostic window. Changes made to individual configuration forms (for example, Spanning Tree, Parent Link, and SNMP Agent settings) take effect when the Save button is clicked on each of those forms.

6.7 Factory Defaults

Click the Factory Defaults button to reset the radio to the default settings.

Important: This action discards all the radio configuration settings.

A prompt to confirm this action will appear before changes take place.

6.8 RLX2-IHNF DFS Support

Some channels in the 5 GHz band are shared with radar and must adhere to *Dynamic Frequency Selection* (DFS) rules. This means that if the radio detects the presence of radar on its operating frequency, it must automatically change to another frequency.

6.8.1 Master Radio Operations

If radar is detected on an operating channel, transmissions must cease within the required *Channel Closing Transmission Time*, and must move to a new channel within the required *Channel Move Time*. Before transmitting on a new DFS channel that has not been previously checked for radar, the Master radio must monitor the channel for the *Channel Availability Check Time* before transmitting. Operations cannot return to a channel where radar was detected for at least the *Non-Occupancy Period*. The values for these parameters are noted in the table below:

Parameter	FCC Value	ETSI Value	ETSI Value 5.600 – 5.650 GHz (Channels 120, 124, & 128)
Channel Availability Check Time	60 seconds	60 seconds	10 minutes
Channel Move Time	10 seconds (12 seconds for “long pulse” radar	10 seconds	10 seconds
Channel Closing Transmission Time	200 milliseconds (plus up to 60 milliseconds over 10 seconds)	1 second	1 second
Non-Occupancy Period	30 minutes	30 minutes	30 minutes

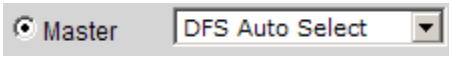
If a Master radio detects radar, it issues a channel change announcement to all Clients and Repeaters in the network. Then it moves to a new channel within the *Channel Move Time*. (Typically, this move time is 500 milliseconds or less.) If the selected channel was not previously checked for the presence of radar, the Master radio must do so for the *Channel Availability Check Time* before it can begin to transmit. If the newly-selected channel is not a DFS channel, or if the channel was previously monitored for radar since the radio was powered on, transmissions can begin immediately.

During the *Channel Availability Check Time*, a radio blinks all three amber Signal Strength LEDS approximately once per second. If radar is detected on the new channel during the *Channel Availability Check Time*, the Master randomly selects another channel and begins the process again.

If a Repeater in a network detects radar, it will notify the Master to change channels.

6.8.2 DFS Auto Select

One of the Master channel selection options is *DFS Auto Select*.



With this selection the radio randomly selects a DFS channel for operation. The actual channel in operation is always shown in the *Current Channel* display:

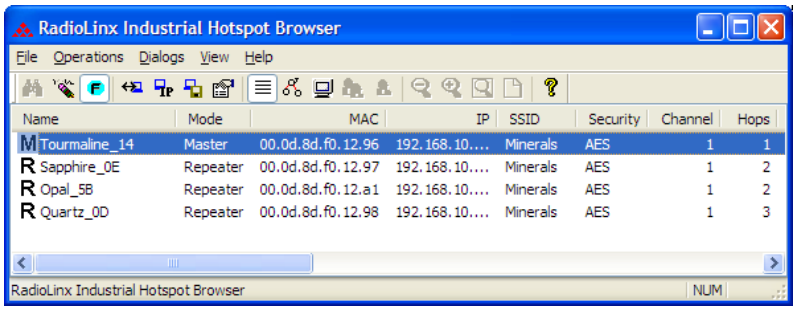
7 RadioLinx Industrial Hotspot Browser

In This Chapter

- Primary radio functions 88
- File Menu 89
- Operations Menu 91
- Dialogs Menu 97
- View Menu 102
- Help Menu 112

The IH Browser finds any radio connected to the network. It can also see basic settings and change the IP address. Access to the radio's Web page can be done. For more information, see Primary radio functions (page 100).

The List view (shown in the illustration) appears with a list of any radios on the same network as the computer running the IH Browser. If a known radio cannot be seen, click the Scan (page 902) button in the tool bar or select Scan from the File menu.



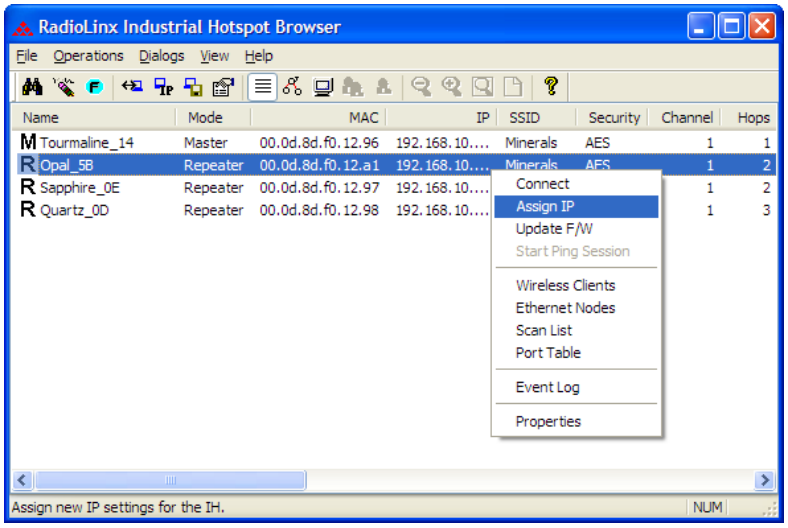
The preceding illustration shows the List View. Refer to Topology view (page 106) to see alternate views.

To clear all the radios from the list, click the Erase button in the tool bar or select Clear from the File menu. Refreshing the list is done by clicking Scan.

If there is trouble viewing radios in the IH Browser, see Troubleshoot missing radios (page 46).

7.1 Primary radio functions

Performing the following primary functions on any listed radio is done by right-clicking the radio name.



Connect (page 92): Log in to the Radio Configuration / Diagnostic Utility to configure a radio or check diagnostics.

Assign IP (page 37, page 92): Assign a temporary IP address to a radio.

Update Firmware (page 93): Update the version of firmware the radio uses.

Start Ping Session (page 94):

Wireless Clients (page 97): View a list of client radios

Ethernet Nodes (page 98): View a list of wired Ethernet nodes connected to the network

Scan List (page 99): View a list of all the radios detected on the network (including those from other vendors)

Port Table (page 100):

Event Log (page 100):

Properties (page 101): View the selected radio's properties.

In addition, there are more options in the File menu.

- Print either a list of the radios' properties or a topology view.
- Change how the IH Browser scans for radios.

7.2 File Menu

The following commands are available on the File menu:

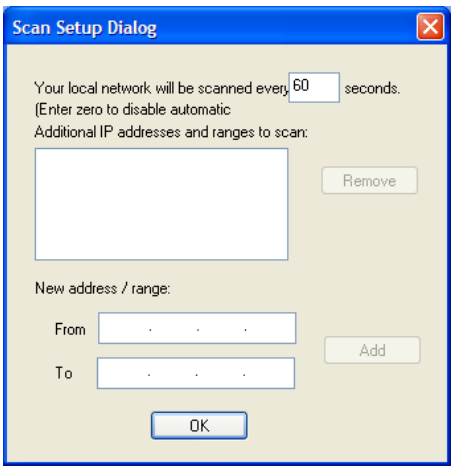
- **Scan Setup** (page 89)
- **Scan** (page 90)
- **Clear** (page 90)
- **Import** (page 90)
- **Export** (page 90)
- **Freeze** (page 90)
- **Print** (page 90)
- **Print Preview** (page 91)
- **Print Setup** (page 91)
- **Exit** (page 91)

7.2.1 Scan Setup

The Scan Setup command allows the configuration of settings that govern how the IH Browser scans for radios. In the top field of the Scan Setup dialog box, adjust how often the IH Browser program automatically scans for radios. Enter a value in seconds.

In the New address/range fields, the program scan type can be adjusted for radios. By default, the program sends a broadcast message to all the radios at the same time, looking for a response. Broadcasts are limited to a local network, and will not be passed through a router.

If there is a router between the PC running the IH Browser and the radio to be scanned, the IP address of the radio or a range of addresses can be added to the scan list. At each interval determined by the scan rate, each IP address is individually queried.



7.2.2 Scan

The IH Browser automatically scans for all active radios on the network at a regular interval, use the Scan command in the File menu to look for active radios at any time.

7.2.3 Clear

Clears (deletes) all entries from the IH Browser window.

7.2.4 Import

Imports an XML file created by the Export command in the IH Browser.

7.2.5 Export

Creates and saves an XML file containing the current configuration and status of all radios discovered by the IH Browser. Use this command under the direction of ProSoft Technical Services, for troubleshooting purposes.

7.2.6 Freeze

Temporarily stops the display from updating. This command is useful for studying network topology and performance without the distraction of radios and other devices appearing and disappearing from the screen.

7.2.7 Print

Prints the contents of the IH Browser window. Depending on the view selected, the radio properties or a topology view can be printed.

7.2.8 Print Preview

Displays a preview of the contents of the IH Browser window. Use this to adjust the placement of elements so that they do not span page boundaries.

7.2.9 Print Setup

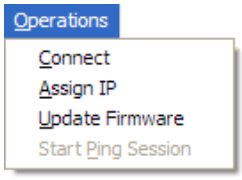
Displays the standard Window Print Setup dialog box.

7.2.10 Exit

Closes the IH Browser.

7.3 Operations Menu

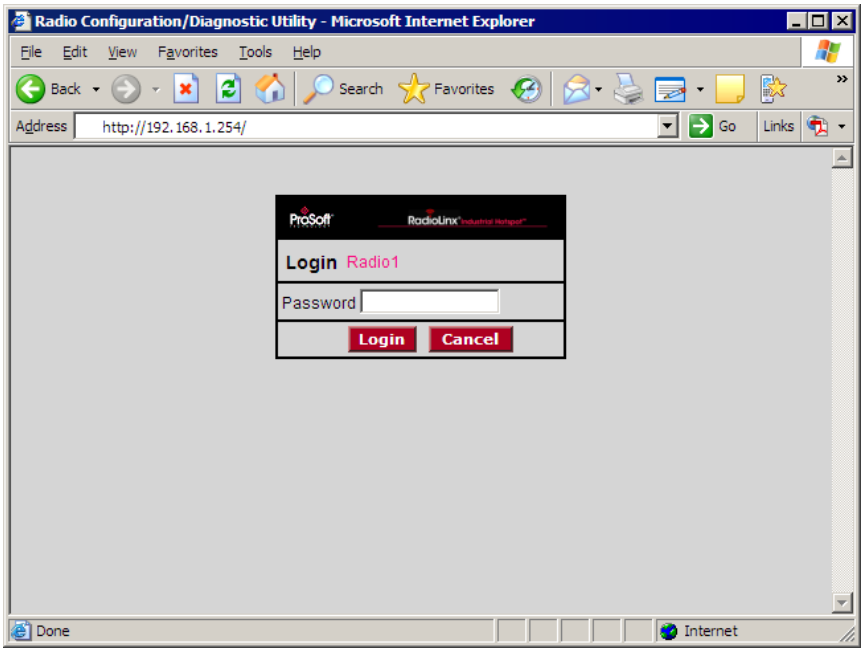
The following commands are available on the Operations Menu:



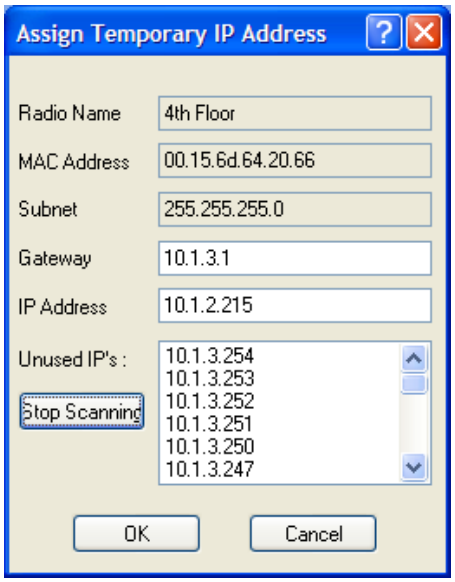
- **Connect** (page 92)
- **Assign IP** (page 37, page 92)
- **Update Firmware** (page 93)
- **Start Ping Session** (page 94)

7.3.1 Connect

To connect to the Radio Configuration / Diagnostic Utility and change radio settings, double-click the radio listing in the IH Browser after it has been assigned an IP address (either manually or with DHCP). Alternatively, the Connect option in the AP Operations menu can be selected. Enter the password to log in to the radio.



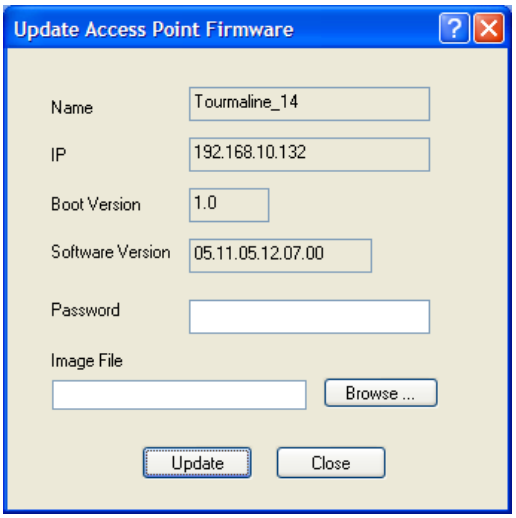
7.3.2 Assign IP



If the radio is connected to a network with a DHCP server, the radio may already have an IP address assigned to it. If no address appears, double-click the radio listing in the IH Browser or select Assign IP in the AP Operations menu. In the next window, click OK to accept the temporary IP address, subnet mask, and default gateway. If necessary, a particular IP address can be entered (see Radio Access settings (page 82)). After an IP address is assigned, configuring the radios can be done in the Radio Configuration / Diagnostic Utility (page 48).

7.3.3 Update Firmware

"Firmware" is the program that runs in the RadioLinx® 802.11abg Industrial Hotspot that allows it to communicate and exchange data between devices, using the radio as a network connection. Different versions of the firmware communicate with other radios in different ways, and provide different levels of functionality.



In order for the RadioLinx Industrial Hotspot radio to communicate with other RLX2 devices, all radios on the network must use the same firmware version.

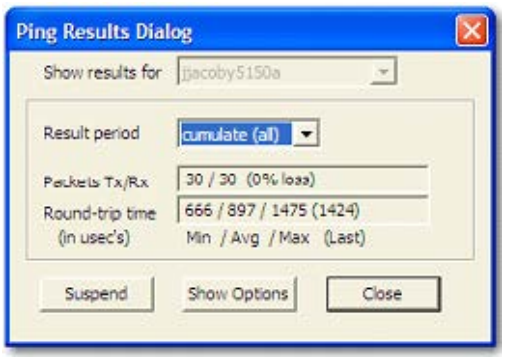
To change the firmware version of the radio:

1. Start RadioLinx Industrial Hotspot Browser.
2. Open the Operations menu, and then choose Update Firmware.
3. Enter the password for the radio. This is the same password used to log into the radio from the Radio Configuration / Diagnostic Utility (page 48).
4. Click the Browse button to locate the Image File (firmware version) to update. Both versions of firmware are available both on the DVD that came with in the box with the radio, and at our web site at www.prosoft-technology.com
5. Click Update to begin copying the new firmware to the radio. Do not disconnect the cable or turn off power to the radio during this operation.

7.3.4 Ping Device

A Ping Session allows traffic to run over the radio network between any two computers running the IH Browser. With it the user can monitor their network over time.

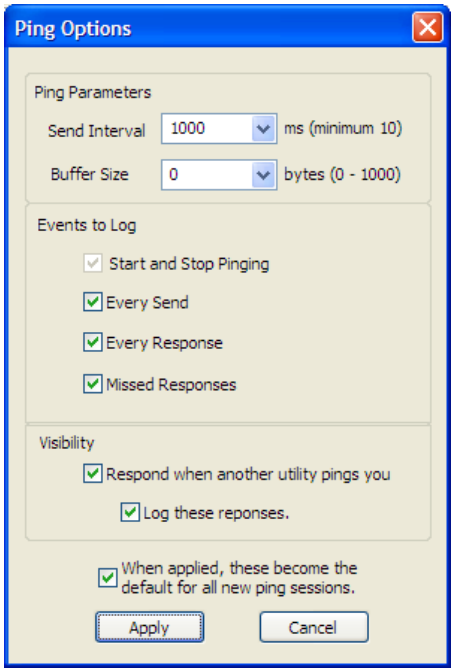
To start the ping session, enable "Show Ping Stations" on the View menu, and then highlight one of the other computers visible in the IH Browser. The session then starts automatically and the Ping Results dialog box opens.



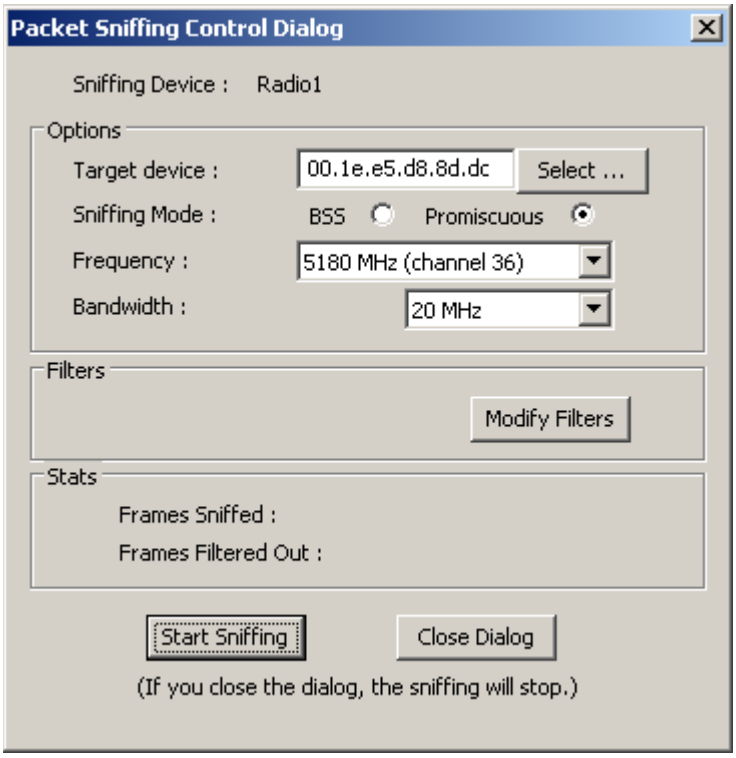
This dialog box displays statistics on the minimum, maximum and average latency between two points on the network.

Ping Options dialog box

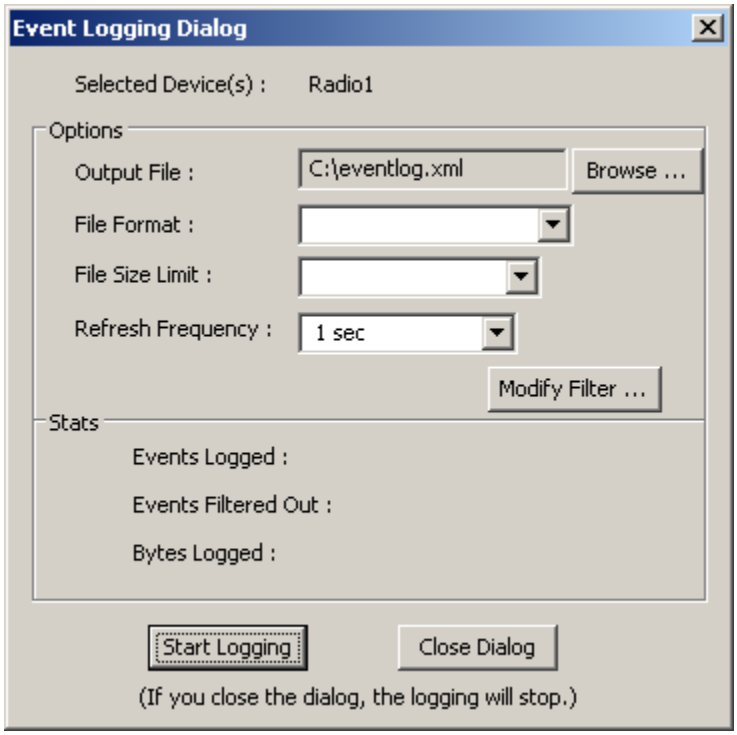
The Ping Options dialog box opens from the *Show Options* button on the Ping Results (page 94) dialog box. Use this dialog box to choose ping parameters, logging options, and response to other stations.



7.3.5 Start Sniffing Packets

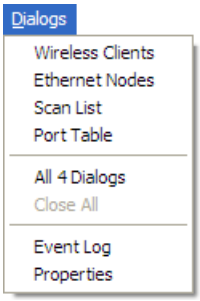


7.3.6 Start Logging Events



7.4 Dialogs Menu

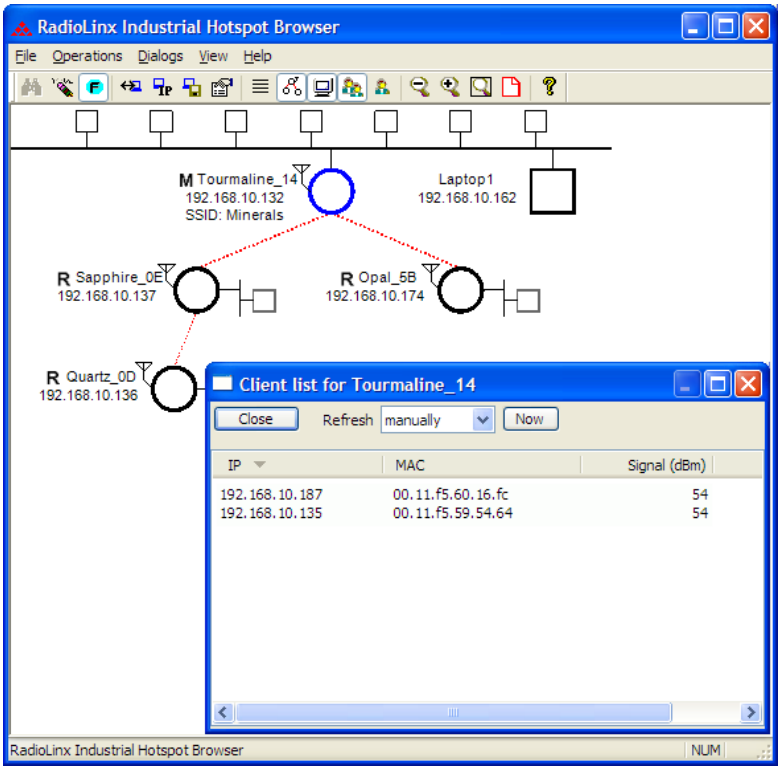
The Dialogs menu contains the following commands:



- **Wireless Clients** (page 97)
- **Ethernet Nodes** (page 98)
- **Scan List** (page 99)
- **Port Table** (page 100)
- **Event Log** (page 100)
- **Properties** (page 101)

7.4.1 Wireless Clients

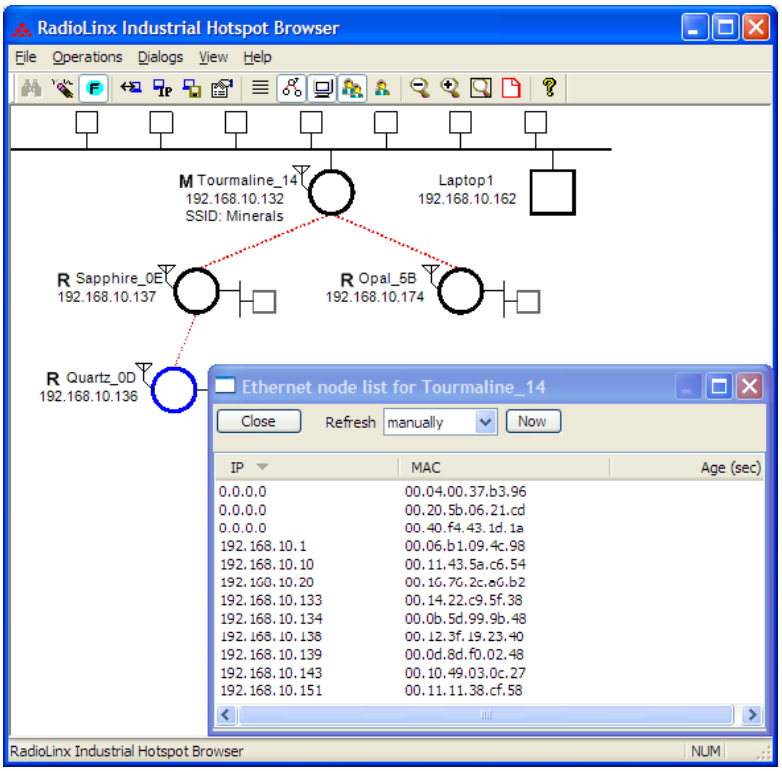
This dialog box opens when the *Wireless Clients* option is selected from the *AP Dialogs* menu. Use this dialog box to see information about wireless clients attached to the radio.



7.4.2 Ethernet Nodes

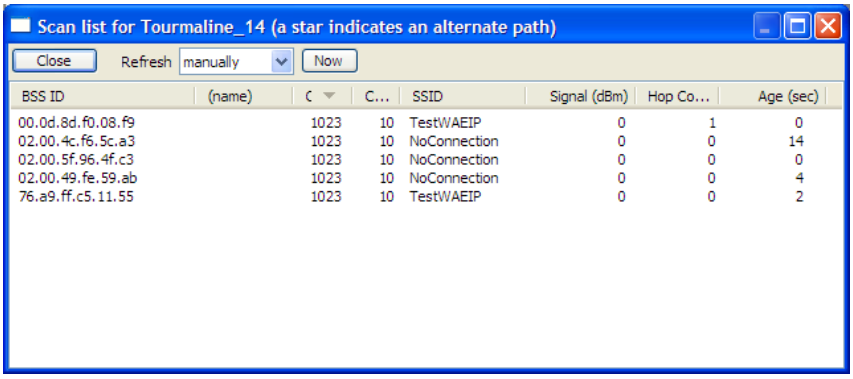
This dialog box opens when the *Ethernet Nodes* option is selected from the *AP Dialogs* menu.

Use this dialog box to see information about Ethernet devices attached to the radios. The following illustration shows a list of Ethernet devices (by IP address and MAC ID) attached to the Ethernet port of Tourmaline_14. In addition to the IP and MAC ID it gives an age for each entry, which is the amount of time since a packet has been heard from that device.



7.4.3 Scan List

This dialog box opens when *Scan List* is selected in the AP Dialogs menu.



The scan list is a list of all the radios that this particular radio "hears" on this channel (via beacons) even if it is not linked to it (different SSID or encryption). This list shows the same information as the Available Parents list in the Radio Configuration / Diagnostic Utility.

List entries marked with a "*" indicate the entry is an alternate path, which can also be seen if the 'parents' button is selected in the menu bar (blue lines will link the radio to its alternate parents).

802.11 Access Point Detector

The RLX2 radio can be used as an installation tool to analyze the 802.11 environment and provide the user with information on choosing antenna location and channel selection.

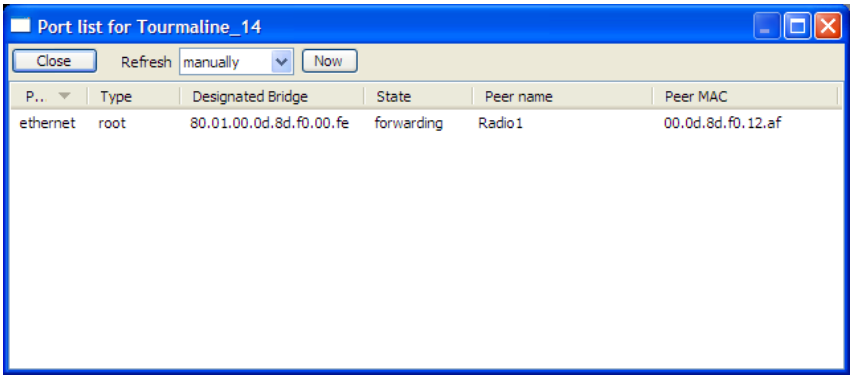
By using the table in the radio, mounting an RLX2 radio with its actual antenna and use it to report information on every active 802.11 radio in the area can be done. It will report:

- Each 802.11 AP heard including SSID
- Actual RSSI from each given in dBm
- Channel of each radio

Use this information to help choose a channel that is least utilized, or to select appropriate antenna types and alignments to minimize interference.

7.4.4 Port Table

This dialog box opens when *Port Table* is selected from the *AP Dialogs* menu.



The port table is a list of all the active ports on the radio. This list shows the same information as the Port status (page 56) list in the Radio Configuration / Diagnostic Utility. Each radio can have up to 34 active ports—one Ethernet cable, one parent RF link, and up to 32 child RF links.

7.4.5 All 4 Dialogs

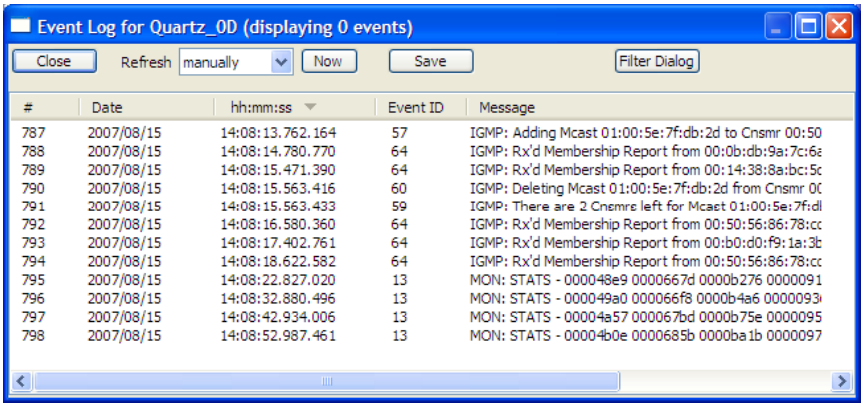
This menu entry simply opens all four “list” dialogs (Scan, Port, Ethernet node, and Client.) The dialogs open on top of each other. Drag the windows to view them completely.

7.4.6 Close All

This entry closes all “list” dialogs that are currently open.

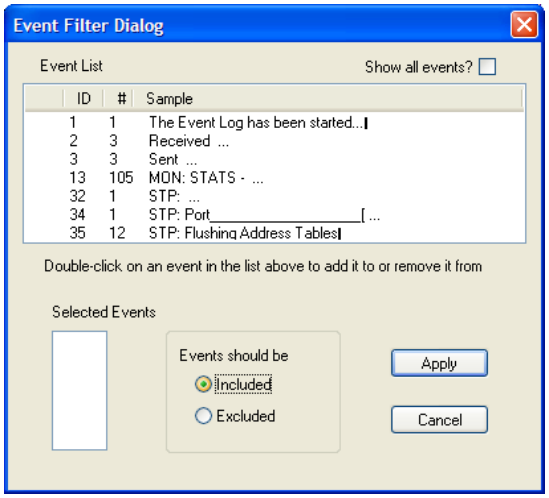
7.4.7 Event Log

The event log allows the extraction of a log from the selected radio. The log shows a history of the radio. The event log can be saved to a file for troubleshooting purposes.



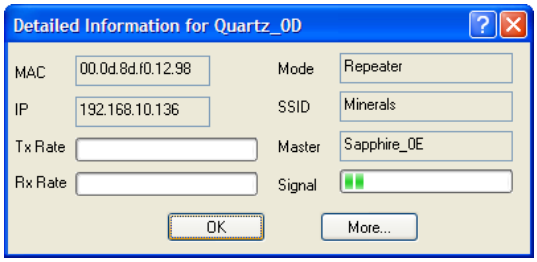
Event Filter

The Event Filter dialog box allows the inclusion or exclusion of specific event types from the event log.

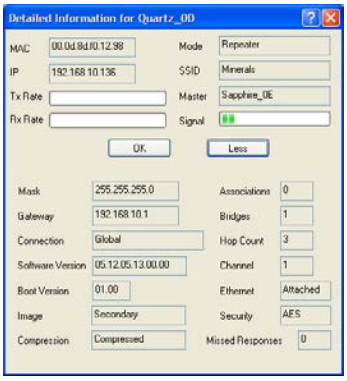


7.4.8 Properties

This dialog box opens when a radio is selected the *Properties* option is selected from the *AP Dialogs* menu.

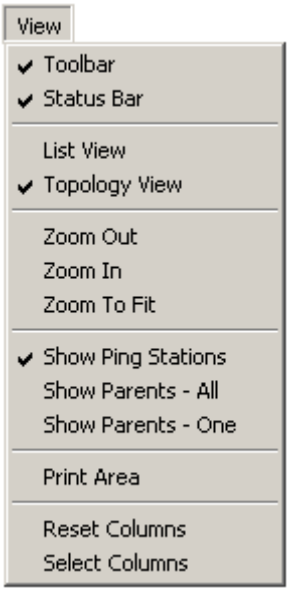


To see additional properties, click the More button.



7.5 View Menu

The View menu contains the following commands:



- **Tool Bar** (page 102)
- **Status Bar** (page 103)
- **List View** (page 103)
- **Topology View** (page 106)
- **Zoom In** (page 108)
- **Zoom Out** (page 108)
- **Zoom to Fit** (page 109)
- **Show Ping Stations** (page 109)
- **Show Parents** (page 110)
- **Print Area** (page 110)
- **Reset Columns** (page 111)
- **Select Columns** (page 111)

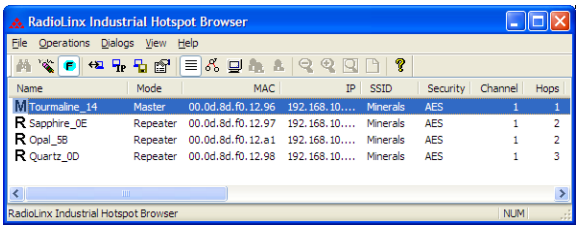
7.5.1 Toolbar

The Tool Bar near the top of the IH Browser window contains buttons to access frequently used commands. Hold the mouse button over each button to view a brief "Tool Tip" explaining the button's use.

7.5.2 Status Bar

The Status Bar at the bottom of the IH Browser displays additional information about the currently selected menu command or tool bar button. On the right side of the Status Bar, the status of the Caps Lock and Num Lock keys on the computer keyboard can be seen. Use the corner of the status bar to drag and resize the IH Browser window.

7.5.3 List View



List View shows a list of all the connected radios in a grid, arranged similarly to data in a spreadsheet. Resize the window or scroll across to see all of the available columns. Click between column headers and drag to the left or right to resize columns. Click on column headers and drag to the left or right to re-order columns.

Tip: Use the *Reset Columns* command to restore the column size and order to their default values. The default columns and their left-to-right display order are:

- Name
- MAC
- IP
- SSID
- Security
- Channel/Width
- Signal (dBm)
- Parent
- RSTP

There are many columns of data that can be displayed. Columns can be hidden as needed. Use *Select Columns* from the *View* Menu to choose the columns of data to display.

Available data columns in List View:

Name	Name of the object in the IH Browser. Names are displayed in a nested tree order, with graphics on some entries that can be identified:  Computer  Wired Network Interface **M** Master Radio **R** Repeater Radio **C** Client Radio
Mode	**This Utility** Displayed for this instance of the IH Browser. **Utility** Displayed for other instances of IH Browsers running on tother systems on the same network. **Local Interface** A network interface detected on the host computer running this instance of the IH Browser. **Master** A radio on the network in Master mode. **Ethernet Client** A radio on the network in Client mode. **Repeater** A radio in the network in Repeater mode.
MAC	Physical *Media Access Control* (MAC) address of the device. All ProSoft devices have a MAC address of the form 00:0D:8D:*XX*:*YY*:*ZZ*
IP	IP address assigned to the device.
Mask	Netmask of the device.
Gateway	IP address of the network gateway for the device.
SSID	*Service Set Identifier* (SSID) is a name assigned to a wireless network. Repeaters and Clients must be configured with the same SSID to connect. Note that Master radios typically advertise their presence by broadcasting their SSID. However, SSID announcements can be disabled so that other wireless devices do not detect such Masters, If a Master is not transmitting its SSID, this field will indicate *Hidden* along with the SSID, for example *ProSoft/hidden*.
Connection	A *Connection* state is only shown for repeaters. *Scanning* is shown while the radio is searching for a master. *Connected* is shown for repeaters that have linked to a master.
Signal (dBm)	The signal strength, in dBm of a Repeater or Client device's link to a Master. Master devices do not report signal strength.

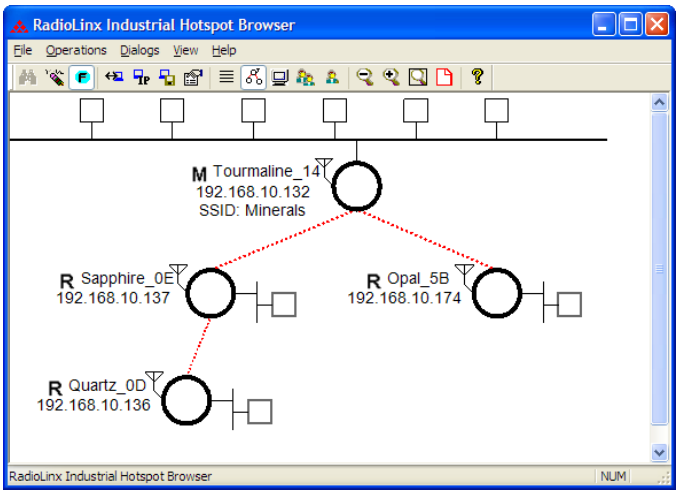
Hops	The number of wireless connections a device is away from the wired connection of a Master. This value is always 1 for a Master radio. For Repeater devices is it a minimum of 2, but can be higher if there are additional hops to the Master. Client devices do not display a hop value.
Parent	The MAC address of the Parent radio to which this Repeater or Client is linked. Not shown for Master devices.
Associations	The number of network elements to which a radio has a wireless connection.
Bridges	The number of device to which this device has a wireless connection. For example, if one Repeater and one Client are linked to a Master, the Master shows 2 in this field, and the other devices show 1.
Tx (kbits/sec)	This is a moving average of transmit throughput in kilobits/second. It does not count packet overhead, only payload data.
Rx (kbits/sec)	This is a moving average of receive throughput in kilobits/second. It does not count packet overhead, only payload data.
FW Ver	Firmware version number. For Network interfaces, this is the version of the communication engine in the IH Browser. For radios, this is the version of the firmware code in the radio. This is *not* the version of the image file installed into the radio (for that information see *Image Ver* described below). .
Boot Ver	For wired network interfaces, this is the version of the network communication engine in the IH Browser (e.g. *WinXP*, *WinVista*.) For radios, this is the version of the bootloader code in the radio.
Image	This is the version of the firmware image that the radio is currently running. It can be *primary* or *secondary*. Each radio has two copies of operating firmware installed, and the radio will automatically transition from one to the other if one of them becomes corrupted.
Compression	Firmware images in the radio can be either *compressed* or *uncompressed*.
Ethernet	The Ethernet status is *Attached* for a radio connected to a wired Ethernet network, otherwise *Detached*.
Channel/Width	The operating channel and channel width. The width value will always be *20MHz* except on 802.11n devices where it can be *20MHz* or *40MHz*. Example: *48, 20* for channel 48 with a 20 MHz channel width.
Security	This indicates the encryption setting for the radio. Valid setting are *WPA/WPA2-AES*; *WPA/WPA2-TKIP*; *WPA/WPA2-AES&TKIP*; *WPA-TKIP+WEP128*; *WEP128*; *WEP64*; and *none*.
Misses	This is the number of times the IH Browser has unsuccessfully attempted to contact the device. Ideally this number should always be zero.
RSTP	This is the setting for RSTP in the radio. Allowed states are *Enabled*, *Disabled*, and *STP*. The *STP* state is a legacy “non-rapid” Spanning Tree option. All radios on a network must have the same *RSTP* state to link properly.

Link Time	The link time of the device, for example *24d,13h,10m, 32s*.
TX Rate	This is the current effective data rate of the device. This may be slower than the configured nominal rate because of retries or other environmental factors. For 802.11a/b/g devices, the data rate is expressed in kilobits or megabits per second (e.g. *54Mb/s*.) For 802.11n devices, the data is expressed in *MCS* rates from 0 to 31 (e.g. *MCS16*.)
Temperature	The internal temperature of the radio as measured on the circuit board in degrees Celsius.
Retries(%)	This value is the percentage of packets transmitted more than once during the last five-second interval.
Uptime	The amount of time the device has been running since the last power cycle or reset. For example *1d,4h,13m,25s*.
Product	The type of RLX2 radio. The values can be *RLX2-IHA*, *RLX2-IHG*, *RLX2-IHFN*, or *RLX2-IHW*.
Image Ver	This is the name the image file loaded into the radio. It matches the *Firmware* label displayed on the main radio webpage. For example, *RLX2_v0016_M*.

7.5.4 Topology View

To see how radios are connected together in the network, select Topology View from the View menu. The Topology view shows a diagram of the network's wireless connections. If a radio does not appear in the view, it is not connected to the network. To change the way a radio is linked to the network, connect to it and make changes through its Web page. For information on these settings, see Parent Link settings (page 61).

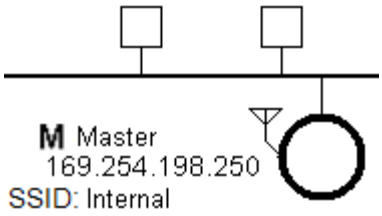
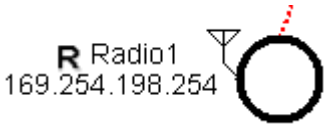
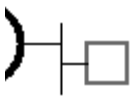
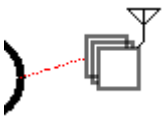
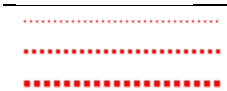
In the topology view, double-click a radio to log in to the Radio Configuration / Diagnostic Utility and change the radio's settings. To view a radio's properties, right-click on a radio representation in the topology view and then select Properties from the resulting menu.



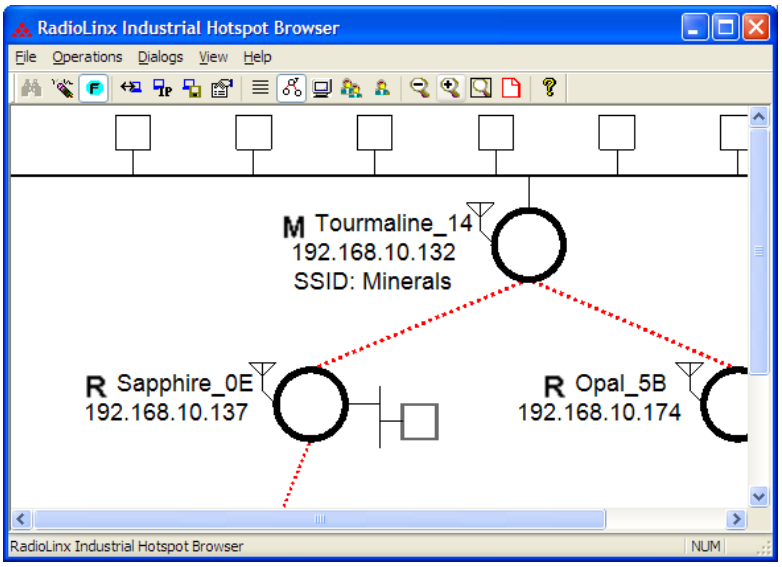
Refer to Topology View key (page 107) for an explanation of the symbols that appear in this view.

Topology View key

For information on the options when right-clicking a radio icon, see IH Browser options (page 85).

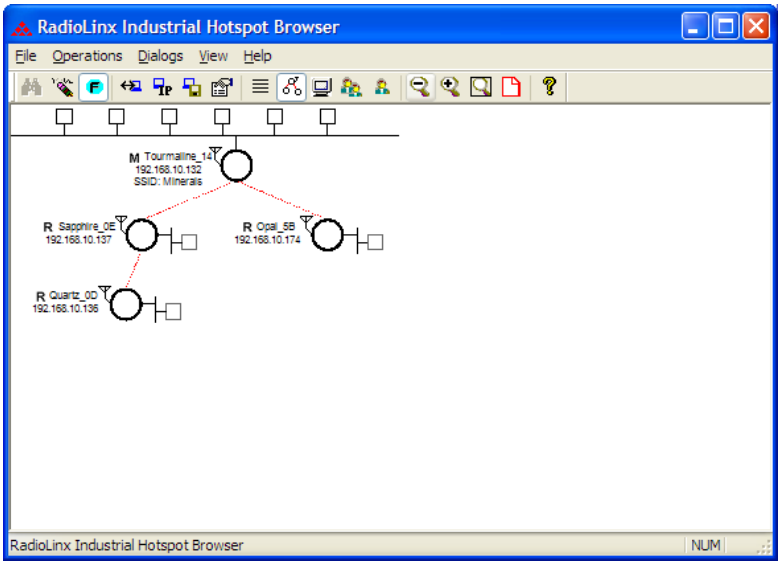
	Master; always shown at the top
	Radio linked to the network
	Radio not linked; no parent
	An Ethernet connection exists to the radio; does not indicate the number of devices on the connection
	Wireless clients (PCMCIA cards) are linked to this radio; the number of clients linked is indicated by the number of boxes
	Signal strength; the width of the line is not calibrated
	Alternate parents.

7.5.5 Zoom In



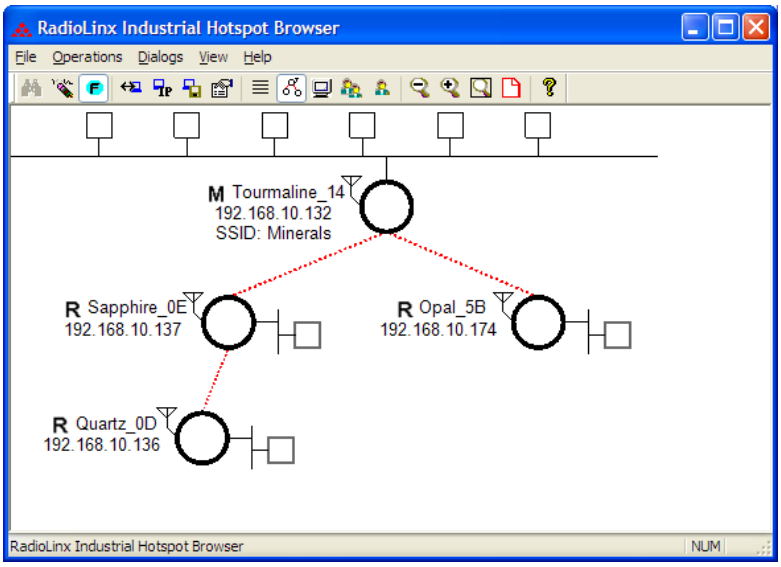
Use the **ZOOM IN** command in Topology View to enlarge the size of the items in the IH Browser window.

7.5.6 Zoom Out



Use the **ZOOM OUT** command in Topology View to to reduce the size of the items in the IH-Browser window.

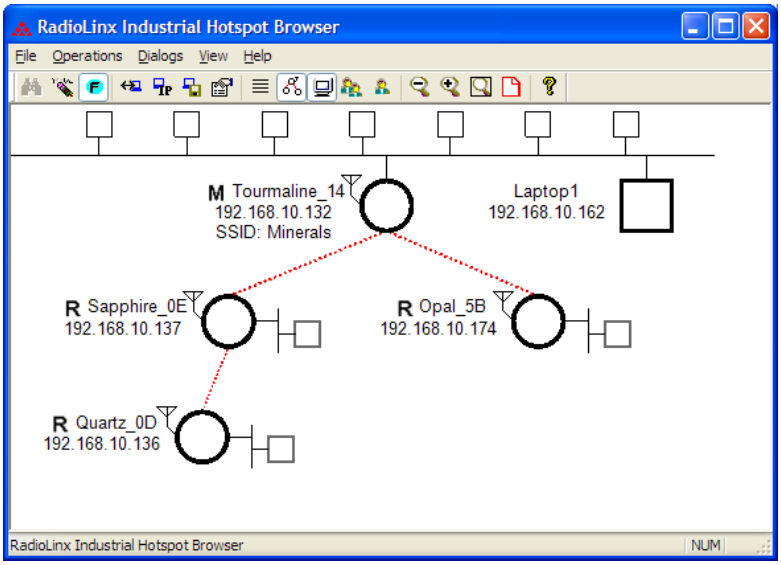
7.5.7 Zoom to Fit



Use the **ZOOM TO FIT** command in Topology View to change the size of the items so that the entire network fits within the IH Browser window.

7.5.8 Show Ping Stations

Ping Stations are other computers running an instance of IH Browser. To test latency between points on the network, select a ping station, open the Operations menu, and then choose Start Ping Session.



7.5.9 Show Parents - All

The *Show Parents* function displays the possible alternate parents for a repeater graphically in the topology view. The link from the repeater to its current parent will be shown in red. If the repeater can hear other radios in the network, links to those radios will be shown in blue. This gives a graphical representation of the number of alternate paths available to a radio should its parent link go down. A detailed list of each of the alternates can be seen by right-clicking and selecting 'Scan List'. This list, though, shows not only radios in the same network but also 802.11 radios on other networks.

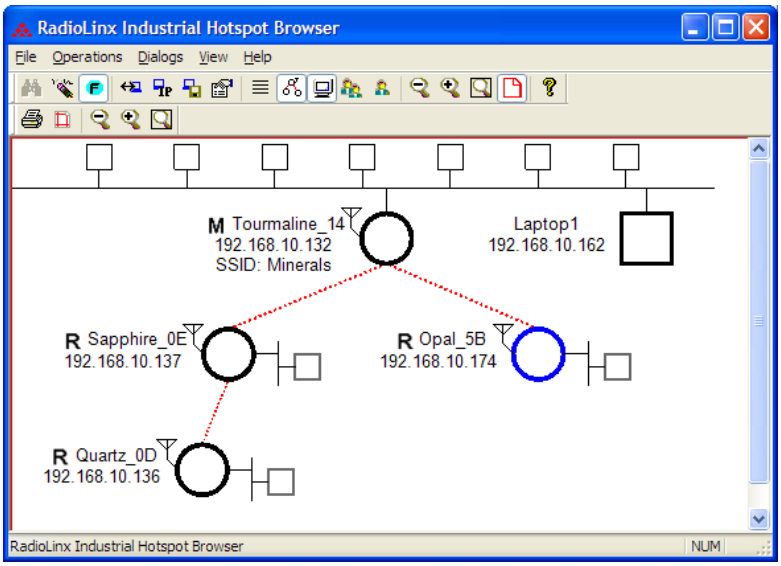
By selecting All, alternate paths for all repeaters in the network will be shown. By selecting One, alternate paths will be shown only for the one repeater that is currently selected.

Show Parents – All is only available in the Topology View.

7.5.10 Show Parents - One

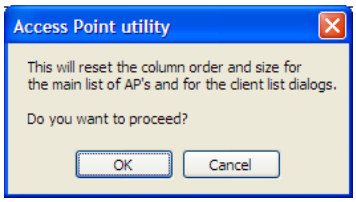
This is similar to *Show Parents – All* except that only the current parent is shown.

7.5.11 Print Area



Use the *Print Area* command to show the border around the area of the IH Browser window. To print, use the Print command on the File menu.

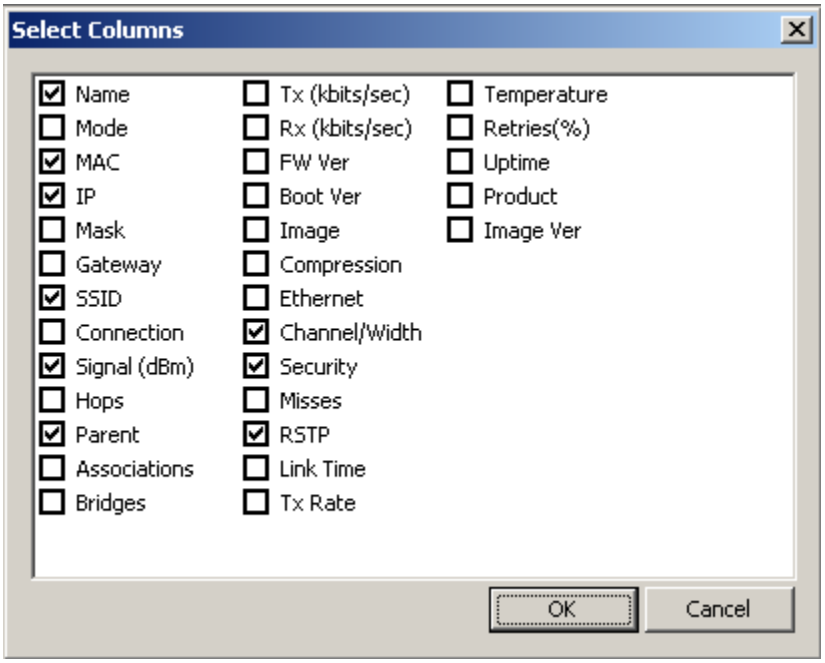
7.5.12 Reset Columns



Use the Reset Columns command to restore the column size and order to their default values. A prompt will appear to confirm this action.

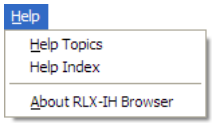
7.5.13 Select Columns

Use the Select Columns command to display the data fields shown in List View.



7.6 Help Menu

The Help menu contains the following commands:



- Help Topics (page 112)
- Help Index
- About the IH Browser (page 113)

7.6.1 Help Topics

Most of the information needed to help use the IH Browser is provided in an online help system. It is available whenever the application is running.

To view the online help, start the IH Browser, open the Help menu, and choose Help Topics.

The IH Browser Help System

The IH Browser has an online help system that works like a web browser. Each dialog box has its own page in the help system, which explains each item on the dialog box.

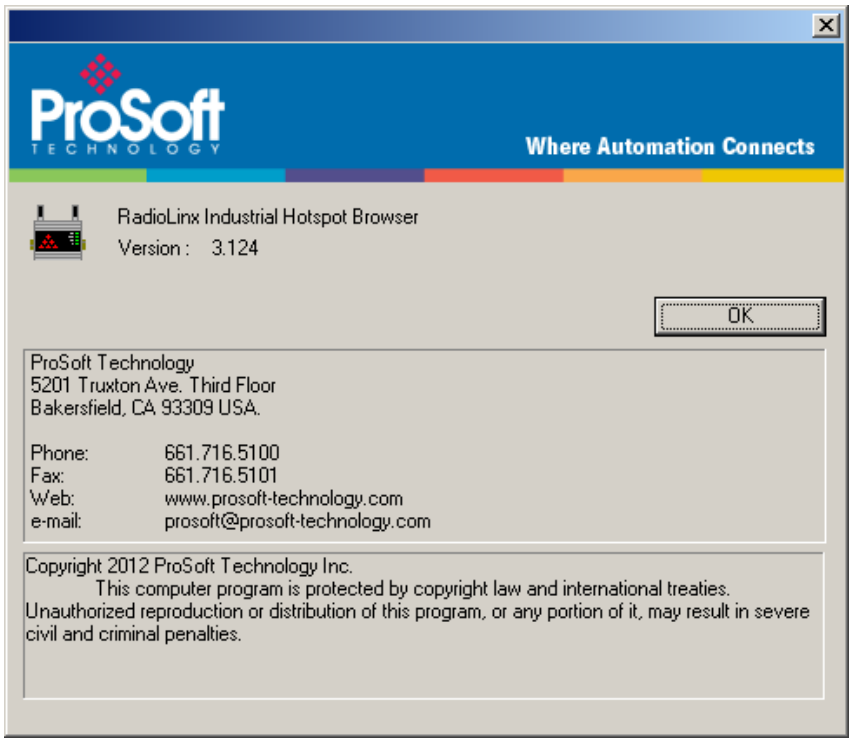
To view the online help, open the Help menu and choose Help Topics.

Many help pages have **links** that are underlined. Click the underlined text to "follow a link" and open a help page.

The Search tab is used to search for words or phrases inside a help file. Click a topic from the list to view the help page.

The Index button shows an index of keywords. Type the first few letters of a keyword to jump directly to a topic. Each keyword is linked to one or more help topics.

7.6.2 About RLX IH Browser



Use this command to view version information about the IH Browser. This information may be needed when contacting ProSoft Technical Services.

8 Reference

In This Chapter

- Product Overview 115
- Compatibility with ProSoft RLXIB Series Radios 117
- Dimensional Drawing 118
- Master Channel/Frequency Table 120
- FCC Emission Regulations 121
- Radio hardware 123

8.1 Product Overview

The RLX2 radio is an industrial high-speed Ethernet radio. Use it in place of Ethernet cables to save money, extend range, and make connections that may not otherwise be feasible. The radio operates as a wireless Ethernet switch. Any data that can be sent over a wired network can also be sent over the radio.

The RLX2 radio series is certified for unlicensed operation in the United States, Canada and Europe at 2.4 and 5 GHz. With approved high-gain antennas, the radios can achieve distances of over 5 miles line-of-sight between them. Multiple repeaters can be used to extend this range to far greater distances.

A highly reliable wireless network can be developed by creating redundant (page 69) wireless paths. Multiple master (page 58) radios can be installed without any special programming or control. Repeater (page 58) radios can connect to any master at any time; if one master goes down, the repeater connects to another. Likewise, if a repeater goes down, any repeater that was connected to it can reconnect to a different repeater, keeping the network intact. Create large, self-healing tree-like networks can be done in this fashion. Fully redundant paths are possible because the Spanning Tree (page 69) protocol in the radios disables and enables paths as necessary to avoid Ethernet loops, which would otherwise halt communications.

In addition to acting as a switch, every master or repeater radio in an RLX2 wireless network can simultaneously act as an 802.11 a, b or g access point. This allows 802.11 WiFi clients to connect and roam between radios for monitoring of the wireless network or general network access. The RLX2 has a special client mode (page 37) that allows connection of any Ethernet device to any existing 802.11 a, b or g access point, regardless of the brand (An example of an 802.11 client is a laptop with a WLAN card).

Note: Wi-Fi is a trademark of the Wi-Fi Alliance, used to describe the underlying technology of wireless local area networks (WLAN) based on the IEEE 802.11 specifications.

A high level of security is inherent with AES (Advanced Encryption Standard) encryption. TKIP (Temporal Key Integrity Protocol) is also available. If necessary, adding WEP128 or WEP64 (Wired Equivalent Protocol) encryption in addition to AES or TKIP for clients that do not support AES can be done. A simple Media Access Control (MAC) filter table restricts the radios or clients that can link to a selected radio according to the MAC IDs entered in the table.

The radio is designed for industrial applications with a metal enclosure, DIN-rail mounting, and shock and vibration tested to IEC 60068.

The RLX2 radio series is easy to use. Use the Radio Configuration / Diagnostic Utility, which runs in a web browser, to configure the radio. Also, an SNMP manager can be used for configuration. The radio comes with a Windows-based utility called *IH Browser*. It finds all the radios on the network and lists information about them. A topology view in the IH Browser shows how the wireless network is linked together at any point in time. Firmware updates can be done at anytime from anywhere on the network. This includes over the wireless link or over the Internet.

ProSoft Technology radios can easily be installed into new or existing systems. The software and manuals can be downloaded from the DVD or ProSoft Technology's web site at www.prosoft-technology.com.

8.2 Compatibility with ProSoft RLXIB Series Radios

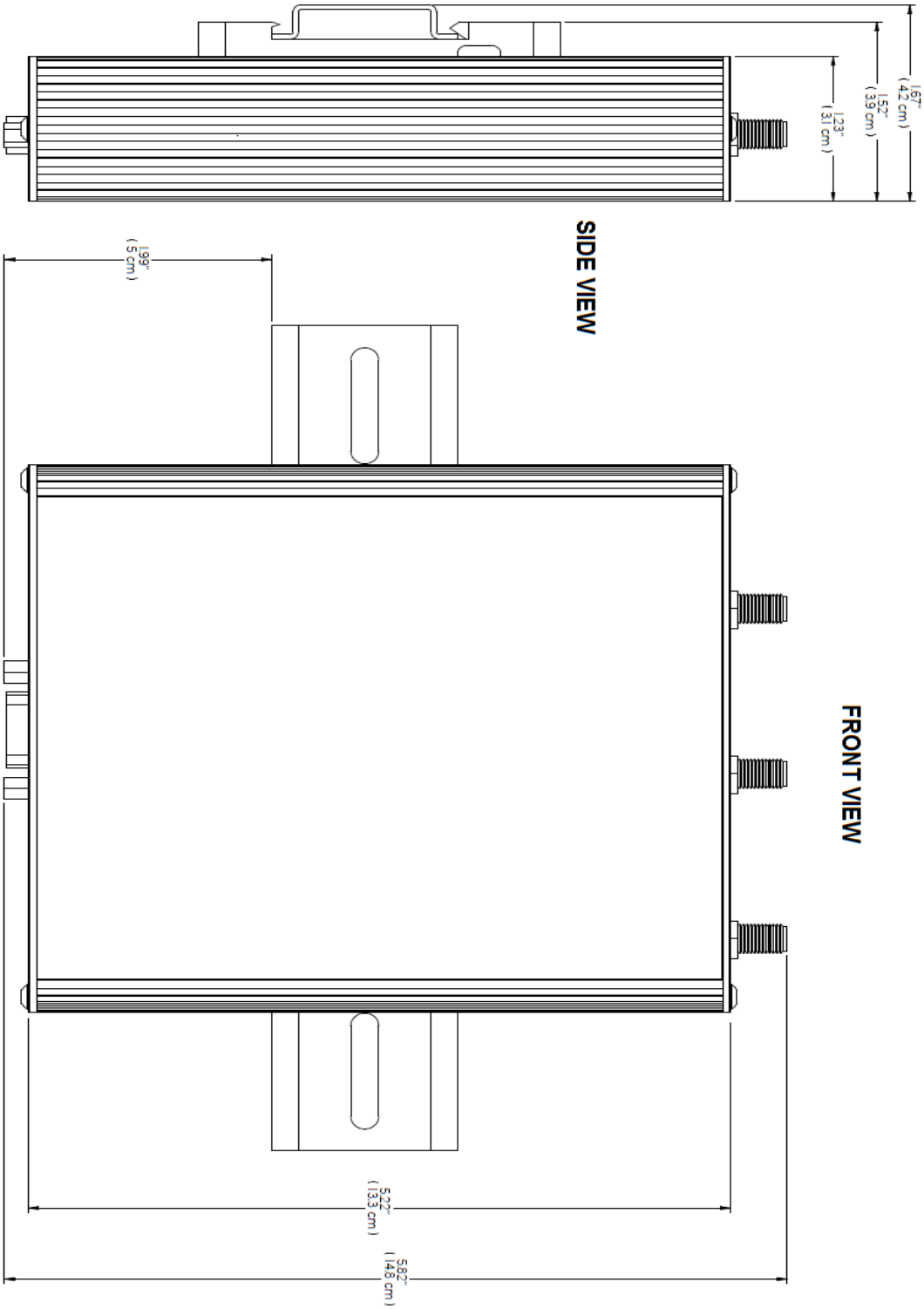
The RLX2 series radios are 100% functionally compatible with ProSoft's legacy RLXIB-IHA, RLXIB-IHG, and RLXIB-IHW radio models. This allows customers with RLXIB series radios to add RLX2 radios to their existing networks without any reconfiguration of existing assets or obsolescence issues. The main differences in the RLX2 series radios are the following improvements:

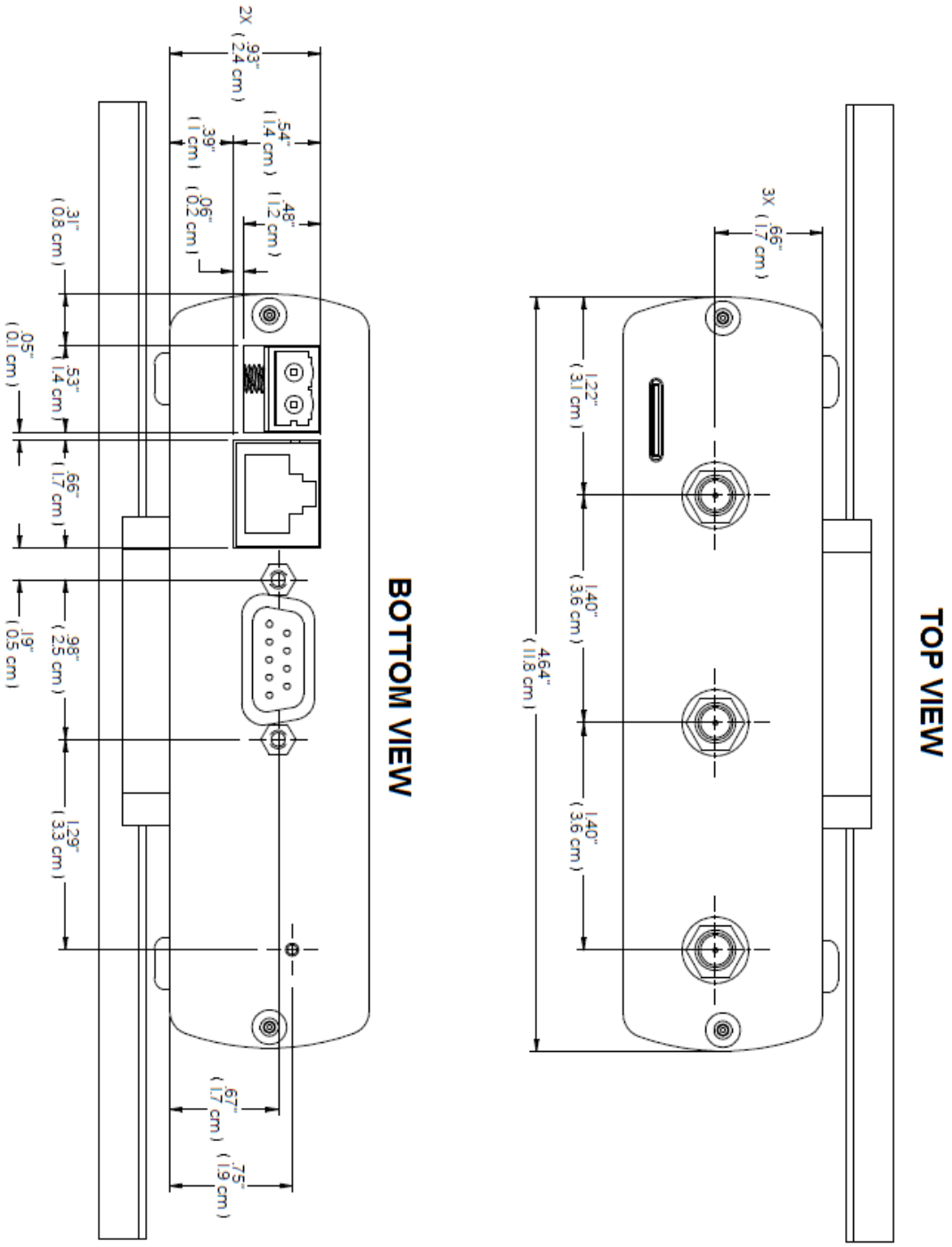
1. Different enclosure size for more efficient heat dissipation.
2. Faster, more efficient electronics that consume less power.
3. Gigabit Ethernet.
4. MicroSD memory cards for configuration data storage.
5. Internal temperature sensor.

The RLX2 series radios will acquire additional functionality as new firmware features are added. These new features will not be ported to the RLXIB radios, but the RLX2 radios will continue to work with RLXIB radios using their existing functionality. The RLX2-IHNF is an 802.11n device that does not have an RLXIB series equivalent. It *cannot* function as a repeater to ProSoft's RLXIB-IHxN series radio products. Specific differences by product are noted in the following table. Specifications that have not changed between the RLXIB and RLX2 series products are not listed.

	RLXIB-IHA	**RLX2-IHA**	**RLXIB-IHG**	**RLX2-IHG**	**RLXIB-IHW**	**RLX2-IHW**	**RLX2-IHNF**
Dimensions	4.5/115W x 4.6/117H x 1.75/45D (inches/mm)	5.82/148W x 4.64/118H x 1.48/38D (inches/mm)	4.5/115W x 4.6/117H x 1.75/45D (inches/mm)	5.82/148W x 4.64/118H x 1.48/38D (inches/mm)	4.5/115W x 4.6/117H x 1.75/45D (inches/mm)	5.82/148W x 4.64/118H x 1.48/38D (inches/mm)	5.82/148W x 4.64/118H x 1.48/38D (inches/mm)
Weight	1.1 lbs (499g)	1.1 lbs (499g)	1.1 lbs (499g)	1.1 lbs (499g)	1.06 lbs (479g)	1.06 lbs (479g)	1.1 lbs (499g)
Typical Power Consumption	< 9W	5.7W	< 9W	4.5W	< 6 W	4.5W	7.1W
Max Power Consumption	9W	10W	9W	8W	6W	8W	9W
Active antenna ports	1	1	1	1	1 Tx/Rx, 1 optional Rx only	1 Tx/Rx, 1 optional Rx only	1, 2, or 3, MIMO or independent antennas
Ethernet Speeds	10/100 MBit	10/100/1000 MBit	10/100 MBit	10/100/1000 MBit	10/100 MBit	10/100/1000 MBit	10/100/1000 MBit
NET and MOD Status LEDs		✓		✓		✓	✓
Fast Roaming		✓		✓		✓	✓
microSD card		✓		✓		✓	✓
Onboard temperature sensor		✓		✓		✓	✓
5 GHz band DFS channels							✓
Use RLXIB Firmware Image	✓		✓		✓		
Use RLX2 Firmware Image		✓		✓		✓	✓

8.3 Dimensional Drawings




TOP VIEW
3X .66" (1.7 cm)
1.22" (3.1 cm)
1.40" (3.6 cm)
1.40" (3.6 cm)
4.64" (11.8 cm)
BOTTOM VIEW
2X .93" (2.4 cm)
.54" (1.4 cm)
.39" (1 cm)
.48" (1.2 cm)
.06" (0.2 cm)
.31" (0.8 cm)
.05" (0.1 cm)
.53" (1.4 cm)
.66" (1.7 cm)
.19" (0.5 cm)
.98" (2.5 cm)
1.29" (3.3 cm)
.67" (1.7 cm)
.75" (1.9 cm)

Master Channel-Frequency Table

The following table shows the channels/frequencies available in each RLX2 radio. Note that radios configured for FCC and ETSI regulatory domains do not have the same channels available. Also, some channels may have usage or power restrictions (e.g. indoor versus outdoor) in some locations.

		FCC RLX2-*XXX*-A versions				ETSI RLX2-*XXX*-E versions			
Channel Number	**Center Frequency (MHz)**	**IHA**	**IHG**	**IHNF**	**IHW**	**IHA**	**IHG**	**IHNF**	**IHW**
1	2412		✓	✓	✓		✓	✓	✓
2	2417		✓	✓	✓		✓	✓	✓
3	2422		✓	✓	✓		✓	✓	✓
4	2427		✓	✓	✓		✓	✓	✓
5	2432		✓	✓	✓		✓	✓	✓
6	2437		✓	✓	✓		✓	✓	✓
7	2442		✓	✓	✓		✓	✓	✓
8	2447		✓	✓	✓		✓	✓	✓
9	2452		✓	✓	✓		✓	✓	✓
10	2457		✓	✓	✓		✓	✓	✓
11	2462		✓	✓	✓		✓	✓	✓
12	2467						✓	✓	✓
13	2472						✓	✓	✓
36	5180	✓		✓	✓	✓		✓	✓
40	5200	✓		✓	✓	✓		✓	✓
44	5220	✓		✓	✓	✓		✓	✓
48	5240	✓		✓	✓	✓		✓	✓
52 (DFS)	5260							✓	
56 (DFS)	5280							✓	
60 (DFS)	5300							✓	
64 (DFS)	5320							✓	
100 (DFS)	5500							✓	
104 (DFS)	5520							✓	
108 (DFS)	5540							✓	
112 (DFS)	5560							✓	
116 (DFS)	5580							✓	
120 (DFS)	5600								
124 (DFS)	5620								
128 (DFS)	5640								
132 (DFS)	5660							✓	
136 (DFS)	5680							✓	
140 (DFS)	5700							✓	
149	5745			✓	✓				
153	5765			✓	✓				
157	5785			✓	✓				
161	5805			✓	✓				
165	5825			✓	✓				

8.4 FCC Emission Regulations

The following charts show the maximum emissions allowed for the FCC in the United States. These data should only be considered guidelines. Consult official FCC documents for the latest official regulations.

In the 2.4 GHz band, the maximum *Equivalent Isotropically Radiated Power* (EIRP) is 4W for multipoint links: that is, radios with omnidirectional antennas. Point-to-Point links using directional antennas are allowed higher EIRP.

8.4.1 2.4 GHz Band, Point-To-Multipoint

Maximum Power From Radio		Maximum Antenna Gain	Maximum EIRP	
dBm	mW	dBi	dBm	W
30	1000	6	36	4
27	500	9	36	4
24	250	12	36	4
21	125	15	36	4
18	63	18	36	4
15	32	21	36	4
12	16	24	36	4

8.4.2 2.4 GHz Band, Point-To-Point

Maximum Power From Radio		Maximum Antenna Gain	Maximum EIRP	
dBm	mW	dBi	dBm	W
30	1000	6	36	4.0
29	800	9	38	6.3
28	630	12	30	10.0
27	500	15	42	16.0
26	400	18	44	25.0
25	316	21	46	39.8
24	250	24	48	63.0
23	200	27	50	100.0
22	160	30	52	158.0

The FCC states that for every 1 dBi power reduction in the radio's transmitter output, the antenna gain may be increased by 3 dB.

8.4.3 5 GHz Bands, Point-To-Multipoint

5 GHz Band	Frequency Range (GHz)	Channels	Permitted Location	Maximum Power from Radio		Maximum EIRP	
				dBm	mW	dBm	mW
UNII	5.15 – 5.25	36, 40, 44	Indoor Only	16	40	22	160
UNII-2	5.25 – 5.35	48, 52, 56, 60, 64	Indoor or Outdoor	23	200	29	800
UNII-2 Extended	5.470 – 5.725	100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140	Indoor or Outdoor	23	200	29	800
UNII-3	5.725 – 5.825	149, 153, 157, 161, 165	Typical Outdoor	29	800	35	3200

8.4.4 5 GHz Bands, Point-To-Point

5 GHz Band	Frequency Range (GHz)	Channels	Permitted Location	Maximum Power from Radio		Maximum EIRP	
				dBm	mW	dBm	mW
UNII	5.15 – 5.25	36, 40, 44	Indoor Only	16	40	22	160
UNII-2	5.25 – 5.35	48, 52, 56, 60, 64	Indoor or Outdoor	23	200	29	800
UNII-2 Extended	5.470 – 5.725	100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140	Indoor or Outdoor	23	200	29	800
UNII-3	5.725 – 5.825	149, 153, 157, 161, 165	Typical Outdoor	30	1000	53	200,000

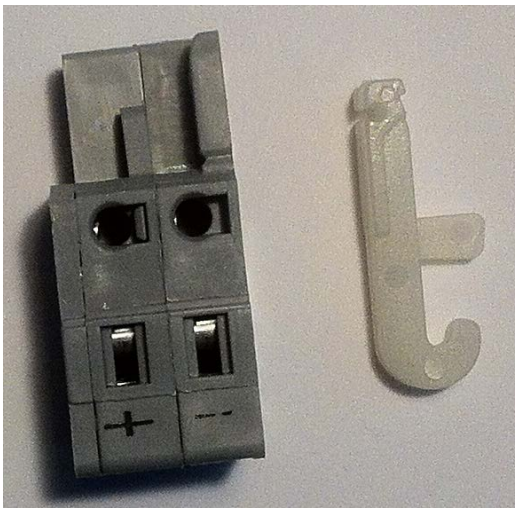
8.5 Radio hardware

8.5.1 Radio power requirements

The RLX2 radios accept voltages between 10 and 24 VDC, with an average power draw of less than 6 Watts. A detachable power connector comes with the radio, as shown below. The connector terminals are labeled + (positive DC connection) and - (DC ground connection).

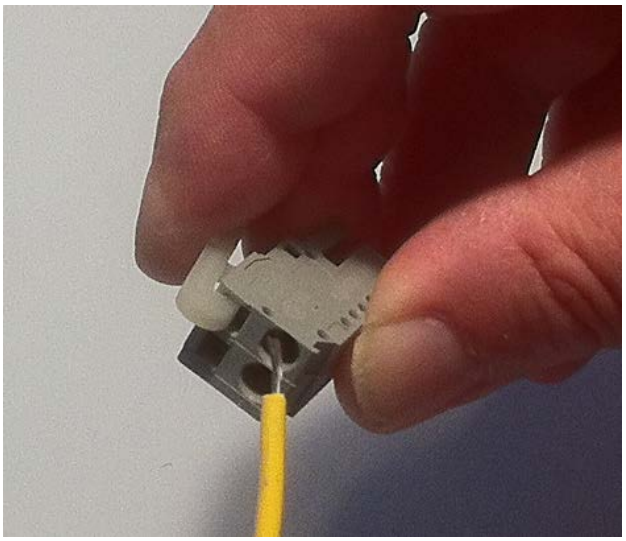
The AC-to-DC power supply adapter supplied with the optional RLX-IHBTK Bench Test Kit can be used. The DC power wires must be less than 3 meters in length to meet regulatory requirements.

Important: When wiring the power connector supplied with the radio, be sure to observe the proper polarity markings on the power connector. **Wiring the connector incorrectly can cause serious damage to the radio which will not be covered under the ProSoft warranty**.

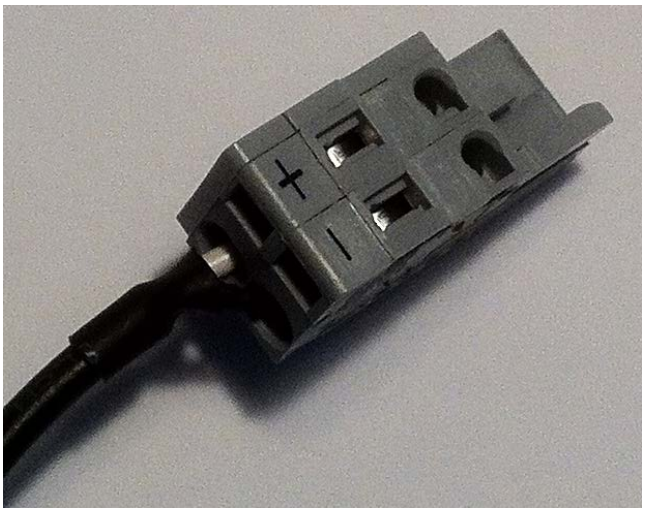


The Power Connector (ProSoft part number 002-0116) is shown on the left in the photo above. Note the + and – polarity markings. The wire installation tool (ProSoft part number 357-0061) shown on the right is helpful for installing wires into the spring-loaded contacts inside power connector.

To use the installation tool, insert it into the connector as shown:



Press down on the installation tool to use it as a level which will open the connector's contacts to insert a wire. A properly-wired power connector is shown:



The RLX2 radios accept power from 802.3af Mode B or passive Power over Ethernet sources supplying 48VDC, with an average power draw of less than 6 watts. ProSoft offers the following passive PoE injectors for use with the RLX2 radios:

POE-48I-AC	Power over Ethernet Injector, AC input
POE-48I-DC-DC	Power over Ethernet Injector, 9 to 36 VDC input voltage

The radio shall be installed by trained personnel only, as outlined to the installation instructions provided with each radio.

The equipment shall be installed by a qualified installer/electrician. The installer/electrician is responsible for obtaining a secured ground connection between the lug terminal on the surge protector to a verified common ground point using a minimum 6 AWG gauge wire. This must be done when attaching power lines to the radio during installation.

A solid ground connection should be verified using a meter prior to applying power to the radio. Failing to secure a proper ground could result in serious injury or death as a result of a lightning strike.

Using Power over Ethernet (PoE) to power remote devices has several advantages including:

- "Carrier Class" Power Over Ethernet System.
- Power can be supplied over long distances, up to 300 feet.
- Power can be available wherever network access is available.
- The power supply can be centrally located where it can be attached to an uninterruptible power supply.
- The user has the ability to easily power on reset the attached equipment from a remote location.
- There is no need to run additional power cabling to the device as power can be supplied over the CAT5, CAT5E, or CAT6 Ethernet cable.
- Used for remote mounted radios to save on cost of coax and reduce RF losses.
- Built-in Ethernet Surge protection to prevent equipment damage.
- Overload and Short Circuit protection.

8.5.2 Ethernet Cable Specifications

The recommended cable is Category 5 or better. A Category 5 cable has four twisted pairs of wires, which are color-coded and cannot be swapped. The module uses only two of the four pairs when running at 10 MBit or 100 MBit speeds. All eight wires are used when running at 1000 MBit speeds.

Category 5e or better cable is recommended for 1000 MBit speeds.

The Ethernet port on the module is Auto-Sensing. Use either a standard Ethernet straight-through cable or a crossover cable when connecting the module to an Ethernet hub, a 10/100/1000 Base-T Ethernet switch, or directly to a PC. The module will detect the cable type and use the appropriate pins to send and receive Ethernet signals.

Ethernet cabling is like U.S. telephone cables, except that it has eight conductors. Some hubs have one input that can accept either a straight-through or crossover cable, depending on a switch position. In this case, ensure the switch position and cable type agree.

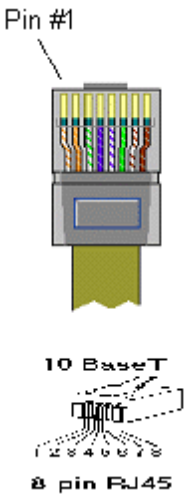
Refer to Ethernet cable configuration (page 126) for a diagram of how to configure Ethernet cable.

8.5.3 Ethernet Cable Configuration

Note: The standard connector view shown is color-coded for a straight-through cable.

Crossover cable

RJ-45 PIN	RJ-45 PIN
1 Rx+	3 Tx+
2 Rx-	6 Tx-
3 Tx+	1 Rx+
6 Tx-	2 Rx-



Straight- through cable

RJ-45 PIN	RJ-45 PIN
1 Rx+	1 Tx+
2 Rx-	2 Tx-
3 Tx+	3 Rx+
6 Tx-	6 Rx-

8.6 RLX2-IHA Detailed Specifications

Radio

Frequency Band (Varies by country)	802.11a 5.150 GHz to 5.250 GHz (FCC/ETSI) 5.725 GHz to 5.850 GHz (FCC)
Wireless Standards	802.11a, 802.11i
Transmit Power (Programmable) (varies by country)	24 dBm (250 mW) @ 6 Mbps 24 dBm (250 mW) @ 24 Mbps 21 dBm (125 mW) @ 54 Mbps
Channel data rates (Modulation)	802.11a: 54, 48, 36, 24, 18, 12, 9, 6 Mbps (OFDM)
Receiver Sensitivity (Typical)	-92 dBm @ 6 Mbps -84 dBm @ 24 Mbps -72 dBm @ 54 Mbps
Channel Selection	36, 40, 44, 48, 149, 153, 157, 161, 165
Security	WPA2 - 802.11i with 128 bit AES-CCM Legacy WPA TKIP, WEP support MAC ID filter Admin password

Physical

Enclosure	Extruded aluminum with DIN and panel mount
Size	14.8 x 11.8 x 3.8 cm (W x H x D) 5.82 x 4.64 x 1.48 inches
Shock	IEC 60068 2-6 (20g, 3-Axis)
Vibration	IEC 60068 2-27 (5g, 10Hz to 150Hz)
Ethernet Ports	One 10/100/1000 Base-T connector, shielded RJ45
Antenna Port	(1) RP-SMA connector
Weight	1.1 lbs (499g)

Environmental

Operating Temperature	-40° C to +75° C
Humidity	Up to 100% RH, with no condensation
External Power PoE Injector Power over Ethernet	10 Vdc to 24 Vdc 48 Vdc 802.3af Compliant
Average Power	Less than 9 Watts

Regulatory Approvals

Wireless Approvals

Visit www.prosoft-technology.com for current wireless approval information.

Hazardous Locations

ANSI/ISA	12.12.01 groups A, B, C, D
CSA	C22.2 No. 213-M1987
ATEX	EN60079-0 and EN60079-15
Ordinary Locations	
CSA/CB	EN60950 N. America & W. Europe
FCC/IC	Part 15, Class A and ICES-03
ETSI	ETSI EN300 328 and ETSI EN301 893

8.7 RLX2-IHG Detailed Specifications

Radio

Frequency Band (Varies by country)	802.11g: 2.412 GHz to 2.462 GHz (FCC) 2.412 GHz to 2.472 GHz (ETSI)
Wireless Standards	802.11g, 802.11i
Transmit Power (Programmable) (varies by country)	24 dBm (250 mW) at 11 Mbps 24 dBm (250 mW) at 24 Mbps 21 dBm (125 mW) at 54 Mbps
Channel data rates (Modulation)	802.11g: (OFDM) Mbps 54, 48, 36, 24, 18, 12, 9, and 6 802.11b: (DSS) Mbps 11, 5.5, 2, and 1
Receiver Sensitivity (Typical)	-94 dBm @ 1 Mbps -92 dBm @ 11 Mbps -84 dBm @ 24 Mbps -72 dBm @ 54 Mbps
Channel Selection	802.11g: 1 to 11 (FCC) 1 to 13 (ETSI)
Security	WPA2 - 802.11i with 128 bit AES-CCM Legacy WPA TKIP, WEP support MAC ID filter Admin password

Physical

Enclosure	Extruded aluminum with DIN and panel mount
Size	Width x Height x Depth 14.8 cm x 11.8 cm x 3.8 cm 5.82 inches x 4.64 inches x 1.48 inches
Shock	IEC 60068 2-6 (20 g, 3-Axis)
Vibration	IEC 60068 2-27 (5 g, 10 Hz to 150 Hz)
Ethernet Ports	One 10/100/1000 Base-T connector, shielded RJ45
Antenna Port	(1) RP-SMA connector
Weight	1.1 lbs (499g)

Environmental

Operating Temperature	-40°F to +167°F (-40°C to +75°C)
Humidity	Up to 100% RH, with no condensation
External Power PoE Injector Power over Ethernet	10 Vdc to 24 Vdc 48 Vdc 802.3af Compliant
Average Power Consumption	less than 9 Watts

Regulatory Approvals

Wireless Approvals

Visit our web site at www.prosoft-technology.com for current wireless approval information.

Hazardous Locations

ANSI/ISA	12.12.01 groups A, B, C, D
CSA	C22.2 No. 213-M1987
ATEX	EN60079-0 and EN60079-15
Ordinary Locations	
CSA/CB	EN60950 N. America & W. Europe
FCC/IC	Part 15, Class A and ICES-03
ETSI	ETSI EN300 328 and ETSI EN301 893

8.8 RLX2-IHNF Detailed Specifications

Radio

Frequency Band	**Frequency**	**Channel**
(Varies by country)	2.412 GHz to 2.462 GHz (FCC) 2.412 GHz to 2.472 GHz (ETSI)	1 to 11 1 to 13
	5.150 GHz to 5.250 GHz (FCC/ETSI) 5.250 GHz to 5.350 GHz (ETSI) 5.470 GHz to 5.580 GHz (ETSI) 5.680 GHz to 5.700 GHz (ETSI) 5.725 GHz to 5.850 GHz (FCC)	36 to 48 52 to 64 100 to 116 136 to 140 149 to 165
Wireless Standards	802.11n, 802.11h, 802.11i, 802.11a, 802.11g (Legacy)	
Transmit Power (Programmable) *Subject to Regional Regulatory Limits	22 dBm @ MCS0, MCS8 (802.11an/gn) 17 dBm @ MCS7, MCS15 (802.11an/gn) 22 dBm @ 6 Mbps (802.11a/g) 17 dBm @ 54 Mbps (802.11a/g)	
	Antenna Impact: 3 Antennas/ MIMO: Use values above 2 Antennas: Subtract 3 dB from values above 1 Antenna: Subtract 5 dB from values above	
Channel data rates (802.11n)	MCS0 through MCS15, 1 Channel or 2 Channels with 1 Stream or 2 Streams	

1 Channel	**2 Channels**	**Rate**	**Streams**
7 Mbps	15 Mbps	MCS0	1 Stream
72 Mbps	150 Mbps	MCS7	
14 Mbps	30 Mbps	MCS8	2 Streams
144 Mbps	300 Mbps	MCS15	

Channel data rates (802.11a/g)	802.11a/g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps
Receiver Sensitivity (Typical)	-92 dBm @ MCS0, MCS8 (802.11an/gn) -70 dBm @ MCS7, MCS15 (802.11an) -74 dBm @ MCS7, MCS15 (802.11gn) -92 dBm @ 6 Mbps (802.11an/gn) -74 dBm @ 54 Mbps (802.11a) -78 dBm @ 54 Mbps (802.11g)
Security	WPA2 Personal – 802.11i AES w/ Passphrase Legacy WPA TKIP, WEP support MAC ID filter
Physical	
Enclosure	Extruded aluminum with DIN rail mount
Size	Width 115 mm x Height 117 mm x Depth 45 mm Width 4.5 inches x Height 4.6 inches x Depth 1.75 inches
Shock	IEC 60068 2-6 (20g, 3-Axis)
Vibration	IEC 60068 2-27 (5g, 10Hz to 150Hz)
Ethernet Port	One 10/100 Base-T connector, shielded RJ45 IEEE 802.3, 802.3u, 802.3x
Antenna Port	(3) RP-SMA connector
Personality Module	Industrial SD Memory Module
Weight	1.1 lbs (499 g)

Environmental	
Operating Temperature	-40°F to +167°F (-40°C to +75°C)
Humidity	Up to 100% RH, with no condensation
External Power PoE Injector	10 Vdc to 24 Vdc 802.3af PoE Powered Device
Average Power Consumption	less than 9 Watts

Agency Approvals & Certifications

Wireless Approvals

Visit our web site at www.prosoft-technology.com for current wireless approval information.

Hazardous Locations	
ANSI/ISA	12.12.01 groups A, B, C, D
CSA	C22.2 No. 213-M1987
ATEX	EN60079-0 and EN60079-15
Ordinary Locations	
CSA/CB	EN60950 N. America & W. Europe
FCC/IC	Part 15, Class A and ICES-03
ETSI	ETSI EN300 328 and ETSI EN301 893

8.9 RLX2-IHW Detailed Specifications

Radio

Frequency Band (Varies by country)	802.11b/g: 2.412 GHz to 2.462 GHz (FCC) 2.412 GHz to 2.472 GHz (ETSI) 802.11a: 5.150 GHz to 5.250 GHz (FCC/ETSI) 5.725 GHz to 5.850 GHz (FCC)
Wireless Standards	802.11a, 802.11b, 802.11g, 802.11i
Transmit Power (Programmable) (varies by country)	Up to 50 mW without amplifier Up to 500 mW with optional amplifier. (not applicable for hazardous locations)
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)	-90 dBm @ 1 Mbps -85 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	WPA2 - 802.11i with 128 bit AES-CCM Legacy WPA TKIP, WEP support MAC ID filter Admin password

Physical

Enclosure	Extruded aluminum with DIN and panel mount
Size	14.8 x 11.8 x 3.8 cm (W x H x D) 5.82 x 4.64 x 1.48 inches
Vibration	IEC 60068 2-6 (20g, 3-Axis)
Shock	IEC 60068 2-27 (5g, 10 Hz to 150 Hz)
Ethernet Ports	One 10/100/1000 Base-T connector, shielded RJ45
Antenna Ports	(2) RP-SMA connectors
Weight	1.06 lbs (479g)
Environmental	
Operating Temperature	-40°C to +75°C (-40°F to +167°F)
Humidity	Up to 100% RH, with no condensation
External Power PoE Injector Power over Ethernet	10 Vdc to 24 Vdc 48 Vdc 802.3af Compliant
Average Power	Less than 9 Watts

Regulatory Approvals

Wireless Approvals

Visit our web site at www.prosoft-technology.com for current wireless approval information.

Hazardous Locations

ANSI/ISA	12.12.01 groups A, B, C, D
CSA	C22.2 No. 213-M1987
ATEX	EN60079-0 and EN60079-15
Ordinary Locations	
CSA/CB	EN60950 N. America & W. Europe
FCC/IC	Part 15, Class A and ICES-03
ETSI	ETSI EN300 328 and ETSI EN301 893

9 Antenna Configuration

In This Chapter

❖ Antennas 135

9.1 Antennas

Connecting antennas to the radio, see Connecting antennas (page 39).

Consider important electrical characteristics when selecting antennas:

- Antenna pattern (page 135)
- Antenna gain (page 136)
- Antenna polarity (page 136)
- Antenna location, spacing, and mounting (page 141)

9.1.1 Antenna Pattern

Information between two wireless devices is transferred via electromagnetic energy radiated by one antenna and received by another. The radiated power of most antennas is not uniform in all directions and has varying intensities. The radiated power in various directions is called the pattern of the antenna. Each antenna should be mounted so that its direction of strongest radiation intensity points toward the other antenna or antennas with which it will exchange signals.

Complete antenna patterns are three-dimensional, although often only a two-dimensional slice of the pattern is shown when all the antennas of interest are located in roughly the same horizontal plane, along the ground rather than above or below one another.

A slice taken in a horizontal plane through the center (or looking down on the pattern) is called the azimuth pattern. A view from the side reveals a vertical plane slice called the elevation pattern.

An antenna pattern with equal or nearly equal intensity in all directions is omnidirectional. In two dimensions, an omnidirectional pattern appears as a circle (in three dimensions, an omnidirectional antenna pattern would be a sphere, but no antenna has true omnidirectional pattern in three dimensions). An antenna is considered omnidirectional if one of its two dimensional patterns, either azimuth or elevation pattern, is omnidirectional.

Beamwidth is an angular measurement of how strongly the power is concentrated in a particular direction. Beamwidth is a three dimensional quantity but can be broken into two-dimensional slices just like the antenna pattern. The beamwidth of an omnidirectional pattern is 360 degrees because the power is equal in all directions.

9.1.2 Antenna Gain

Antenna gain is a measure of how strongly an antenna radiates in its direction of maximum radiation intensity compared to how strong the radiation would be if the same power were applied to an antenna that radiated all of its power equally in all directions. Using the antenna pattern, the gain is the distance to the furthest point on the pattern from the origin. For an omnidirectional pattern, the gain is 1, or equivalently 0 dB. The higher the antenna gain is, the narrower the beamwidth, and vice versa.

The amount of power received by the receiving antenna is proportional to the transmitter power multiplied by the transmit antenna gain, multiplied by the receiving antenna gain. Therefore, the antenna gains and transmitting power can be traded off. For example, doubling one antenna gain has the same effect as doubling the transmitting power. Doubling both antenna gains has the same effect as quadrupling the transmitting power.

9.1.3 Antenna Polarity

Antenna polarization refers to the direction in which the electromagnetic field lines point as energy radiates away from the antenna. In general, the polarization is elliptical. The simplest and most common form of this elliptical polarization is a straight line, or linear polarization. Of the transmitted power that reaches the receiving antenna, only the portion that has the same polarization as the receiving antenna polarization is actually received. For example, if the transmitting antenna polarization is pointed in the vertical direction (vertical polarization, for short), and the receiving antenna also has vertical polarization, the maximum amount of power possible will be received. On the other hand, if the transmit antenna has vertical polarization and the receiving antenna has horizontal polarization, no power should be received. If the two antennas have linear polarizations oriented at 45° to each other, half of the possible maximum power will be received.

9.1.4 Whip antennas

Use a 1/2 wave straight whip or 1/2 wave articulating whip (2 dBi) antenna with RLX2 radios. These antennas are the most common type in use today. Such antennas are approximately 5 inches long, and are likely to be connected to a client radio (connected directly to the radio enclosure). These antennas do not require a ground plane. Articulating antennas and non-articulating antennas work in the same way. An articulating antenna bends at the connection.

9.1.5 Collinear array antennas

A collinear array antenna is typically composed of several linear antennas stacked on top of each other. The more stacked elements it has, the longer it is, and the more gain it has. It is fed in on one end.

The antenna pattern is torroidal. Its azimuthal beamwidth is 360° (omnidirectional). Its vertical beamwidth depends on the number of elements/length, where more elements equal narrower beamwidth. The antenna gain also depends on the number of elements/length, where more elements produce higher gain. Typical gain is 5 to 10 dBi.

The antenna polarity is linear, or parallel to the length of the antenna.

9.1.6 Yagi Array Antenna

A yagi antenna is composed of an array of linear elements, each parallel to one another and attached perpendicular to and along the length of a metal boom. The feed is attached to only one of the elements. Elements on one side of the fed element are longer and act as reflectors; elements on the other side are shorter and act as directors. This causes the antenna to radiate in a beam out of the end with the shorter elements. The pattern depends on the overall geometry, including the number of elements, element spacing, element length, and so on. Sometimes the antenna is enclosed in a protective tube hiding the actual antenna geometry.

The antenna pattern (page 135) is a beam pointed along the boom toward the end with the shorter elements. The beamwidth varies with antenna geometry but generally is proportional to the length (where longer length produces a narrower beam).

The antenna gain (page 136) varies with antenna geometry but generally is proportional to the length (where longer length produces higher gain). Typical values are 6 to 15dBi.

The antenna polarity is Linear (parallel to the elements, perpendicular to the boom).

Refer to the Antenna Types overview section for other types of approved antennas (page 139).

9.1.7 Parabolic reflector antennas

A parabolic reflector antenna consists of a parabolic shaped dish and a feed antenna located in front of the dish. Power is radiated from the feed antenna toward the reflector. Due to the parabolic shape, the reflector concentrates the radiation into a narrow pattern, resulting in a high- gain beam.

The antenna pattern is a beam pointed away from the concave side of the dish. Beamwidth and antenna gain vary with the size of the reflector and the antenna construction. Typical gain values are 15 to 30 dBi.

The antenna polarity depends on the feed antenna polarization.

9.1.8 RLX2 Approved antennas

In the U.S. and Canada, use antennas that are specifically approved by the U.S. Federal Communications Commission (FCC) and Industry Canada for use with the RLX2 radios. Contact ProSoft Technology or visit www.prosoft-technology.com for a current list of approved antennas.

- Whip
- Collinear array
- Yagi array (page 137)
- Parabolic reflector (page 138)

Antenna selection depends on whether the bi-directional amplifier is being used or not. For each approved antenna, there is a specified minimum distance the antennas must be separated from users for safe exposure limits, according to FCC part 2.1091.

Approved antennas in Europe and other countries accepting CE (page 140)

Approved antennas in Mexico (page 140)

Approved antenna table

Use the following approved antennas when the radio module is connected directly to an antenna. Refer to Approved antennas with power amp (page 140) for a table of approved antennas with bi-directional power amplifiers.

Type	Pattern	Gain	Connector	Size (cm)	Min. distance from Body
1/2 Wave	Omni	2 dB	SMA-RP	7H x 1.5	20 cm
1/2 Wave art.	Omni	2 dB	SMA-RP	10H x 1.0	20 cm
Collinear Array	Omni	3 dB	SMA-RP	6H x 3.0	20 cm
Collinear Array, art.	Omni	5 dB	SMA-RP	19H x 1.0	20 cm
Collinear Array	Omni	5 dB	SMA-RP	19H x 1.0	20 cm
Collinear Array	Omni	8 dB	N-RP	43H x 1.6	20 cm
Collinear Array	Omni	9 dB	N-RP	43H x 1.6	20 cm
Collinear Array	Omni	12 dB	N-RP	106H x 4.0	25 cm
Patch	Directional	8 dB	SMA-RP	15.0H x 15.0	20 cm
Patch	Directional	11 dB	SMA-RP	22H x 12.7	22 cm
Patch	Directional	13 dB	N-RP	22H x 22	28 cm
Patch*	Directional	19 dB	N-RP	15.5 x 15.5	57 cm
Yagi	Directional	14 dB	N-RP	81L x 9.0	28 cm
Parabolic*	Directional	15 dB	N-RP	40H x 51W x 25D	36 cm
Parabolic*	Directional	19 dB	N-RP	58H x 66W x 26D	57 cm
Parabolic*	Directional	24 dB	N-RP	78H x 96W x 29D	100 cm

* Only allowed in a point-to-point network.

Approved antennas in Europe/CE

The gain of the antenna connected to the main antenna port, minus the antenna cable loss, must be less than 4 dB to stay below the 100-mW EIRP transmit power limit.

The AUX port is only used to receive; it never transmits.

Note: In France, the user is responsible for ensuring that the selected frequency channels comply with French regulatory standards. At the time of this printing, only channels 10 through 13 can be used in France.

Approved antennas in Mexico

The gain of the antenna connected to the main antenna port, minus the antenna cable loss, must be less than 12 dB to stay below the 650-mW EIRP transmit power limit.

Note: In Mexico, the user is responsible for ensuring that the selected frequency channels comply with Mexican regulatory standards. At the time of this printing, only channels 9 through 11 can be used outdoors (1 through 8 cannot); however, channels 1 through 11 can all be used indoors.

Approved antennas with power amp

When the radio is used in conjunction with the amplifier, the antennas are limited to antennas listed in the following table.

Type	Pattern	Gain	Connector	Size (cm)	Min. distance from Body
1/2 Wave	Omni	2 dB	SMA-RP	7H x 1.5	20 cm
1/2 Wave art.	Omni	2 dB	SMA-RP	10H x 1.0	20 cm
Collinear Array	Omni	3 dB	SMA-RP	6H x 3.0	20 cm
Collinear Array, art.	Omni	5 dB	SMA-RP	19H x 1.0	20 cm
Collinear Array	Omni	5 dB	SMA-RP	19H x 1.0	20 cm
Collinear Array	Omni	8 dB	N-RP	43H x 1.6	20 cm
Collinear Array	Omni	9 dB	N-RP	43H x 1.6	20 cm
Collinear Array*	Omni	12 dB	N-RP	106H x 4.0	25 cm
Patch	Directional	8 dB	SMA-RP	15.0H x 15.0	20 cm
Patch*	Directional	11 dB	SMA-RP	22H x 12.7	20 cm
Patch*	Directional	13 dB	N-RP	22H x 22	28 cm
Yagi*	Directional	14 dB	N-RP	81L x 9.0	28 cm

* Only allowed in a point-to-point network.

9.1.9 Antenna location, spacing, and mounting

Consider the following points regarding antenna location, spacing, and mounting:

- When placing antennas, ensure a clear line of sight between the master radio's antenna and all of the other radio antennas.
- If the site base contains obstructing terrain or structures, mount the antenna on a tower or rooftop to provide a line-of-sight path. The line-of-sight consideration becomes more important as the transmission path becomes longer.
- Mount the antennas as high off the ground as is practical. The higher an antenna is above the ground, the greater its range.
- Mount the antennas away from massive structures. Radio signals bounce off metal walls, for example, which can compromise a clear signal.
- Mount antennas to minimize the amount of nearby metal structures in the antenna pattern.
- Mount the antennas and install radios away from sources of RF interference.
- Use the shortest possible antenna cable length. Signals lose power over the cable's distance.
- Choose antennas that are appropriate for the network's intended function.
- If antennas are on radios on the same network, mount them so they have the same polarity. If the antennas are on separate networks, mount them so they have a different antenna polarity—for example, mount one antenna vertically and the other horizontally.
- Space radios at least three feet (one meter) apart so they do not overload each other. If antennas must be near each other:
  - Mount omnidirectional antennas directly above each other.
  - Position directional antennas so they do not point at nearby antennas. Place antennas side by side if they point in the same direction. Place antennas back to back if they point in opposite directions.

10 Support, Service & Warranty

In This Chapter

- Contacting Technical Support 143
- Warranty Information..... 144

Contacting Technical Support

ProSoft Technology, Inc. (ProSoft) is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

1 Product Version Number
2 System architecture
3 Network details

If the issue is hardware related, we will also need information regarding:

1 Module configuration and associated ladder files, if any
2 Module operation and any unusual behavior
3 Configuration/Debug status information
4 LED patterns
5 Details about the serial, Ethernet or fieldbus devices interfaced to the module, if any.

Note: *For technical support calls within the United States, an after-hours answering system allows 24-hour/7-days-a-week pager access to one of our qualified Technical and/or Application Support Engineers.*

Internet	Web Site: www.prosoft-technology.com/support E-mail address: support@prosoft-technology.com
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Warranty Information

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Glossary of Terms

Symbols & Numeric

802.11

A group of wireless specifications developed by the IEEE. It details a wireless interface between devices to manage packet traffic.

802.11a

Operates in the 5 GHz frequency range with a maximum 54 Mbit/sec signaling rate.

802.11b

Operates in the 2.4 GHz Industrial, Scientific, and Measurement (ISM) band. Provides signaling rates of up to 11 Mbit/sec and is the most commonly used frequency.

802.11g

Similar to 802.11b but supports signaling rates of up to 54 Mbit/sec. Operates in the heavily used 2.4 GHz ISM band but uses a different radio technology to boost throughput.

802.11i

Sometimes Wi-Fi Protected Access 2 (WPA 2). WPA 2 supports the 128-bit and above advanced encryption Standard, along with 802.1x authentication and key management features.

802.11n

Designed to raise effective WLAN throughput to more than 100 Mbit/sec.

A

Access Point

A generic term for an 802.11 radio that "attaches" other 802.11 radios (clients) to a wired network. Some APs can also bridge to one another.

Ad hoc Mode

Wireless network framework in which devices can communicate directly with one another without using an AP or a connection to a regular network. RLX2 radio products do not support *Ad hoc* mode.

AES

Advanced Encryption Standard. New standard for encryption adopted by the U.S. government for secure communications.

Amplifier

A device connected to an antenna used to increase the signal strength and amplify weak incoming signals.

Antenna

A device connected to a wireless transceiver that concentrates transmitted and received radio waves to increase signal strength and thus the effective range of a wireless network.

ASCII

American Standard Code for Information Interchange. A communication mode in which each eight-bit byte in a message contains one ASCII character code. ASCII characters (or hexadecimal characters) are sometimes used as a key to encrypt data and ensure its secure transmission.

Association

Process whereby two 802.11 radios establish communications with each other. Requirements for communication include common SSID (network names) and encryption settings.

Authenticate

The process of confirming the identity of someone connecting to a network.

Authentication Server

A back-end database server that confirms the identity of a supplicant to an authenticator in an 802.1x-authenticated network.

B

Band

Another term for spectrum used to indicate a particular set of frequencies. Wireless networking protocols work in either the 2.4 GHz or the 5 GHz bands.

Bandwidth

(See Throughput)

Base Station

See Wireless Gateway

Baud Rate

The speed of communication between devices on the network. All devices must communicate at the same rate.

bps

Bits per Second. A measure of data transmission speed across a network or communications channel; bps is the number of bits that can be sent or received per second.

C

CACT

CACT is an acronym for *Channel Availability Check Time*, a parameter used in DFS channel selection. During DFS when a radio changes channels, it must listen for the CACT on the new channel before beginning operations. For most channels the CACT is 60 seconds.

Channel

One portion of the available radio spectrum that all devices on a wireless network use to communicate. Changing the channel on the access point/router can help reduce interference.

Channel Move Time

The maximum time a radio can take to transition to another channel when radar is detected. Typically 10 seconds.

Client, Radio Mode

A radio in *Client* mode can connect to any Access Point, but can only support one Ethernet device. See also *Repeater, Radio Mode*.

Client, Software

A client is a software program, or the device on which that program runs, that makes requests for information from a software program, or the device on which that program runs, in a client-server relationship.

A Client on an Ethernet network is equivalent to a Master on a serial network.

Configuration PC

A Computer that contains the configuration tools for the RLX2 radio series.

D

dBi

Decibels referenced to an "ideal" isotropic radiator in free space; frequently used to express antenna gain

dBm

Decibels referenced to one milliwatt (mW); an "absolute" unit used to measure signal power (transmit power output or received signal strength)

DCE

Data communications equipment. A modem, for example.

Decibel (dB)

A measure of the ratio between two signal levels; used to express gain (or loss) in a system.

Default Gateway

The IP address of a network router where data is sent if the destination IP address is outside the local subnet. The gateway is the device that routes the traffic from the local area network to other networks such as the Internet.

Device-to-Device Network (Peer-to-Peer Network)

Two or more devices that connect using wireless network devices without the use of a centralized wireless access point. Also known as a peer-to-peer network.

DFS

DFS stands for *Dynamic Frequency Selection*, a requirement for operation on certain frequencies in the 5 GHz band in many countries. When a radio operates on a DFS frequency, it must sense the presence of radar and automatically change to another channel if radar is detected.

DHCP

The dynamic host configuration protocol is an Internet protocol, similar to BootP, for automating the configuration of computers that use TCP/IP. DHCP can be used to automatically assign IP addresses, to deliver IP stack configuration parameters, such as the subnet mask and default router, and to provide other configuration information, such as the addresses for printer, time, and news servers.

Direct Sequence Spread Spectrum

One of two approaches (with frequency hopping spread spectrum) for sorting out overlapping data signals transmitted via radio waves. 802.11b uses DSSS

Directional Antenna

Transmits and receives radio waves off the front of the antenna.

Diversity Antenna

An antenna system that uses multiple antennas to reduce interference and maximize reception and transmission quality.

DTE

Data Terminal Equipment, for example, a computer or terminal.

Dual Band

A device that is capable of operating in two frequencies. On a wireless network, dual-band devices are capable of operating in both the 2.4 GHz (802.11b/g) and 5 GHz (802.11a) bands.

E

EAP

Extensible Authentication Protocol. A protocol that provides an authentication framework for both wireless and wired Ethernet enterprise networks.

EIRP

Equivalent isotropically radiated power (EIRP) is the amount of power that would have to be emitted by an isotropic antenna (that evenly distributes power in all directions and is a theoretical construct) to produce the peak power density observed in the direction of maximum antenna gain.

Encryption

Method of scrambling data so that only the intended viewers can decipher and understand it.

ESD

Electrostatic Discharge. Can cause internal circuit damage to the coprocessor.

ESSID

Extended Service Set Identifier. A name used to identify a wireless network.

F

Firmware

Firmware is the embedded software code that that runs in the module to direct module function (similar to the BIOS in a personal computer). This is distinguished from the Setup/Diagnostic Application software that is installed on the Configuration PC.

Frequency Hopping

A radio that rapidly changes its operating frequency several times per second following a pre-determined sequence of frequencies. The transmitting and receiving radios are programmed to follow the same frequency hopping sequence.

Frequency Hopping Spread Spectrum

Changes or hops frequencies in pattern known to both sender and receiver. FHSS is little influenced by radio stations, reflections, or other environmental factors. However, it is much slower than DSSS.

Fresnel Zone

An elliptical area on either side of the straight line of sight that must also be clear for a long-range wireless network to work.

Full-Duplex

A communications circuit or system designed to simultaneously transmit and receive two different streams of data. Telephones are an example of a full-duplex communication system. Both parties on a telephone conversation can talk and listen at the same time. If both talk at the same time, their two signals are not corrupted.

G

Gain

The amount by which an antenna concentrates signal strength in a wireless network.

Gateway

In wireless terms, a gateway is an access point with additional software capabilities such as providing NAT and DHCP.

Guard Interval (GI)

An interval of time between data packet transmissions. The guard interval time for 802.11a/b/g systems is fixed at 800 microseconds. 802.11n devices can also use a 400 microsecond guard interval, falling back to 800 microseconds if excessive data corruption is detected.

H

Half-Duplex

A communications circuit or system designed to transmit and receive data, but not both simultaneously. CB or walkie-talkie radios are an example of a half-duplex communication system. Either parties on a radio conversation may talk or listen; but both cannot talk at the same time without corrupting each other's signal. If one operator is "talking", the other must be "listening" to have successful communication.

Hz

Hertz. The international unit for measuring frequency equivalent to the older unit of cycles per second. One megahertz (MHz) is one million hertz. One gigahertz (GHz) is one billion hertz. The standard US electrical power frequency is 60 Hz. 802.11a devices operate in the 5 GHz band; 802.11b and g devices operate in the 2.4 GHz band.

I

IEEE

Institute of Electrical and Electronics Engineers, Inc. IEEE is a professional organization with members in over 175 countries and is an authority in technical areas such as computer engineering and telecommunications. IEEE developed the 802.11 specifications.

IP Address

A 32-bit identification number for each node on an Internet Protocol network. These addresses are represented as four sets of 8-bit numbers (numbers from 0 to 255), separated by periods ("dots").

Networks using the TCP/IP Protocol route messages based on the IP address of the destination. Each number can be 0 to 255. For example, 192.168.0.100 could be an IP address. Each node on the network must have a unique IP address.

K

Key

A set of information (often 40 to as much as 256 bits) that is used as a seed to an encryption algorithm to encrypt (scramble) data. Ideally, the key must also be known by the receiver to decrypt the data.

L

LAN

A system of connecting PCs and other devices within the same physical proximity for sharing resources such as internet connections, printers, files, and drives. When Wi-Fi is used to connect the devices, the system is known as a wireless LAN or WLAN.

LED

Light-emitting diode.

Line of Sight (LoS)

A clear line from one antenna to another in a long-range wireless network.

Link point

The graphical point next to a radio icon that represents the connection point for RF communications between radios. An RF connection between two radios is called an RF Link and is represented as a graphical black line between the radio's link points.

M

MAC ID

Media Access Control address. Every 802.11 device has its own MAC address. This is a unique identifier used to provide security for wireless networks. When a network uses a MAC table, only the 802.11 radios that have had their MAC addresses added to the network's MAC table are able to get on the network.

Master device

Device that is connected to the Master radio.

Mbps

Megabits per second, or millions of bits per second. A measure of bandwidth.

Megahertz

A measure of electromagnetic wave frequency equal to one million hertz. Often abbreviated as MHz and used to specify the radio frequency used by wireless devices.

MIC

Message Integrity Check. One of the elements added to the TKIP standard. A "signature" is added by each radio on each packet it transmits. The signature is based on the data in the packet, a 64-bit value (key) and the MAC address of the sender. The MIC allows the receiving radio to verify (check) that the data is not forged.

MIMO

Multiple Input Multiple Output refers to using multiple antennas in a Wi-Fi device to improve performance and throughput. MIMO technology takes advantage of a characteristic called multipath, which occurs when a radio transmission starts out at Point A and the reflects off or passes through surfaces or objects before arriving, via multiple paths, at Point B. MIMO technology uses multiple antennas to collect and organize signals arriving via these paths.

Modbus

The Modbus protocol provides the internal standard that the MODICON® controllers use for parsing messages. During communications on a Modbus network, the protocol determines how each controller will know its device address, recognize a message addressed to it, determine the kind of action to be taken, and extract any data or other information contained in the message. If a reply is required, the controller will construct the reply message and send it using Modbus protocol.

Modem

Stands for MODulator-DEModulator, a device that converts digital signals to analog signals and vice-versa. Analog signals can be transmitted over communications links such as telephone lines.

N

Network

A series of stations or nodes connected by some type of communication medium. A network may consist of a single link or multiple links.

Node

An address or software location on the network.

Non-Occupancy Period

The time during which a radio cannot return to a frequency where radar was detected. This time is typically 30 minutes. Typically a radio will not return to a channel where radar was previously detected unless absolutely necessary.

Null Modem Cable

A specialty cross-communication cable with female connectors on each end used for direct connection between devices when no modems are present. Commonly used as a quick and inexpensive way to transfer files between two PCs without installing a dedicated network card in each PC.

P

Panel Antenna

An antenna type that radiates in only a specific direction. Panel antennas are commonly used for point-to-point situations. Sometimes called Patch antennas.

Parabolic Antenna

An antenna type that radiates a very narrow beam in a specific direction. Parabolic antennas offer the highest gain for long-range point-to-point situations.

Peer-to-Peer Network

Each radio in a Peer-to-Peer network has the ability to receive data from - and transmit data to - any other radio in the network.

Point-Multipoint (Broadcast) Network

A network type where a single master radio sends data to every remote radio in the network. This is done repeatedly until every remote radio individually receives and acknowledges the data. Each remote radio sends pending data to the master radio that receives and acknowledges data sent from each remote. In this configuration, there are multiple remote radios referenced to a single master radio.

Point-Multipoint (Modbus) Network

A network with a single Master radio and multiple Remote radios. The devices cabled to the radios communicate through the Modbus standard protocol. The Master radio sends data to a Remote radio based on the Modbus address of the Modbus device. The data is only sent to the single Remote device based on its address. Each Remote radio sends its data only to the Master radio. The Master and Remote radios acknowledge that data was received correctly.

Point-to-Multipoint

A wireless network in which one point (the access point) serves multiple other points around it. Indoor wireless networks are all point-to-multipoint, and long-range wireless networks that serve multiple clients usually employ either a single omnidirectional antenna or multiple sector antennas.

Point-to-Point Network

A network consisting of a single Master radio and a single Remote radio. All data from the Master is received and acknowledged by one Remote. All data from the single Remote is received and acknowledged by the Master radio.

Poll

A method of electronic communication.

Power Supply

Device that supplies electrical power to the I/O chassis containing the processor, coprocessor, or other modules.

Protocol

The language or packaging of information that is transmitted between nodes on a network.

Q

QoS

Quality of Service. Required to support wireless multimedia applications and advanced traffic management. QoS enables Wi-Fi access points to prioritize traffic and optimize the way shared network resources are allocated among different applications.

R

Range

The distance covered by a wireless network radio device. Depending on the environment and the type of antenna used, Wi-Fi signals can have a range of up to a mile.

Remote Access Point

One of a number of secondary access points in a wireless network that uses WDS to extend its range. Remote access points (sometimes called relay access points) connect to a master access point.

Remote device

Devices connected remote radios

Repeater

A Repeater is a device used to extend the range of a Wi-Fi signal. Placed at the edge of signal reception, a repeater simply receives and re-transmits the signal.

Repeater, Radio Mode

A RLX2 radio in *Repeater* mode can only connect to other ProSoft radios, but any number of Ethernet network devices can be attached to it. See also *Client, Radio Mode*.

RS-232

Recommended Standard 232; the standard for serial binary signals between DTE and DCE devices.

RTU (Remote Terminal Unit)

Modbus transmission mode where each eight-bit byte in a message contains two four-bit hexadecimal characters. There are two transmission modes (ASCII or RTU). The main advantage of the RTU mode is that its greater character density allows better data throughput than ASCII mode for the same baud rate; each message is transmitted in a continuous stream (See also ASCII, above).

S

Sector Antenna

An antenna type that radiates in only a specific direction. Multiple sector antennas are commonly used in point-to-multipoint situations.

Signal Diversity

A process by which two small dipole antennas are used to send and receive, combining their results for better effect.

Signal Loss

The amount of signal strength that's lost in antenna cable, connectors, and free space. Signal loss is measured in decibels. Also referred to as gain loss.

Signal Strength

The strength of the radio waves in a wireless network.

Simplex

A communications circuit or system designed to either transmit data or receive data, but not both. Broadcast television is an example of simplex communication system. A television station sends a TV signal but cannot receive responses back from the television sets to which it is transmitting. The TV sets can receive the signal from the TV station but cannot transmit back to the station.

Site Survey

A comprehensive facility study performed by network managers to ensure that planned service levels will be met when a new wireless LAN, or additional WLAN segments to an existing network are deployed. Site surveys are usually performed by a radio frequency engineer and used by systems integrators to identify the optimum placement of access points to ensure that planned levels of service are met. Site surveys are sometimes conducted following the deployment to ensure that the WLAN is achieving the necessary level of coverage. Site surveys can also be used to detect rogue access points.

Spectrum

A range of electromagnetic frequencies.

Spread Spectrum

A form of wireless communication in which a signal's frequency is deliberately varied. This increases bandwidth and lessens the chances of interruption or interception of the transmitted signal.

SSI

Service Set Identifier is a sequence of characters unique to a specific network or network segment that's used by the network and all attached devices to identify themselves and allow devices to connect to the correct network when one or more than one independent network is operating in nearby areas.

Subnet Mask

A mask used to determine what subnet an IP address belongs to. An IP address has two components: the network address, and the host (node or device) address. For example, consider the IP address 150.215.017.009. Assuming this is part of a Class B network (with a subnet mask of 255.255.0.0), the first two numbers (150.215) represent the Class B network address, and the second two numbers (017.009) identify a particular host on this network.

T

TKIP

Temporal Key Integrity Protocol. The wireless security encryption mechanism in Wi-Fi Protected Access. TKIP uses a key hierarchy and key management methodology that removes the predictability that intruders relied upon to exploit the WEP key. In increases the size of the key from 40 to 128 bits and replaces WEP's single static key with keys that are dynamically generated and distributed by an authentication server, providing some 500 trillion possible keys that can be used on a given data packet. If also includes a Message Integrity Check (MIC), designed to prevent the attacker from capturing data packets, altering them, and resending them. By greatly expanding the size of keys, the number of keys in use, and by creating an integrity checking mechanism, TKIP magnifies the complexity and difficulty involved in decoding data on a Wi-Fi network. TKIP greatly increases the strength and complexity of wireless encryption, making it far more difficult (if not impossible) for a would-be intruder to break into a Wi-Fi network.

U

UART

Universal Asynchronous Receiver/Transmitter

W

WAP

Wireless Application Protocol. A set of standards to enable wireless devices to access internet services, such as the World Wide Web and email.

WDS

Wireless Distribution System. Enables access points to communicate with one another in order to extend the range of a wireless networks. Used in 802.11g based access points.

WEP

Wired-Equivalent Privacy protocol was specified in the IEEE 802.11 standard to provide a WLAN with a minimal level of security and privacy comparable to a typical wired LAN, using data encryption.

Wi-Fi

A certification mark managed by a trade group called the Wi-Fi Alliance. Wi-Fi certification encompasses numerous standards including 802.11a, 802.11b, 802.11g, WPA, and more. Equipment must pass compatibility testing to receive the Wi-Fi mark.

Wi-Fi CERTIFIED™

The certification standard designating IEEE 802.11-based wireless local area network (WLAN) products that have passed interoperability testing requirements developed and governed by the Wi-Fi alliance.

Wi-Fi Interoperability Certificate

A statement that a product has passed interoperability testing and will work with other Wi-Fi CERTIFIED products.

Wi-Fi Protected Setup

Wi-Fi Protected Setup™ (previously called Wi-Fi Simple Config) is an optional certification program developed by the Wi-Fi alliance designed to ease set up of security enabled Wi-Fi networks in the home and small office environment. Wi-Fi Protected Setup supports methods (pushing a button or entering a PIN into a wizard-type application) that are familiar to most consumers to configure a network and enable security.

Wireless Gateway

Term used to differentiate between an access point and a more-capable device that can share an internet connection, serve DHCP, and bridge between wired and wireless networks.

Wireless Network

Devices connected to a network using a centralized wireless access point.

WLAN

Wireless Local Area Network. A type of local area network in which data is sent and received via high-frequency radio waves rather than cables or wires.

WPA

Wi-Fi Protected Access is a data encryption specification for 802.11 wireless networks that replaces the weaker WEP. It improves on WEP by using dynamic keys, Extensible Authentication Protocol to secure network access, and an encryption method called Temporal Key Integrity Protocol (TKIP) to secure data transmissions.

WPA2

An enhanced version of WPA. It is the official 802.11i standard. It uses Advanced Encryption Standard instead of TKIP. AES supports 128-bit, 192-bit, and 256-bit encryption keys.

Y

Yagi Antenna

An antenna type that radiates in only a specific direction. Yagi antennas are used in point-to-point situations.

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