

Parameter	Description
IGMP Query Interval	Specifies the number of seconds between queries (if the timer is not pre-empted by a query from another device). By RFC specification, only one device on a network should generate IGMP queries. As such, the radio only sends an IGMP query if another device has not sent a query within the radio's IGMP QUERY INTERVAL setting, even if IGMP QUERY GENERATION is enabled.
Multicast State Count	Specifies the number of queries the radio generates before a device is removed from the multicast group on this radio if no response is received from the device.

4.6.2 STP Settings

You use the parameters in the **STP SETTING** group in the *Radio Configuration / Diagnostic Utility* to specify the Spanning Tree Protocol parameters of your RLX2-IHx series radio.

The screenshot shows the configuration interface for a RadioLin Industrial Hotspot. The top section displays radio information: Radio Name (RLX2 Master 1), Radio MAC (00.0D.8D.F0.B0.68), Radio Type (RLX2-IHW-A), Firmware (RLX2_v0036G_R), Update every (15 sec), Up Time (0 Day 0 Hr. 1 Min. 2 Sec.), and Link Time (n/a). The Signal Strength is shown as Master. Below this is a navigation menu with tabs for Basic Settings, Advanced Settings, Parent Link, Advanced Network Settings, Serial Settings, QoS, and VLAN. The Advanced Network Settings tab is active, showing three sub-sections: IGMP Settings, STP Settings (highlighted with a red box), and SNMP Agent. The STP Settings section includes options for Enable Spanning Tree (unchecked), Ethernet Edge Port (checked), Bridge Times (Priority: 32770, Hello Time: 2 s, Max Age: 20 s, Forward Delay: 10 s), Path Costs (Wireless: 200, Ethernet: 100), and Cable Break Detection (unchecked, Threshold: 10 dB). The IGMP Settings section includes IGMP Multicast Filtering (Enabled), Default Propagation Action (Flood), IGMP Query Generation (Timed Interval), IGMP Query Interval (60 seconds), and Multicast State Count (3 query frames). The SNMP Agent section includes Enable (checked), Allow Any Manager (selected), Allow IP (0.0.0.0), Community String (public), and Permission (Read only). At the bottom, there are buttons for Apply Changes, Cancel Changes, Factory Defaults, and Help. A footer note states: Factory Defaults: Reset ALL radio parameters to defaults (not just ones on this page).

Parameter	Description
Enable Spanning Tree	<p>Select this check box to enable Spanning Tree Protocol (STP).</p> <ul style="list-style-type: none"> ▪ If you enable Spanning Tree (recommended), the radio blocks redundant connections. Additionally, the radio flushes the Ethernet switch table when the network topology changes. See Rapid Spanning Tree Functionality (page 103). ▪ If you disable Spanning Tree (clear the check box), there can be redundant connections if the radio creates multiple radio links in parallel with each other. This also disables the other parameters in the STP SETTINGS group. <p>All RLX2-IHx series radios support the Rapid Spanning Tree Protocol (RSTP), and default to this mode when you enable Spanning Tree.</p>
Ethernet Edge Port	<p>Select this check box to enable the Ethernet Edge Port function (recommended) when no RSTP device is connected to the Ethernet port. This allows immediate communication through the Ethernet port.</p> <p>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 is forced to adhere to the timer based transition protocol of STP.</p> <p>Therefore on network transitions and power up, communications are not allowed over the Ethernet port for 30 to 45 seconds unless you enable ETHERNET EDGE PORT. This setting specifies that no redundant connections exist out the Ethernet port and communication can start immediately. If for some reason the radio receives a BPDU (bridge protocol data unit) on this port, the RSTP protocol negotiates properly and handles any possible redundant paths.</p> <p>Note: You can select ETHERNET EDGE PORT without selecting ENABLE SPANNING TREE.</p>
Bridge Times	Configures the timing intervals to use.
Priority	<p>Determines which device is the root of the RSTP. The RSTP device with the lowest priority becomes the root bridge.</p> <ul style="list-style-type: none"> ▪ 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. ▪ For Master radios, set this value to 32769 to prevent the radio from being the root over a wired switch. ▪ For Repeater radios, set this value to 32770. This specifies that if the network only has RLX2-IHx series radios, the Master radio becomes the root.
Hello Time	Specifies the rate at which the radio sends out BPDUs. The recommended industry standard is 2 seconds.
Max Age	<p>Specifies the age limit for protocol information for a port.</p> <p>The radio measures the age of the received protocol information recorded for a port and discards it when the information's age limit exceeds this value. The timeout value for this timer is the maximum age parameter of the root.</p>
Forward Delay	Specifies the timeout for time spent by a port in the learning and listening states. The timeout value is the forward delay parameter of the root.
Path Costs	RSTP and STP algorithms use a cost to determine which connections should be used in the Spanning Tree. The radio forms the Spanning Tree by determining the lowest cost paths from any RSTP device back to the root.

Parameter	Description
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 .

Rapid Spanning Tree Functionality

Rapid Spanning Tree Protocol (RSTP) is an advanced networking function that shuts off ports as necessary to prevent data packet loops when more than one network path is available. If loops exist in an Ethernet network, the devices can circulate packets endlessly, consuming all the bandwidth and making the network unusable.

RSTP allows the radios to create truly redundant connections between any two points in the network, but use only one path at a time. The radios detect the redundant paths and use only one primary connection for communications. If the primary connection fails, the radios quickly change to the secondary connection to a state to forward packets, allowing the network to adapt itself to handle problems without requiring your intervention.

RTSP uses active communications between network devices to quickly propagate changes and transitions in the network. Because RTSP is an IEEE standard, RLX2-IHx series radios work in conjunction with wired Ethernet switches to form a redundant network.

Each RSTP device (RLX2-IHx series radio or Ethernet switch) communicates with other RSTP devices in the network using packets called Bridge Protocol Data Units (BPDUs). Each device sends BPDUs out each of the devices ports. In a wired switch, this is from each of the Ethernet ports. In an RLX2-IHx series Radio, this is from both the Ethernet port and each wireless link. BPDUs allow each RSTP device in the network to make sure that the proper connections still exist.

The *Port Status* dialog box shows a list of all ports and their state. In the *Radio Configuration / Diagnostic Utility*, on the **BASIC SETTINGS** tab, click **PORT STATUS**. See Viewing the Radio Port Status (page 67). In this example, the RLX2-IHx series 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)

Port Status Amethyst_BD

Spanning Tree Protocol: Wireless Ports Rapid STP Ethernet Port Rapid STP

Spanning Tree Root: MAC 00.1E.C5.26.DA.1C

Priority 32738 Max Age 20s Hello Time 2s Forward Delay 15s

#	Connection	State	Designation	Path Cost	Designated Bridge
1	Ethernet-Disconnected	Forwarding	Des gnated	800	00.05.87.01.00.ED
2	RF Parent: 00.05.87.01.01.14	Forwarding	Root	500	00.05.87.01.01.14
11	RF Child 00.05.87.01.01.5C	Forwarding	Des gnated	700	00.05.87.01.00.ED
12	RF Child 00.0D.8D.F0.0C.4F	Forwarding	Des gnated	700	00.05.87.01.00.ED

Top Next Prev Refresh

BPDUs are sent out the port at a rate called the *Hello Time* set in the *Radio Configuration / Diagnostic Utility* on the **ADVANCED NETWORK SETTINGS** tab. The accepted standard value for this parameter is 2 seconds. If a radio (or any other RSTP device) does not get a BPDU from a device for a time period equal to two Hello Times, the radio assumes the RSTP device is no longer available. The radio can then open a redundant 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 reverts to normal Spanning Tree operation on the ports connected to those devices.

RSTP provides a performance enhancement over STP.

- A radio using the STP algorithm reverts 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.
- A radio using the RSTP algorithm uses active handshaking between adjacent RSTP devices to re-negotiate the network topology. This process takes only one to two seconds.

Each RLX2-IHx series radio contains a switch table that tells the radio how to forward Ethernet packets to get them to their correct destination. When the network topology changes, the radio immediately flushes its Ethernet switch table. This allows the radio to pass traffic immediately over the new network topology and learn the configuration in the process. Until the radio completely learns the new topology, it broadcasts the packets to their destination. As the radios see each packet and rebuilds the Ethernet switch table, the radios return to directing packets to their destinations.

4.6.3 SNMP Agent

You use the parameters in the **SNMP AGENT** group in the *Radio Configuration / Diagnostic Utility* to specify the Simple Network Management Protocol parameters of your RLX2-IHx series radio.

The screenshot shows the configuration page for a radio. The 'SNMP Agent' section is highlighted with a red box. It contains the following settings:

- Enable
- Allow Any Manager
- Allow IP 0.0.0.0
- Community String: public
- Permission: Read only
- Read/Write

Below the SNMP Agent section is the 'Cable Break Detection' section with an 'Enable' checkbox and a 'Threshold 10 dB' setting.

SNMP is a network management protocol that is often used with TCP/IP and Ethernet. It offers an alternative to using the *Radio Configuration / Diagnostic Utility*, and allows you to use an SNMP manager application to change radio settings and view diagnostics.

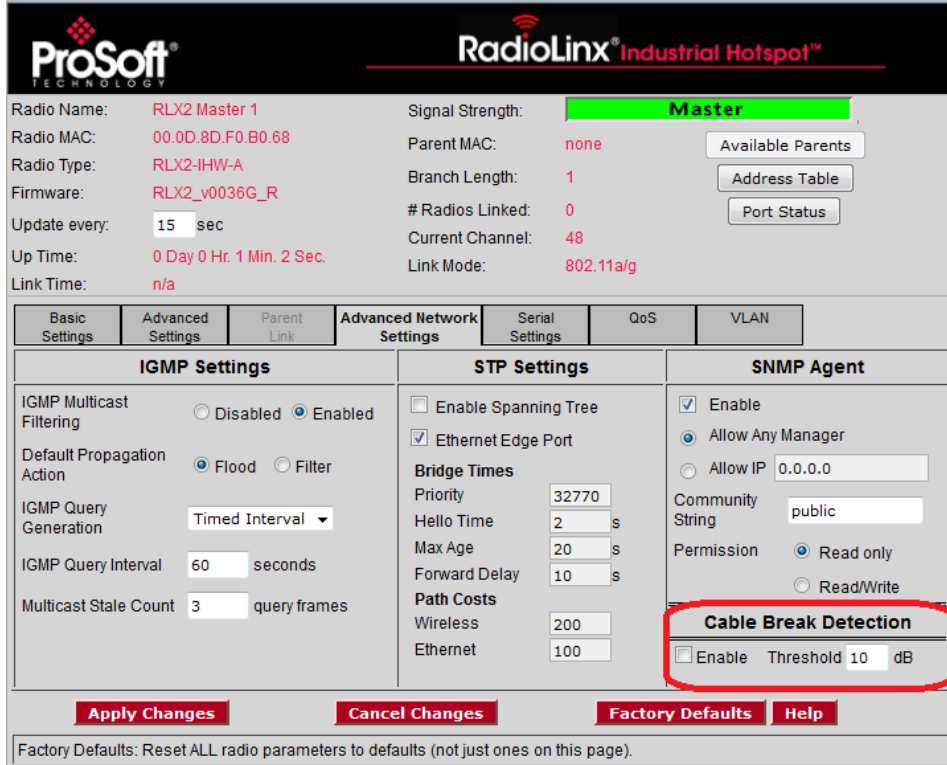
Parameter	Description
Enable	Select this check box to enable the following SNMP agent.
Allow Any Manager	Specifies that any user can change the radio configuration from any computer using SNMP.
Allow IP	Specifies that only an SNMP manager with a particular IP address can change the radio configuration. You must enter the IP address.
Community String	Specifies a <i>community string</i> (similar to a password) that an SNTP manager must use to access the radio's SNMP agent.
Permission	Specifies the permission level to assign to this radio. READ ONLY - The SNMP manager can view, but cannot change the radio configuration. READ/WRITE - The SNMP manager can view and make changes to the radio configuration.

- The RLX2-IHx series radio's SNMP agent supports SNMP protocol version 1.4 and 2.
- MIBs:
 - RFC12133-MIB (partial; internet.mgmt.MIB-2.system, .interfaces, .snmp)
 - ROMAP-MIB (internet.private.enterprises.romap)
- It also supports a selection of standard SNMP traps, including Cold Start, which the radio sends when it initializes.

4.6.4 Cable Break Detection

One common application interconnects a line of RLX2-IHx Masters with Radiating Cable, allowing mobile platforms to move down the line roaming from Master to Master. The radiating cable between the Masters allows them to receive each other's packets, in particular each other's Beacon frames. It is therefore possible for a Master to detect if the Radiating Cable between itself and the next or previous Master is broken or damaged. When enabled, this feature will produce an SNMP Trap whenever it detects an RSSI drop to one of its Monitored Peers.

A cable break is defined as a change in RSSI greater than the Cable Break Threshold. The RLX2-IHx will automatically determine the closest Peers and will adopt a baseline RSSI from each Peer when it is first picked to be monitored.



Parameter	Description
Enable	Select this check box to enable the <i>Cable Break Detection</i> feature
Threshold	Configures the RSSI change (in dB) observed while monitoring a neighboring RLX2-IHx Master that will trigger a cable break indication via an SNMP Trap.

4.7 Configuring Serial Settings

You use the **SERIAL SETTINGS** tab in the *Radio Configuration / Diagnostic Utility* to specify the serial communication parameters for a RLX2-IHx series radio. Serial Settings includes four groups:

- **SERIAL ENCAPSULATION MODE**
- **REMOTE IP SETTINGS**
- **PACKET DELINEATION**
- **PORT SETTINGS**

ProSoft TECHNOLOGY **RadioLinX Industrial Hotspot™**

Radio Name: **RLX2 Master 1** Signal Strength: **Scanning...**
 Radio MAC: **00.0D.8D.F0.79.24** Parent MAC: **none** Available Parents
 Radio Type: **RLX2-IHNF-A** Branch Length: **n/a** Address Table
 Firmware: **RLX2_v0036-DEVA_R** # Radios Linked: **0** Port Status
 Update every: **15** sec updating... Current Channel: **6**
 Up Time: **1 Day 0 Hr. 17 Min. 11 Sec.** Link Mode: **none**
 Link Time: **n/a**

Basic Settings | Advanced Settings | Parent Link | Advanced Network Settings | **Serial Settings** | QoS | VLAN

Serial Encapsulation Mode **None(default)**

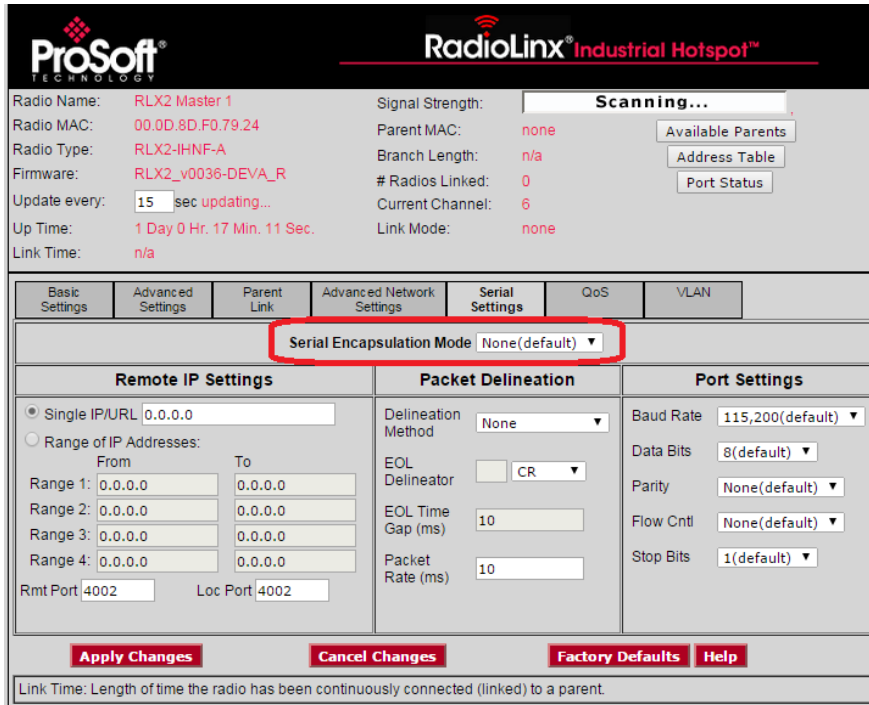
Remote IP Settings	Packet Delineation	Port Settings
<input checked="" type="radio"/> Single IP/URL 0.0.0.0 <input type="radio"/> Range of IP Addresses: From To Range 1: 0.0.0.0 0.0.0.0 Range 2: 0.0.0.0 0.0.0.0 Range 3: 0.0.0.0 0.0.0.0 Range 4: 0.0.0.0 0.0.0.0 Rmt Port 4002 Loc Port 4002	Delineation Method None EOL Delineator CR EOL Time Gap (ms) 10 Packet Rate (ms) 10	Baud Rate 115,200(default) Data Bits 8(default) Parity None(default) Flow Cntl None(default) Stop Bits 1(default)

Apply Changes **Cancel Changes** **Factory Defaults** **Help**

Link Time: Length of time the radio has been continuously connected (linked) to a parent.

4.7.1 Serial Encapsulation Mode Setting

You use the **SERIAL ENCAPSULATION MODE** parameter in the *Radio Configuration / Diagnostic Utility* to specify the serial encapsulation parameter of your RLX2-IHx series radio.



Parameter	Description
Serial Encapsulation Mode	<p>Specifies the serial encapsulation that the radio uses in serial communication.</p> <p>NONE - No serial data encapsulation.</p> <p>UDP - You can use programs on networked computers to send short messages or Datagrams. The radio uses the serial port to transmit and receive packets.</p> <p>Note: In UDP mode if you enter a multicast group address in the REMOTE IP SETTINGS group parameters, then packets are sent to that address or addresses.</p> <p>TCP SERVER - Only connections from this address will be accepted. Once the session is established, the serial port is enabled to transmit and receive packets.</p> <p>Note: To accept connections from any IP address the parameter should be set to 0.0.0.0.</p> <p>TCP CLIENT - In TCP Client mode, a TCP connection will be established with this address.</p>

When the session is established, the serial port is enabled to transmit and receive packets.

4.7.2 Remote IP Settings

You use the **REMOTE IP SETTINGS** parameters in the *Radio Configuration / Diagnostic Utility* to specify the address and port information for the remote radios for serial communication of your RLX2-IHx series radio.

The screenshot shows the configuration interface for a RadioLinx Industrial Hotspot. The top section displays radio information: Radio Name (RLX2 Master 1), Radio MAC (00:0D:8D:F0:79:24), Radio Type (RLX2-IHNF-A), Firmware (RLX2_v0036-DEVA_R), Update every (15 sec), Up Time (1 Day 0 Hr: 17 Min: 11 Sec), and Link Time (n/a). Below this is a navigation menu with tabs for Basic Settings, Advanced Settings, Parent Link, Advanced Network Settings, Serial Settings, QoS, and VLAN. The Serial Settings tab is active, showing Serial Encapsulation Mode (None/default). The Remote IP Settings section is highlighted with a red box and includes: Single IP/URL (0.0.0.0), Range of IP Addresses (with four ranges), Rmt Port (4002), and Loc Port (4002). Other sections include Packet Delineation (Delineation Method: None, EOL Delineator: CR, EOL Time Gap: 10 ms, Packet Rate: 10 ms) and Port Settings (Baud Rate: 115,200, Data Bits: 8, Parity: None, Flow Cntl: None, Stop Bits: 1). Buttons for Apply Changes, Cancel Changes, Factory Defaults, and Help are at the bottom.

Parameter	Description
Single IP/URL Address	Specifies the IP address or URL of the radio to receive encapsulated serial protocol packets from this radio.
Range of IP Addresses	Specifies up to 4 IP Address ranges for radios to receive encapsulated serial protocol packets from this radio.
Rmt Port	Specifies the remote UDP port number to use for encapsulated serial data transmission.
Loc Port	Specifies the local UDP port number to use for encapsulated serial data transmission.

4.7.3 Packet Delineation Settings

You use the **PACKET DELINEATION** parameters in the *Radio Configuration / Diagnostic Utility* to specify the way the radio separates serial packets for serial communication of your RLX2-IHx series radio.

Parameter	Description
Delineation Method	<p>Specifies the packet separator.</p> <p>TIME GAP - The radio uses a minimum time gap between characters that that the radio interprets as a delineator for a packet. This uses the EOL TIME GAP parameter.</p> <p>NONE - The radio sends all data received between packet delineation events to the remote radio in a single network frame.</p> <p>CHARACTER - The radio uses a character sequence in the stream of characters that indicates the delineator for the packet. This uses the EOL DELINEATOR parameter.</p>

EOL Delineator	Specifies the type of delineator the radio uses between packets when you select CHARACTER for DELINEATION METHOD .																															
<table border="1"> <thead> <tr> <th data-bbox="540 281 690 317">Type</th> <th data-bbox="690 281 824 317">Decimal</th> <th data-bbox="824 281 959 317">Hex</th> <th data-bbox="959 281 1385 317">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="540 323 690 415">Use Text</td> <td data-bbox="690 323 824 415"></td> <td data-bbox="824 323 959 415"></td> <td data-bbox="959 323 1385 415">Any string of characters. Enter the string of characters in the EOL Delineator box.</td> </tr> <tr> <td data-bbox="540 422 690 457">CR</td> <td data-bbox="690 422 824 457">13</td> <td data-bbox="824 422 959 457">0D</td> <td data-bbox="959 422 1385 457">Carriage Return</td> </tr> <tr> <td data-bbox="540 464 690 499">ESC</td> <td data-bbox="690 464 824 499">27</td> <td data-bbox="824 464 959 499">1B</td> <td data-bbox="959 464 1385 499">Escape</td> </tr> <tr> <td data-bbox="540 506 690 541">LF</td> <td data-bbox="690 506 824 541">10</td> <td data-bbox="824 506 959 541">0A</td> <td data-bbox="959 506 1385 541">Line Feed (New Line / nl)</td> </tr> <tr> <td data-bbox="540 548 690 583">Null</td> <td data-bbox="690 548 824 583">00</td> <td data-bbox="824 548 959 583">00</td> <td data-bbox="959 548 1385 583">Null</td> </tr> <tr> <td data-bbox="540 590 690 625">Spacebar</td> <td data-bbox="690 590 824 625">32</td> <td data-bbox="824 590 959 625">20</td> <td data-bbox="959 590 1385 625">Space</td> </tr> <tr> <td data-bbox="540 632 690 657">Tab</td> <td data-bbox="690 632 824 657">09</td> <td data-bbox="824 632 959 657">09</td> <td data-bbox="959 632 1385 657">Horizontal Tab</td> </tr> </tbody> </table>	Type	Decimal	Hex	Description	Use Text			Any string of characters. Enter the string of characters in the EOL Delineator box.	CR	13	0D	Carriage Return	ESC	27	1B	Escape	LF	10	0A	Line Feed (New Line / nl)	Null	00	00	Null	Spacebar	32	20	Space	Tab	09	09	Horizontal Tab
Type	Decimal	Hex	Description																													
Use Text			Any string of characters. Enter the string of characters in the EOL Delineator box.																													
CR	13	0D	Carriage Return																													
ESC	27	1B	Escape																													
LF	10	0A	Line Feed (New Line / nl)																													
Null	00	00	Null																													
Spacebar	32	20	Space																													
Tab	09	09	Horizontal Tab																													
EOL Time Gap (milliseconds)	<p>Specifies the time gap the radio uses between packets when you select TIME GAP for DELINEATION METHOD. This is the length of time that must elapse after a character is received (from the local attached device) before the radio marks the end of a packet.</p> <p>The smallest valid value for this parameter is limited by the device and is platform dependent.</p>																															
Packet Rate (milliseconds)	<p>Specifies the minimum time gap that the radio interprets as an inter-packet space. When the radio detects this time gap, it defines the characters received up to that point as a single packet and sends it to the remote radio.</p> <p>Valid values are 1,000 to 500,000.</p>																															

4.7.4 Port Settings

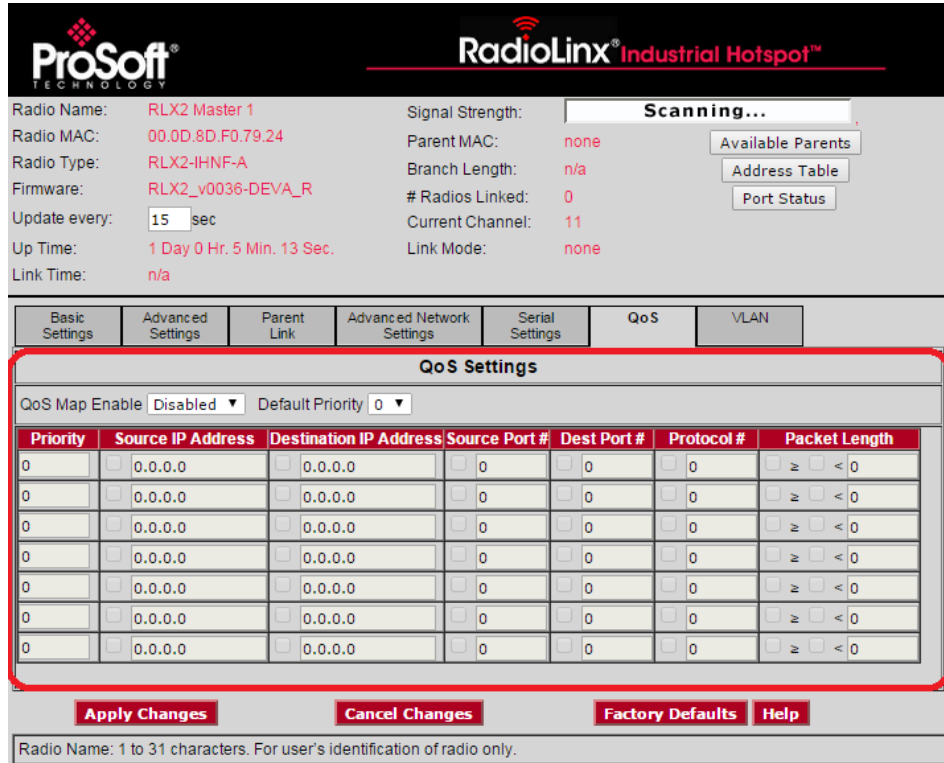
You use the **PORT SETTINGS** parameters in the *Radio Configuration / Diagnostic Utility* to specify the serial port settings of your RLX2-IHx series radio.

The screenshot shows the configuration utility interface for a RadioLin Industrial Hotspot. The top section displays radio information: Radio Name (RLX2 Master 1), Radio MAC (00.0D.8D.F0.79.24), Radio Type (RLX2-IHNF-A), Firmware (RLX2_v0036-DEVA_R), Update every (15 sec), Up Time (1 Day 0 Hr. 17 Min. 11 Sec.), Link Time (n/a), Signal Strength (Scanning...), Parent MAC (none), Branch Length (n/a), # Radios Linked (0), Current Channel (6), and Link Mode (none). Below this is a navigation bar with tabs for Basic Settings, Advanced Settings, Parent Link, Advanced Network Settings, Serial Settings, QoS, and VLAN. The Serial Settings tab is active, showing Serial Encapsulation Mode (None/default). The Port Settings section is highlighted with a red box and contains the following parameters: Baud Rate (115,200/default), Data Bits (8/default), Parity (None/default), Flow Cntl (None/default), and Stop Bits (1/default). Other sections include Remote IP Settings and Packet Delineation. At the bottom are buttons for Apply Changes, Cancel Changes, Factory Defaults, and Help, and a footer note: Link Time: Length of time the radio has been continuously connected (linked) to a parent.

Parameter	Definition
Baud Rate	Specifies the baud rate for the serial port on the radio. This must match the baud rate setting on the connected serial device.
Data Bits	Specifies the number of data bits for the serial port on the radio. This must match the data bits setting on the connected serial device. Values: 5, 6, 7 or 8
Parity	Specifies the parity for the serial port on the radio. This must match the parity setting on the connected serial device. Values: None, Even, Odd, 1 or 0
Flow Control	Specifies the flow control (handshaking) mode for the serial port on the radio. This must match the handshaking mode setting on the connected serial device. Values: None or Hardware
Stop Bits	Specifies the stop bits for the serial port on the radio. The stop bits on the radio must match the stop bits setting on the connected serial device. Values: 1 or 2

4.8 Configuring Quality of Service (QoS) Settings

You use the **QoS** settings tab in the *Radio Configuration / Diagnostic Utility* to specify the packet priority value parameters for a RLX2-IHx series radio.



RLX2-IHx series radios always prioritize frames using QoS for packets received already marked with a priority value. The **QoS** tab allows you to set the default priority for frames that the radio receives without any priority markings. In addition, you can map a priority value to packets received without priority markings according to a set of matching criteria.

Parameter	Description
QoS Map Enable	Specifies whether the the RLX2-IHx series radio uses the priority mapping function. ENABLED - The radio uses the priority mapping table to prioritize packets without a priority value. You must select Enabled before you can edit the QoS Map table. DISABLED - The radio does not set priority values for packets without a priority value.
Default Priority	Specifies the default priority for packets received on the Ethernet interface without a priority value (default is 0 - no priority).

Parameter	Description
QoS Map Table	<p>Specifies up to eight separate match criteria to identify and assign priority values to received Ethernet packets. Each filter has several parameters that you can enable by selecting the check box to the left of each parameter. When you enable multiple parameters in a row, all enabled parameters in that row must match before the radio assigns the specified PRIORITY value to a packet.</p> <p>PRIORITY - The priority value the radio assigns to the received Ethernet frame if it was not already marked with a priority value and if all enabled parameters in the same row match.</p> <p>SOURCE IP ADDRESS - A parameter match occurs for all packets received from the device with this source IP address.</p> <p>DESTINATION IP ADDRESS - A parameter match occurs for all packets received addressed to the device with this destination IP address.</p> <p>SOURCE PORT No. - A parameter match occurs for all IP packets received with this source port value.</p> <p>DEST PORT No. - A parameter match occurs for all IP packets received with this destination port value.</p> <p>PROTOCOL No. - A parameter match occurs for all IP packets received with this protocol number.</p> <p>PACKET LENGTH - A parameter match occurs for all iP packets received with the correct packet length.</p> <ul style="list-style-type: none"> ▪ You must enter a packet length threshold ▪ You must select the match criteria: Select < to match if the length of the received packet is LESS THAN the threshold. ▪ Select ≥ to match if the length is GREATER THAN OR EQUAL TO the threshold. ▪ Select both < and ≥ to match ALL PACKET LENGTHS.

4.9 Configuring VLAN Settings

You use the **VLAN** tab in the *Radio Configuration / Diagnostic Utility* to specify the Virtual Local Area Network parameters of a RLX2-IHx series radio. When the radio sends a packet, it includes the selected VLAN packet ID.

The screenshot shows the configuration interface for a ProSoft RadioLinX Industrial Hotspot. The top navigation bar includes tabs for Basic Settings, Advanced Settings, Parent Link, Advanced Network Settings, Serial Settings, QoS, and VLAN. The VLAN Settings section is highlighted with a red box and contains the following configuration options and table:

VLAN Settings

VLAN Enable: Disabled

Ethernet (ingress) PVID:

SSID (ingress) PVID:

Local/Mgmt (ingress) PVID:

Access Local from All VLAN's

VLAN ID	Ethernet	Ethernet	SSID	Local/App
	Member	Egress Action	Member	Member
1	<input checked="" type="checkbox"/>	Untag	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
0	<input type="checkbox"/>	Untag	<input type="checkbox"/>	<input type="checkbox"/>
0	<input type="checkbox"/>	Untag	<input type="checkbox"/>	<input type="checkbox"/>
0	<input type="checkbox"/>	Untag	<input type="checkbox"/>	<input type="checkbox"/>
0	<input type="checkbox"/>	Untag	<input type="checkbox"/>	<input type="checkbox"/>
0	<input type="checkbox"/>	Untag	<input type="checkbox"/>	<input type="checkbox"/>
0	<input type="checkbox"/>	Untag	<input type="checkbox"/>	<input type="checkbox"/>
0	<input type="checkbox"/>	Untag	<input type="checkbox"/>	<input type="checkbox"/>

Buttons: **Apply Changes**, **Cancel Changes**, **Factory Defaults**, **Help**

Radio Name: 1 to 31 characters. For user's identification of radio only.

RLX2-IHx series radios support port based VLANs. Each RLX2-IHx series radio can be considered to have 3 different ports or interfaces; the Ethernet interface, the local applications stack of the radio itself, and the 802.11 BSS created by each radio, allowing client devices to associate. You can configure the VLAN settings for the Ethernet interface on all RLX2-IHx series radios. You can configure the VLAN for the Local and SSID ports on the Master radio. The Master radio pushes these settings to each connected Repeater radio. This allows the VLAN settings for a bridged network rooted at a Master radio to have common settings for these two ports. This ensures, for example, that if the Local interface is set to a management VLAN, the all Repeater radios are accessible from a Management PC. For more information, see Appendix D - RLX2-IHx series Virtual LAN (VLAN) Functionality (page 175).

You can think of the Ethernet ports for the Master radio and its associated Repeater radios as a smart switch. Transporting tagged frames to the appropriate remote Ethernet port is automatic and does not require any settings.

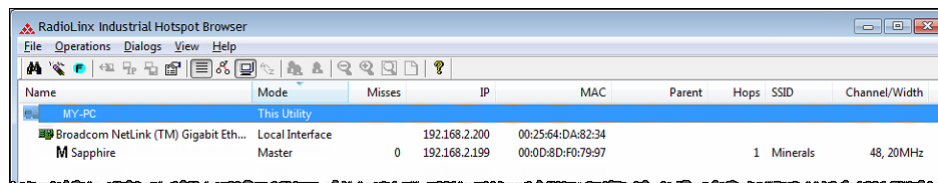
Parameter	Description
VLAN Enable	<p>Select this check box to enable the VLAN function of the radio.</p> <ul style="list-style-type: none"> ▪ When enabled, packets received by the radio on an interface that are not VLAN tagged are assigned to the VLAN as set by the PVID parameter of the respective interface. ▪ When disabled, the radio still bridges received Ethernet packets that are VLAN tagged but does not act on the VLAN ID of the frame or add or remove any VLAN tags.
Ethernet (ingress) PVID SSID (ingress) PVID Local/Mgmt (ingress) PVID	<p>Specifies the PVID setting representing the VLAN ID to assign to non-tagged ingress frames from each interface (Ethernet, SSID, Local/Mgmt).</p>
Access Local from all VLANs	<p>Select this check box to allow the Mgmt interface to be accessible from all VLANs and interfaces (supported by the Local/Mgmt interface).</p>
VLAN Settings	<p>Specifies the details for each VLAN.</p> <p>You use the VLAN Table to make each of the interfaces a member of a particular VLAN ID, and specify whether frames sent from the Ethernet interface should be tagged or untagged for a particular VLAN. You can configure up to 10 different VLAN ID's.</p> <p>VLAN ID - The ID of the VLAN to be assigned to the radio's interfaces. Valid VLAN ID's range from 1 to 4096. Note that VLAN ID's 1956 and 1957 are reserved and cannot be used.</p> <p>ETHERNET MEMBER - Select this check box to make the Ethernet interface of the radio a member of the VLAN indicated by the row's VLAN ID.</p> <p>ETHERNET EGRESS ACTION - Specifies whether frames belonging to the row's VLAN ID are sent out the Ethernet port as TAGGED or UNTAGGED.</p> <p>SSID MEMBER - Select this check box to make the SSID (BSS) of the RLX2-IHx series a member of the VLAN indicated by the row's VLAN ID.</p> <p>LOCAL/APP MEMBER - Select this check box to make the radio's Local/App interface is a member of the VLAN indicated by the row's VLAN ID.</p>

5 Using the IH Browser to Manage your Radios

In This Chapter

- ❖ Viewing the Radios in the IH Browser 118
- ❖ Viewing the Radio Properties 126
- ❖ Setting the Radio IP Address in the IH Browser 128
- ❖ Assigning a Temporary IP Address 129
- ❖ Viewing Additional Data in the IH Browser 130
- ❖ Connecting to the Radio Configuration Utility 130
- ❖ Updating the Radio Firmware 132
- ❖ Pinging Devices on the Network 133
- ❖ Viewing Network Data in the IH Browser 135

The *RadioLinx Industrial Hotspot Browser* (IH Browser) finds RLX2-IHx series radios connected to the network. It displays the radio's status and basic settings.

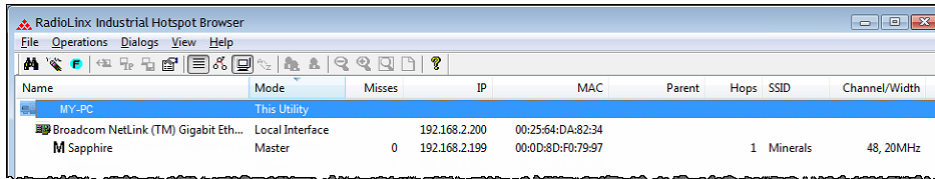


You can use the IH Browser to perform a number of tasks, including:

- View all the radios connected through the network to your PC in either a list (table) or topology view.
- Assign a temporary IP address to a radio.
- Update the firmware in the radio.
- View a list of client radios.
- View a list of all the access points detected on the network (including those from other vendors)
- View the radio's properties.
- Open the *Radio Configuration / Diagnostic Utility* in a web browser on your PC to configure or check diagnostics for your radio.
- Show the Event Log with a history of events that occurred on the radio.
- Send a ping command to a radio or other IP address.
- View a list of wired Ethernet nodes connected to the network.
- View a list of all the active interface ports on the radio.
- View the radio's Event Log.

5.1 Viewing the Radios in the IH Browser

Start the IH Browser: see Starting the IH Browser (page 24). If the radio is powered up and connected, it appears in the IH Browser. Note that the *MAC* address is the same address as that of the label on the radio. The *List* view (shown in the image below) displays the RLX2-IHx series radios (or previous generation RLXIB radios, except the RLCIB-IHN) on the same network as the computer running the IH Browser.





Note: You can perform many common tasks by right-clicking on the radio and choosing a command.

5.1.1 Refreshing the Display in the IH Browser

To refresh the display

If you have made changes to a radio's configuration, refresh the IH Browser by clearing and scanning the display using the buttons on the toolbar.

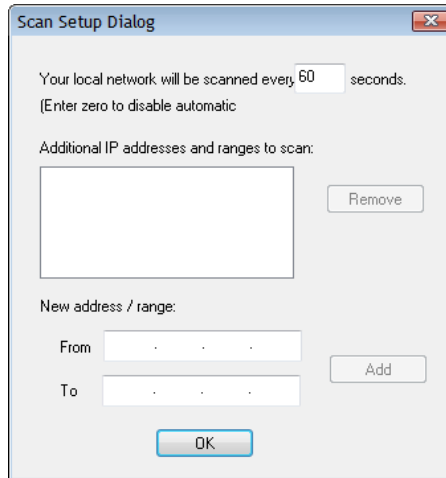
-  The *Erase* button clears the radios from display (or from the **FILE** menu choose **CLEAR**).
-  The *Scan* button rescans the network for RLX2-IHx series radios (or from the **FILE** menu choose **SCAN**).

5.1.2 Defining the Scan Parameters in the IH Browser

You use the Scan Setup dialog box to specify how the IH Browser refreshes the display when scanning the network. By default, the program sends a broadcast Scan message to all the radios at the same time, then waits for them to respond. 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, enter the IP address of a single radio or the range of IP addresses of multiple radios. This adds them to the IP addresses the IH Browser scans.

To define the scan parameters, from the **FILE** menu, choose **SCAN SETUP**.




Parameter	Description
Local network scanning interval	Specifies how often the IH Browser scans the network before updating the display. Enter zero to disable automatic scanning. You can still scan the network manually. See Refreshing the Display in the IH Browser (page 42).
Additional IP addresses	Displays the IP addresses the IH Browser scans at the scanning interval.
Remove	Removes the selected IP address or range. Click on an IP address or address range to select it.
New Address / Range	Enter the new IP address (in FROM) or range of IP addresses (in FROM and To) and then click ADD .

5.1.3 Freezing the Display in the IH Browser

Freezing the display in the IH Browser prevents it from updating with new data.

To freeze the display

-  The *Freeze* button on the IH Browser toolbar prevents the display from updating (or from the **FILE** menu choose **FREEZE**).
- Click the *Freeze* button again to start updating the display.

5.1.4 Changing IH Browser Columns in List View

You can change the columns that appear in the IH Browser main window in List View.

To change the columns in the IH Browser window

- 1 From the **VIEW** menu, click **SELECT COLUMNS**.
- 2 In the *Select Columns* dialog box, click the check boxes for the columns you want to appear in the window.

To reset the columns in the IH Browser window to the default



From the **VIEW** menu, click **RESET COLUMNS**.

5.1.5 Switching between List and Topology Views

You can switch between the List and Topology Views in the IH Browser main window.

- The *List View* is the default view, and shows a list of all the connected radios in a grid, similar to a spreadsheet.
- 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. The Topology View is display-only. If you want to change the way a radio is linked to the network, see *Configuring Parent Link Settings* (page 94).



To switch between the List and Topology views


-  The *List View* button switches to the List View (or from the **VIEW** menu choose **LIST VIEW**). For a description of the available columns, see *List View Columns* (page 121).
-  The *Topology View* button switches to the Topology View (or from the **VIEW** menu choose **TOPOLOGY VIEW**). For a description of the *Topology View*, see *Topology View Description* (page 124).

To change the columns in the List View


- To resize a column, click between column headers and drag to the left or right.
- To re-order the columns, click a column header and drag it to the left or right.
- To sort the radios, click a column header to change the sort order
- To change the displayed columns, from the **VIEW** menu choose **SELECT COLUMNS**.

To zoom in and out in the Topology View

-  The *Zoom In* button magnifies the *Topology View* (or from the **VIEW** menu choose **ZOOM IN**).
-  The *Zoom Out* button shrinks the *Topology View* (or from the **VIEW** menu choose **ZOOM OUT**).

-  The *Zoom to Fit* button resizes the *Topology View* to fit the window (or from the **VIEW** menu choose **ZOOM TO FIT**).

To sort radios alphabetically in the Topology View

-  The *Sort Alphabetically* button sorts the radios in the by name *Topology View* (or from the **VIEW** menu choose **SORT ALPHABETICALLY**).



To change a radio's configuration in either view

Double-click a radio to start the *Radio Configuration / Diagnostic Utility* for the radio. See *Connecting to the Radio Configuration Utility* (page 44).

List View Columns

This topic describes the available columns in the *List View*. See *Switching between List and Topology Views* (page 120) for more information on the *List View* columns.

Note: You can display most of the same information for the radio in the Detailed Information dialog box the IH Browser. See *Viewing the Radio Properties* (page 126).

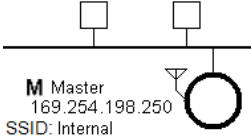
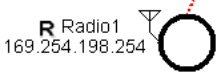


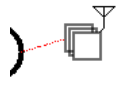


Column Name	Description
Name	<p>Displays the devices in the IH Browser. Names appear in a nested tree order. The icons on some entries help identify the type of device.</p> <p> Computer</p> <p> Wired Network Interface</p> <p>M Master Radio</p> <p>R Repeater Radio</p> <p>C Client Radio</p> <p>Bc Bridging Client Radio</p>
Mode	<p>Displays a text description of the devices in the IH Browser.</p> <p>THIS UTILITY - This instance of the IH Browser.</p> <p>UTILITY - Other instances of IH Browsers running on other systems on the same network.</p> <p>LOCAL INTERFACE - A network interface detected on the computer running this instance of the IH Browser.</p> <p>MASTER - A radio on the network in Master mode.</p> <p>ETHERNET CLIENT - A radio on the network in Client mode</p> <p>BRIDGING CLIENT - A radio on the network in Bridging Client mode.</p> <p>REPEATER - A radio in the network in Repeater mode.</p>
MAC	<p>Displays the physical Media Access Control (MAC) address of the devices. All ProSoft Technology devices have a MAC address in the form 00:0D:8D:XX:YY:ZZ.</p>

IP	Displays the IP addresses assigned to the devices.
Mask	Displays the network mask for the device.
Gateway	Displays the IP address of the network gateway for the device.
SSID	Displays the Service Set Identifier (SSID). This is a name assigned to a wireless network device. Repeater and Client radios must be configured with the same SSID to connect. Note that Master radios typically broadcast their SSID. However, you can disable SSID broadcasting so that other wireless devices cannot detect the Master radio, If a Master is not broadcasting its SSID, this field includes the word HIDDEN along with the SSID of the radio; for example <i>ProSoft/hidden</i> .
Connection	Displays the connection state for a Repeater radio. SCANNING - The radio is searching for a Master radio. CONNECTED - The radio is linked to a Master radio.
Signal (dBm)	Displays the signal strength, in dBm of a Repeater or Client radio's link to a Master device. Master devices do not report signal strength.
Hops	Displays the number of wireless connections from the device to the wired connection of a Master. This value is always 1 for a Master radio. For Repeater radios, the value is at least 2, but can be higher if there are more hops to the Master radio. Client radio do not display a hop value.
Parent	Displays the MAC address of the Parent radio to which this Repeater or Client radio is linked. This is blank for Master devices.
Associations	Displays the number of non-bridge wireless connections to this radio. Client or Bridging Client radios that are connected always show 1 in this column (and 0 in the Bridges column).
Bridges	Displays the number of non-bridge wireless connections to this radio. Client or Bridging Client radios that are connected always show 1 in this column (and 0 in the Bridges column).
Tx (kbits/sec)	Displays a moving average of transmit throughput in kilobits/second. It does not count packet overhead, and only counts payload data. For Repeater radios, this shows the throughput only for the radio link to the Parent radio. For Master radios, this is the throughput sum of all the Master's radio links.
Rx (kbits/sec)	Displays a moving average of receive throughput in kilobits/second. It does not count packet overhead, and only counts payload data. For Repeater radios, this shows the throughput only for the radio link to the Parent radio. For Master radios, this is the throughput sum of all the Master's radio links.
FW Ver	Displays the firmware version number. <ul style="list-style-type: none"> ▪ For IH Browser entries, this is the version of the IH Browser itself. ▪ 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	Displays the boot loader code version number. <ul style="list-style-type: none"> ▪ For IH Browser entries, 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 boot loader code in the radio.
Image	Displays the type of the firmware image that the radio is currently running (PRIMARY or SECONDARY). Each radio has two copies of operating firmware installed, and the radio will automatically switch from one to the other if one of them becomes corrupted.

Compression	Displays the compression state of the firmware images in the radio (COMPRESSED or UNCOMPRESSED).
Ethernet	Displays the Ethernet status for the radio. ATTACHED - The radio is connected to a wired Ethernet network. DETACHED - The radio is not connected to a wired Ethernet network.
Channel/Width	Displays the operating channel and channel width. The width value is always 20MHz except on 802.11n devices where it can be 20MHz or 40MHz. Example: 48, 20 MHz for channel 48 with a 20 MHz channel width.
Security	Displays the encryption type setting for the radio. Some valid settings are AES, TKIP, AES&TKIP, WEP128 TKIP, WEP128, WEP64 .
Misses	Displays the number of times the IH Browser has failed to receive a response from the device after a scan. Ideally this number should always be zero.
RSTP	Displays the setting for RSTP in the radio (ENABLED, DISABLED, and STP). The STP state is a legacy "non-rapid" Spanning Tree mode that the radio automatically uses if it detects a peer wired bridge in STP mode. All radios on a network must have the same RSTP state to link properly.
Link Time	Displays the link time of the device; for example 24d,13h,10m,32s. This time resets to zero on a Roam, or if the link is dropped and re-established with the same Parent radio.
TX Rate	Displays the current modulation data rate that the radio is using for transmission. This may be slower than the configured nominal rate because of retries or other environmental factors. <ul style="list-style-type: none"> ▪ For 802.11a/b/g devices, the data rate is expressed in kilobits or megabits per second (for example, 54Mb/s). ▪ For 802.11n devices, the data is expressed in MCS rates from 0 to 15 (for example, MCS7).
Temperature	Displays the internal temperature of the radio as measured on the circuit board in degrees Celsius. Note that internal measured temperature always exceeds the ambient external temperature.
Retries(%)	Displays the ratio of packet re-transmission to total packet transmissions during the last five-second interval for the radio.
Uptime	Displays the amount of time the radio has been running since the last power cycle or reset; for example, 1d,4h,13m,25s.
Product	Displays the model number of the RLX2 radio; for example RLX2-IHA, RLX2-IHG, RLX2-IHFN, RLX2-IHFN-W, or RLX2-IHW .
Image Ver	Displays the name of the image file loaded into the radio; for example, RLX2_v0036_R . It matches the Firmware label displayed for the radio in the <i>Radio Configuration / Diagnostic Utility</i> .


Topology View Description

This topic describes the *Topology View*. See *Switching between List and Topology Views* (page 120) for more information on the *Topology View*.

	<p>Indicates the Master radio; always shown at the top,</p>
	<p>Indicates a radio linked to the network</p>
	<p>Indicates a radio not linked to a Parent radio, but on the same network as the computer hosting the IH Browser.</p>
	<p>Indicates that an Ethernet connection exists to the radio, but does not indicate the number of devices on the connection</p>
	<p>Indicates that wireless clients (such as laptops and tablet computers) are linked to this radio. The number of clients linked is indicated by the number of boxes and/or a number.</p>
	<p>Indicates signal strength between radios. The width of the line is not calibrated, but a wider line indicates a relatively stronger signal strength.</p>
	<p>Indicates links to alternate Parent radio candidates that could be chosen if the current Parent link drops or degrades.</p>

5.1.6 Printing the View in the IH Browser

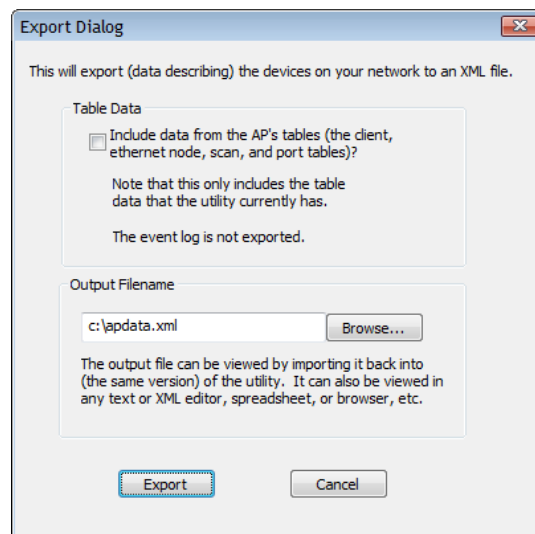
You can print the current view in the IH Browser.

- To print the current view, from the **FILE** menu choose **PRINT**.
- To define the page orientation, paper source, and size, from the **FILE** menu choose **PRINT SETUP**.
- To preview the printed view, from the **FILE** menu choose **PRINT PREVIEW**. This can help you adjust the view in the IH Browser so it does not break across pages when printed.
- In the *Topology View*, to display a border around the area to be printed, do one of the following:
 - From the **VIEW** menu, choose **PRINT AREA**.
 - On the IH Browser toolbar click the  **Show Page Outline** button.

5.1.7 Importing and Exporting IH Browser Data

You can export data from, and import data into, the IH Browser. Exporting data creates and saves an XML file containing the current configuration and status of all radios discovered by the IH Browser. You can use this command under the direction of ProSoft Technical Services, for troubleshooting purposes. Importing data brings in the data from a previously created IH Browser XML file.

- To export data from the IH Browser, from the **FILE** menu choose **EXPORT**. You can choose to include the data from the current *Wireless Client*, *Ethernet Nodes*, *Scan List*, and *Port Table* tables. See Viewing Additional Data in the IH Browser (page 130) for information about those tables.

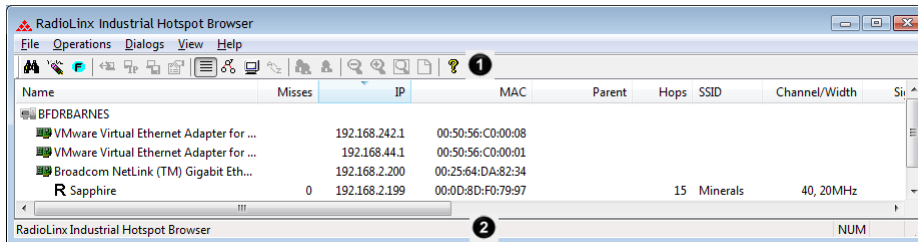


- To import data from an export file created in the IH Browser, from the **FILE** menu choose **IMPORT**.

5.1.8 Hiding the Toolbar and Status Bar in the IH Browser

You can hide and display the Toolbar and Status bar in the IH Browser window.

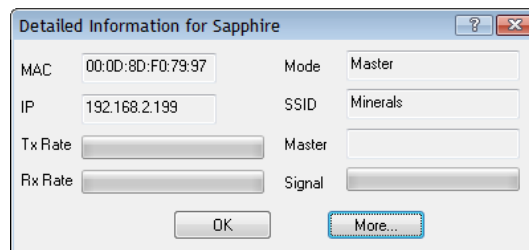
- To hide and show the Toolbar (1 in the image below), from the **VIEW** menu choose **TOOLBAR**.
- To hide and show the Status Bar (2 in the image below), from the **VIEW** menu choose **STATUS BAR**.



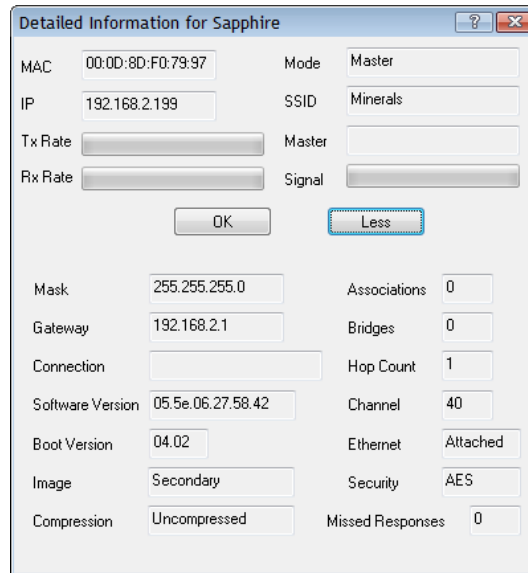
5.2 Viewing the Radio Properties

The *Detailed Information* dialog box shows information about the currently selected radio.

- 1 In the IH Browser, select (click) a radio in either the *List View* or *Topology View*.
- 2 From the **DIALOGS** menu choose **PROPERTIES**, or right-click the radio and choose **PROPERTIES**.



3 Click **MORE** to display more information.



Note: You can display most of the same information in the *List View* in the IH Browser. See List View Columns (page 121).

Parameter	Description
MAC	Displays the MAC address of the selected radio.
IP	Displays the IP address of the selected radio.
Mode	Displays the mode of the selected radio (MASTER, REPEATER, CLIENT, BRIDGING CLIENT)
SSID	Displays the SSID of the selected radio.
TX Rate	Displays a green bar when there is transmit activity.
RX Rate	Displays a green bar when there is receive activity.
Master	Displays the MAC address of the radio's current Master radio.
Signal	Displays a green bar when there is a signal.
More / Less	Click MORE to expand the dialog box and display more information. Click LESS to reduce the dialog box and display less information.
Mask	Displays the network mask for the current radio.
Gateway	Displays the network gateway IP for the current radio.
Connection	Displays the connection state for a Repeater radio. SCANNING - The radio is searching for a Master radio. CONNECTED - The radio is linked to a Master radio.
Software Version	Displays 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 described below).

Parameter	Description
Boot Version	Displays the boot loader code version number. This is the version of the boot loader code in the radio.
Image	Displays the type of the firmware image that the radio is currently running (PRIMARY or SECONDARY). Each radio has two copies of operating firmware installed, and the radio will automatically switch from one to the other if one of them becomes corrupted.
Compression	Displays the compression state of the firmware images in the radio (COMPRESSED or UNCOMPRESSED).
Associations	Displays the number of non-bridge wireless connections to this radio. Client or Bridging Client radios that are connected always show 1 in this column (and 0 in the Bridges column).
Bridges	Displays the number of non-bridge wireless connections to this radio. Client or Bridging Client radios that are connected always show 1 in this column (and 0 in the Bridges column).
Hop Count	Displays the number of wireless connections from the device to the wired connection of a Master. This value is always 1 for a Master radio. For Repeater radios, the value is at least 2, but can be higher if there are more hops to the Master radio. Client radio do not display a hop value.
Channel	Displays the operating channel for radio.
Ethernet	Displays the Ethernet status for the radio. ATTACHED - The radio is connected to a wired Ethernet network. DETACHED - The radio is not connected to a wired Ethernet network.
Security	Displays the encryption type setting for the radio. Some valid settings are AES , TKIP , AES&TKIP , WEP128 TKIP , WEP128 , WEP64 .
Missed Responses	Displays the number of times the IH Browser has failed to receive a response from the device after a scan. Ideally this number should always be zero.

5.3 Setting the Radio IP Address in the IH Browser

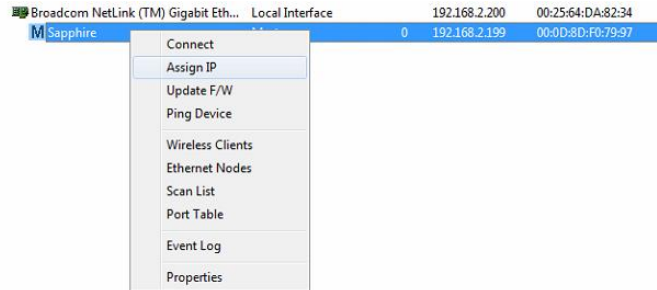
To set the radio IP address

- If the radio is on a network with a DHCP server, it gets an IP address through DHCP.
- If the radio is not on a network with a DHCP server, the radio appears with an IP address of 0.0.0.0. You can assign a temporary IP address to assist with configuring the radio. See Assigning a Temporary IP Address (page 42).

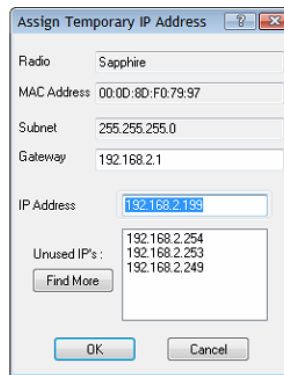
5.4 Assigning a Temporary IP Address

A temporary IP address allows you to access and configure a radio using the IH Browser and the *Radio Configuration / Diagnostic Utility*.

- 1 In the IH Browser, right-click the radio and then click **ASSIGN IP**.

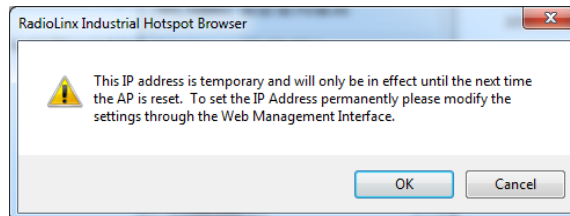


This opens the *Assign Temporary IP Address* dialog box.



The **UNUSED IP'S** list are the IP addresses that are currently available on the network.

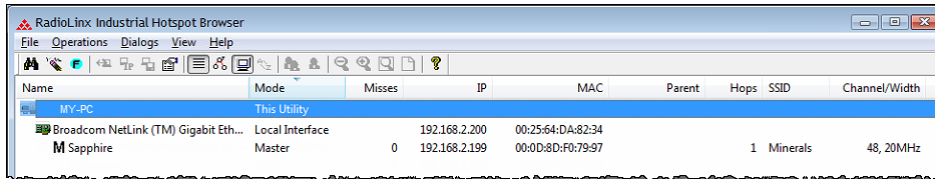
- 2 The IH Browser suggests the network parameters for the temporary IP address. It queries the IP addresses, and displays them if it does not receive a response. Click one of the unused IP's, or enter an unused IP address, and click **OK**. The IH Browser warns you that the IP address is temporary.



- 3 Click **OK** and refresh the display in the IH Browser. Your radio should now appear in the IH Browser window with the temporary IP address.
- 4 To set a permanent IP address for the radio, see *Configuring a Radio - Getting Started* (page 44).

5.5 Viewing Additional Data in the IH Browser

Start the IH Browser (see Starting the IH Browser (page 24)). If the radio is powered up and connected, it appears in the IH Browser. Note that the *MAC* address is the same address as that of the label on the radio. The *List* view (shown in the image below) displays the RLX2-IHx series radios (or previous generation RLXIB radios, except the RLCIB-IHN) on the same network as the computer running the IH Browser.



Note: You can perform many common tasks by right-clicking on the radio and choosing a command.

5.6 Connecting to the Radio Configuration Utility

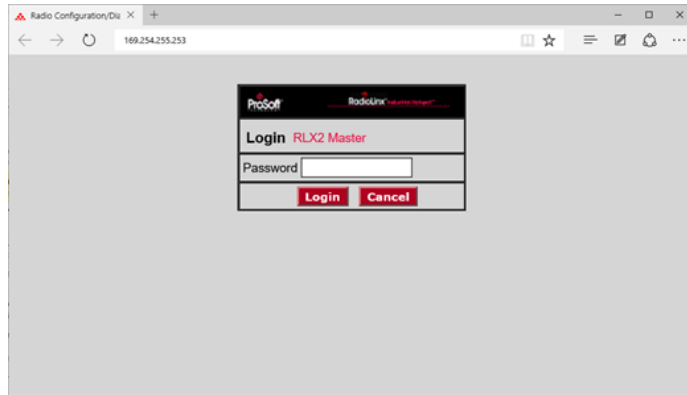
This section describes how to connect to the *Radio Configuration / Diagnostic Utility* using a web browser such as Internet Explorer or Firefox on your PC or other network-enabled device.

To connect to the Radio Configuration / Diagnostic Utility

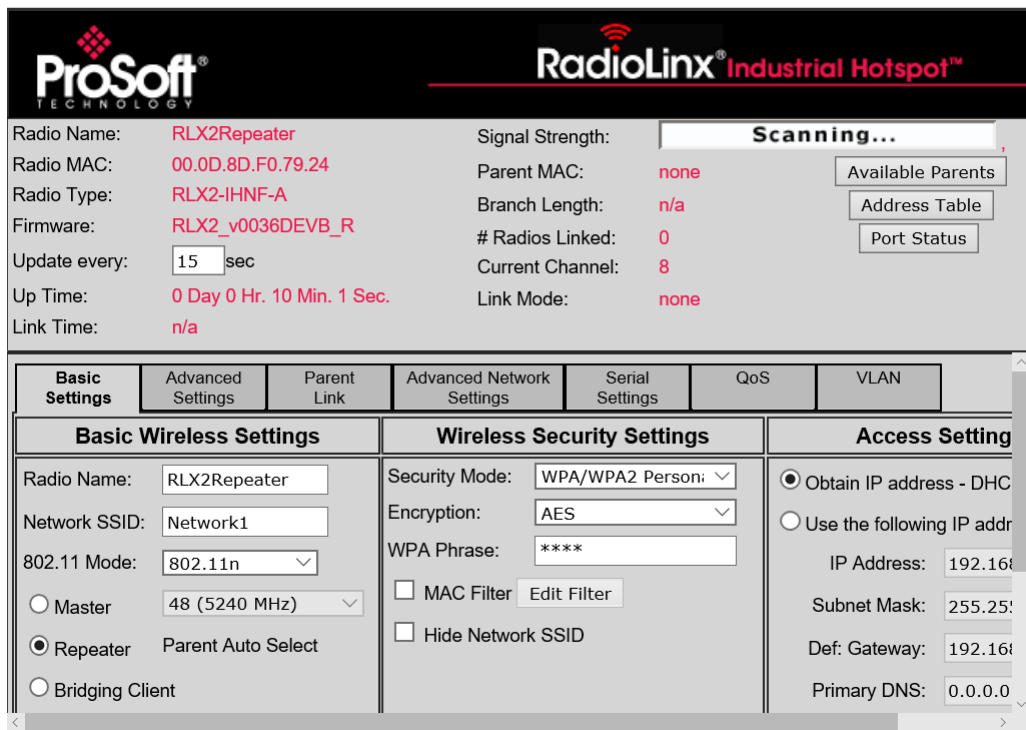
Important: Your computer or other device must be connected to the same network as the RLX2-IHx series radio.

- 1 Open the *Radio Configuration / Diagnostic Utility* for the radio. You can do this in any of three ways:
 - In the IH Browser List view or Topography view, right-click the radio and then click **CONNECT**.
 - In the IH Browser List view or Topography view, double-click the radio.
 - Open a web browser on your PC, and then in the address bar, type `http://`, followed by the IP address for the radio, and then press **ENTER**. For example, `http://192.168.6.10`.

The login screen appears in the web browser.



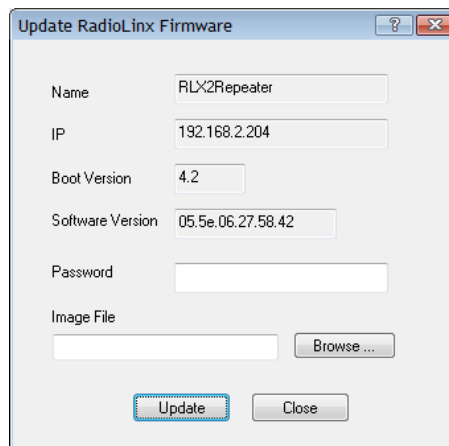
- 2 Enter the password and then click **LOGIN**. The default password is *password*. If you have lost the password for the radio, you can reset the radio to its default settings. See *Resetting a RLX2-IHx series Radio* (page 148). This opens the *Radio Configuration / Diagnostic Utility* for the radio. Note that some parameters may be different from the image depending on your specific radio model.



Tip: You can display the help topic for any parameter in the *Radio Configuration / Diagnostic Utility* by clicking the parameter name. The parameter name turns blue when you move the cursor over a parameter with a help topic. There is also a short description of the censored control at the bottom of the window.

5.7 Updating the Radio Firmware

From time to time, ProSoft Technology may release new firmware for the RLX2-IHx series radio that may include new features and corrected anomalies. We recommend that all RLX2-IHx series radios in a network use the same firmware version. If your network has a mix of RLX2-IHx series models, you can load the same firmware image file into each of them.



To update the firmware in the radio


- 1 Download the radio firmware image from the Prosoft Technology web site at www.prosoft-technology.com and save it to a known location (such as the Windows Desktop).
- 2 Start the IH Browser and click on an RLX2-IHx series radio to select it.
- 3 From the **OPERATIONS** menu choose **UPDATE FIRMWARE**. You can also right-click the radio and choose **UPDATE F/W**.
- 4 Enter the password for the radio. This is the same password that you use to log into the radio when you start the *Radio Configuration / Diagnostic Utility*. See Connecting to the Radio Configuration Utility (page 44).
- 5 Click **BROWSE** to locate the firmware image file to load.
- 6 Click **UPDATE** to begin copying the new firmware to the radio.

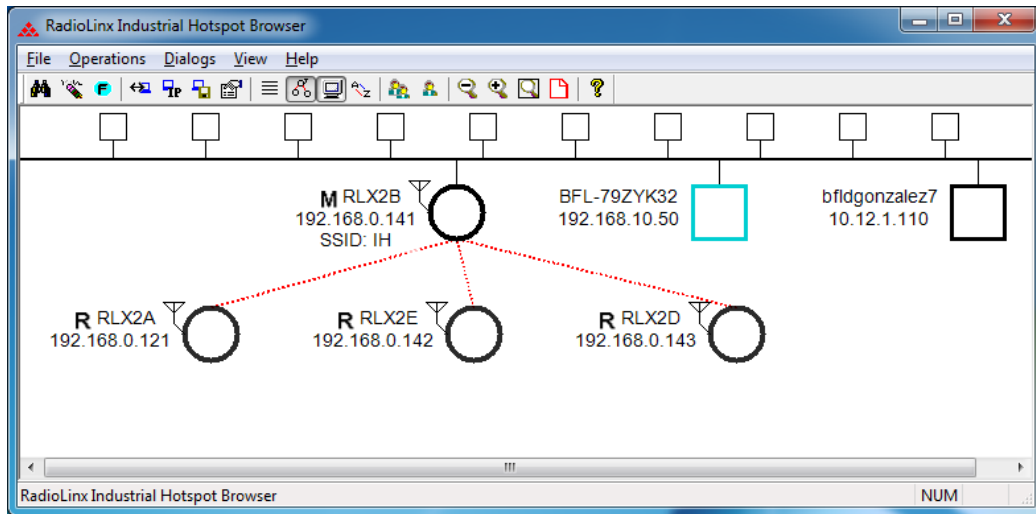
Important: Do not turn off power to the radio during this operation.

5.8 Pinging Devices on the Network

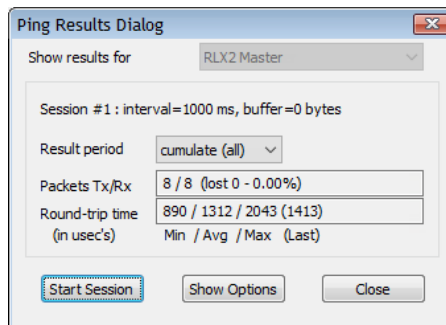
You can use the Ping command to test the latency of the network link between the PC running the IH Browser and any other PC that is also running the IH Browser (called *Ping Stations*).

Note: Currently there is no location information when a ping station responds to an IH Browser scan, therefore, all Ping stations are shown connected to the top main network. It is also possible to select an RLX2-IHx series and start a Ping Session with it.

- 1 Start the IH Browser on your computer.
- 2 To start the ping session, do one of the following:
 - From the **VIEW** menu choose **SHOW PING STATIONS**.
 -  Click the *Show Browsers* button on the toolbar.



- 3 Click (highlight) one of the other computers visible in the IH Browser.
- 4 From the **OPERATIONS** menu choose **PING DEVICE** to open the *Ping Results Dialog* box.



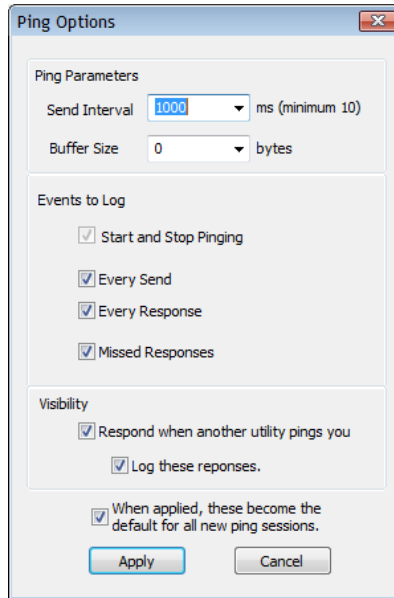
This dialog box displays statistics on the minimum, maximum and average latency between two points on the network.

- 5 Click **SHOW OPTIONS** to change the Ping parameters. See Ping Options Dialog Box (page 134).

Note: If there is no PC with an IH Browser behind a remote RLX2-IHx series radio, you can select and ping the radio itself to test its wireless link.

5.8.1 Setting the Ping Parameters

Use the *Ping Options* dialog box to choose Ping parameters, logging options, and response to other stations. For more information, see Pinging Devices on the Network (page 133).



Parameter	Description
Send Interval	Specifies the time between ping signals in milliseconds. The minimum interval is 10 ms.
Buffer Size	Specifies the buffer size in bytes (the number of bytes sent on the ping).
Start and Stop Pinging	Select this check box to log the beginning and ending of the ping session.
Every Send	Select this check box to log every ping signal sent.
Every Receive	Select this check box to log every ping response received.
Missed Responses	Select this check box to log every missed ping response (when a device does not respond to a ping signal).

Respond when another utility pings you	Select this check box to reply to a ping request from another device.
Log these responses	Select this check box to log each ping response sent to another device.
When applied, these become the default for all new ping sessions	Select this check box to use these settings for all future ping sessions with any device.

5.9 Viewing Network Data in the IH Browser

The IH Browser **DIALOGS** displays four dialog boxes that allow you to monitor the network connections for the selected radio in either the List View or Topology View. The four dialog boxes show:

- The Wireless clients attached to the radio.
- The Information about devices detected via the Ethernet interface of the radio.
- The 802.11 Access Points that are detected by this particular radio.
- The active ports on the radio.

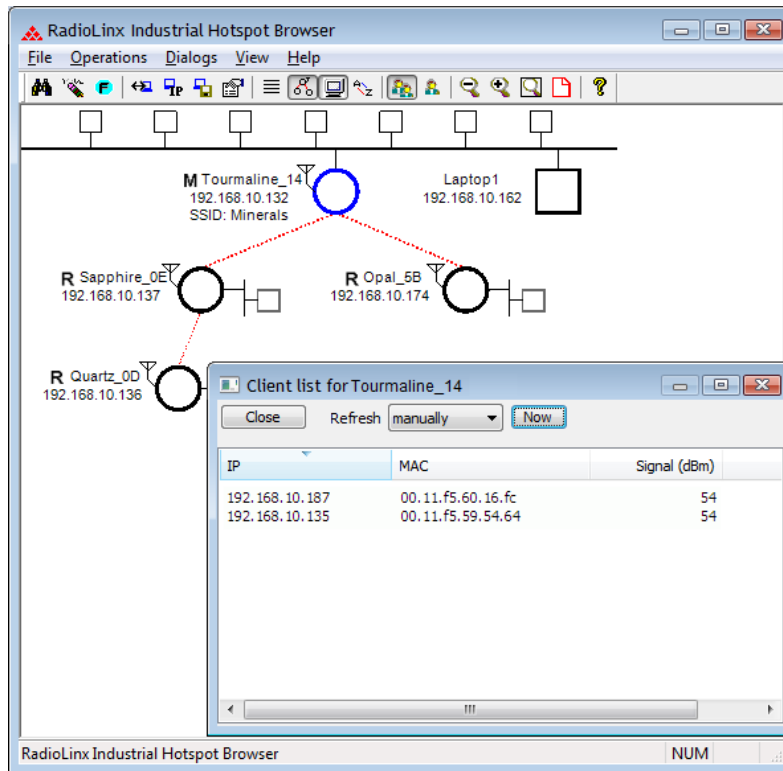
You can display two or more of the dialog boxes at the same time.

- You can display all four dialog boxes with one command: from the **DIALOGS** menu choose **All 4 DIALOGS**.
- You can also close all the open dialogs boxes: from the **DIALOGS** menu choose **CLOSE ALL**.

5.9.1 Viewing Wireless Clients in the IH Browser

The *Client List* dialog box shows information about wireless clients connected to the currently selected radio.

- 1 In the IH Browser, select (click) a radio in either the *List View* or *Topology View*.
- 2 From the **DIALOGS** menu choose **WIRELESS CLIENTS**, or right-click the radio and choose **WIRELESS CLIENTS**.

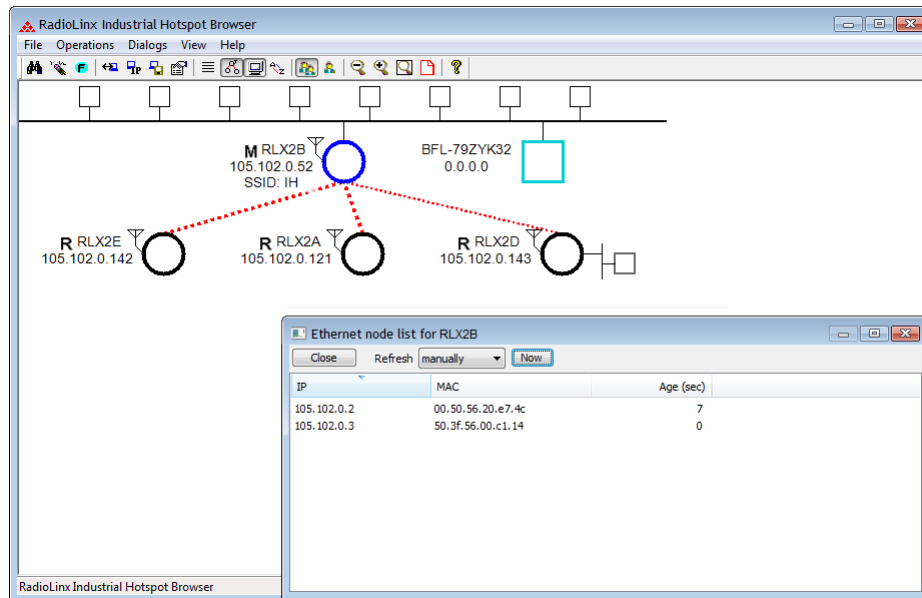


Parameter	Description
Refresh	Specifies the data refresh interval in seconds or minutes. Select MANUALLY to prevent the IH Browser from automatically updating the data.
Now	Click Now to manually update the data.
IP	Displays the IP addresses of the wireless clients connected to the selected radio.
MAC	Displays the MAC addresses of the wireless clients connected to the selected radio.
Signal (dBm)	Displays the strength of the signal from the wireless clients connected to the selected radio.
Age (sec)	Displays the age of the connection to the wireless clients connected to the selected radio (the amount of time since a packet has been received from that device).

5.9.2 Viewing Ethernet Nodes in the IH Browser

The *Ethernet Node List* dialog box shows information about devices detected by the Ethernet interface to the currently selected radio.

- 1 In the IH Browser, select (click) a radio in either the *List View* or *Topology View*.
- 2 From the **DIALOGS** menu choose **ETHERNET NODES**, or right-click the radio and choose **ETHERNET NODES**.



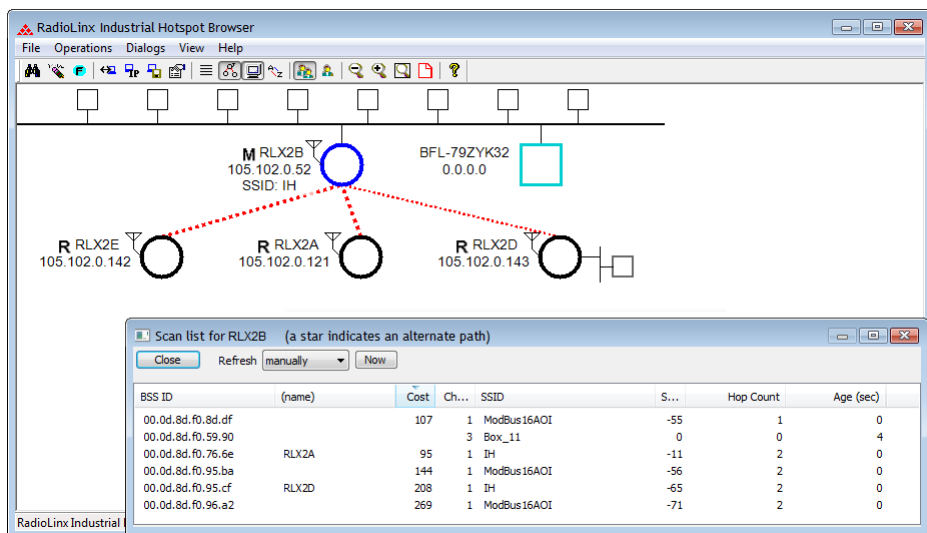
Parameter	Description
Refresh	Specifies the data refresh interval in seconds or minutes. Select MANUALLY to prevent the IH Browser from automatically updating the data.
Now	Click Now to manually update the data.
IP	Displays the IP addresses of the wireless clients connected to the selected radio.
MAC	Displays the MAC addresses of the wireless clients connected to the selected radio.
Age (sec)	Displays the age of the connection to the wireless clients connected to the selected radio (the amount of time since a packet has been received from that device).

5.9.3 Viewing the Scan List in the IH Browser

The *Scan List* dialog box shows all 802.11 Access Points known to the selected radio on this channel (through beacons), even if the Access Point is not linked to the radio (has a different SSID or uses different encryption). See *Detecting 802.11 Access Points* (page 32).

Note: This list shows some of the same information available in the *Available Parents* table in the *Radio Configuration / Diagnostic Utility*. See *Viewing Available Parents for a Radio* (page 65).

- 1 In the IH Browser, select (click) a radio in either the *List View* or *Topology View*.
- 2 From the **DIALOGS** menu choose **SCAN LIST**, or right-click the radio and choose **SCAN LIST**.



List entries marked with an asterisk * indicate that the entry is an alternate path, which you can also see if you select the *Parents* button from the toolbar in the *Topology* view (blue lines link the radio to its alternate parents).

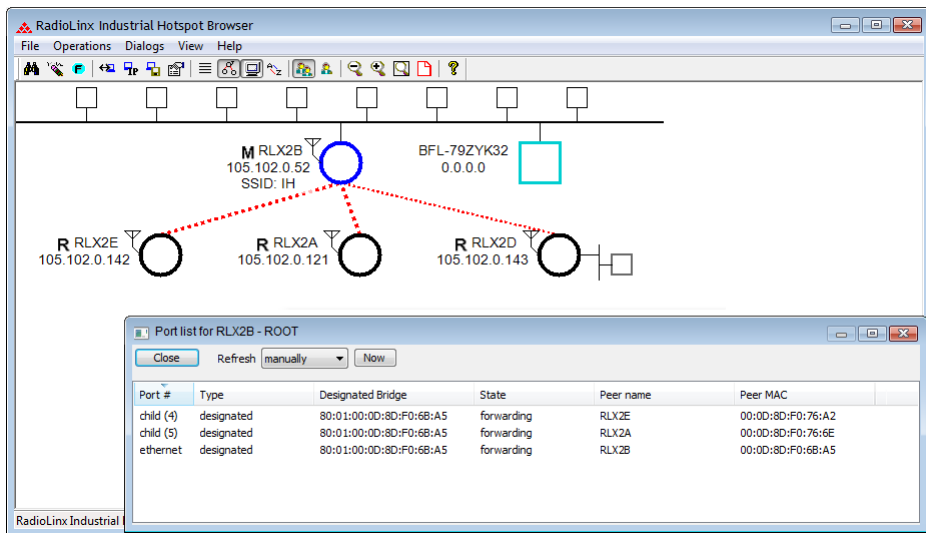
Parameter	Description
Refresh	Specifies the data refresh interval in seconds or minutes. Select MANUALLY to prevent the IH Browser from automatically updating the data.
Now	Click Now to manually update the data.
BSS ID	Displays the Basic Service Set Identifier. This is the MAC addresses of the wireless clients known to the selected radio.
(name)	The name for RLX2-IHx series radios.

Parameter	Description
Cost	Displays the calculated parent selection cost. The radio evaluates the link it has to its parent once per second to determine if this link is the best parent to use. The radio calculates the cost for each entry. The cost calculation is based not only on the strongest signal, but on several other factors to provide optimum network communication.
Channel	The radio channel on which the device is transmitting. The channel list indicates the channel number as well as the frequency (2.4 GHz or 5 GHz bands). Important: The RLX2-IHx series radio is supplied with a dual-band antenna that supports both frequency ranges. If you use a different antenna with the RLX2-IHx series radio, you must choose a channel and frequency range supported by the antenna. See Appendix G - Antenna Configuration (page 185).
SSID	Displays the network name (Service Set Identifier) of the Ethernet device to which the radio is connected. The radio name appears for RLX2-IHx series radios.
Signal (dBm)	Displays the strength of the signal from the wireless clients connected to the selected radio.
Hop Count	Displays the number of hops to the Master device. A value of 0 (zero) appears for non-ProSoft Technology devices.
Age (sec)	Displays the age of the connection to the wireless clients connected to the selected radio (the amount of time since a packet has been received from that device).

5.9.4 Viewing the Port Table in the IH Browser

The *Port List* dialog box shows all active ports on the selected radio.

- 1 In the IH Browser, select (click) a radio in either the *List View* or *Topology View*.
- 2 From the **DIALOGS** menu choose **PORT TABLE**, or right-click the radio and choose **PORT TABLE**.



The port table is a list of all the active ports on the radio. Each RLX2-IHx series radio has up to 34 active ports: one Ethernet wired port, one parent radio frequency link, and up to 32 child radio frequency links.

Parameter	Description
Refresh	Specifies the data refresh interval in seconds or minutes. Select MANUALLY to prevent the IH Browser from automatically updating the data.
Now	Click Now to manually update the data.
Port #	Displays the selected radio's port number.
Type	Displays the type of the port (ETHERNET PORT , PARENT RF LINK , CHILD RF LINK).
Designated Bridge	The next bridge toward the Spanning Tree root for this port.
State	Displays the current Spanning Tree state of the port (BLOCKING , LEARNING , LISTENING , and FORWARDING). Forwarding packets can be transferred.
Peer Name	Displays the name of the Master radio if the current radio is a Repeater radio.
Peer MAC	Displays the MAC address of the Master radio if the current radio is a Repeater radio.

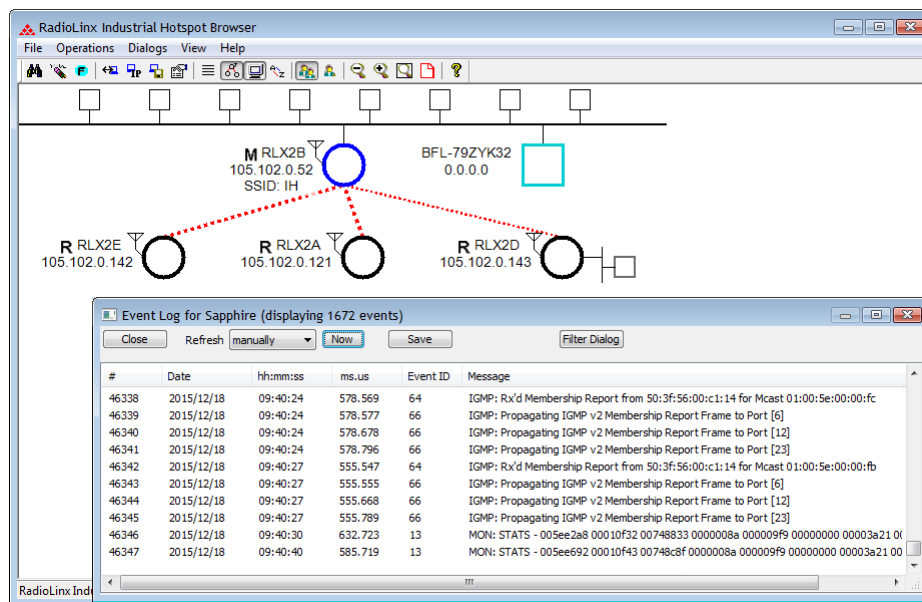
5.9.5 Viewing the Radio Event Log in the IH Browser

The *Event Log* dialog box displays the history of events that have been recorded by the currently selected radio. This can be useful for troubleshooting problems.

- 1 In the IH Browser, select (click) a radio in either the *List View* or *Topology View*.
- 2 From the **DIALOGS** menu choose **EVENT LOG**, or right-click the radio and choose **EVENT LOG**.

The Event Log shows the history of a particular radio. You can save the Event Log to a text file for troubleshooting purposes.

Note: The filter conditions that you set in the *Event Log Filter* dialog box affect both the display of events in the *Event Log* dialog box, and the events in the file you create when you click **SAVE**. See *Setting the Event Log Filter* (page 142).



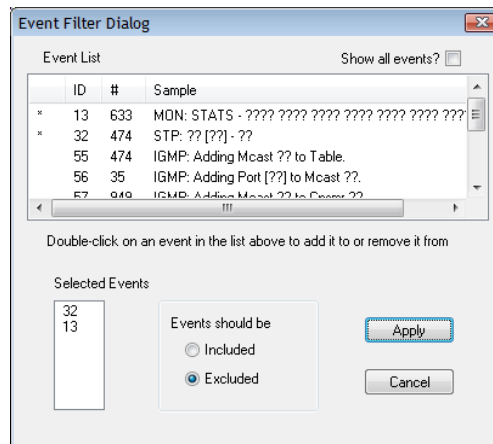
Parameter	Description
Refresh	Specifies the data refresh interval in seconds or minutes. Select MANUALLY to prevent the IH Browser from automatically updating the data.
Now	Click Now to manually update the data.
Save	Click SAVE to save the Event Log to a file for troubleshooting or sending to ProSoft Technology Technical Support.
Filter Dialog	Click FILTER DIALOG to change the Event Log filtering to show or hide certain events. See <i>Setting the Event Log Filter</i> (page 142).

Setting the Event Log Filter

The *Event Filter* dialog box allows you to include or exclude specific event types from the Event Log. The filter conditions that you set in this dialog box affect both the display of events in the *Event Log* dialog box, and the events in the file you create when you click **SAVE** in the *Event Log* dialog box.

Note: The filter conditions are reset to the default state (include all events) when you close the *Event Log* dialog box.


- 1 In the IH Browser, click on a radio in either the *List View* or *Topology View*.
- 2 From the **DIALOGS** menu choose **EVENT LOG**, or right-click the radio and choose **EVENT LOG**.
- 3 In the *Event Log* dialog box, click **FILTER**.
- 4 Double-click on an event in the **EVENT LIST** to add it to the **SELECTED EVENTS** list. An asterisk (*) appears next to the event types in the Selected Events list. You can double-click on the event in the **EVENT LIST** a second time to remove it from the **SELECTED EVENTS** list.
- 5 Use the **EVENTS SHOULD BE** parameters to include only the selected events, or exclude the selected events.

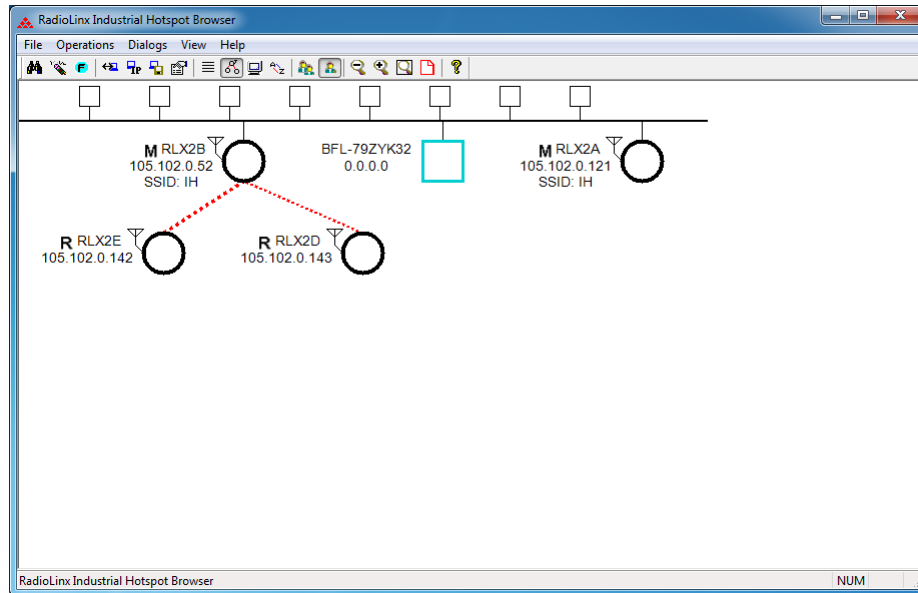



Parameter	Description
Event List	Displays a list of different types of events in the log, sorted by EVENT ID . By default, this list only includes events types that are in the radio's Event Log. <ul style="list-style-type: none"> ▪ Double-click an event type to add it to the Selected Events list. ▪ Double-click the event type again to remove it from the Selected Events list.
Show all events	Select this check box to show all event types, even if the type is not in the radio's Event Log.
Selected Events	Displays the list of selected event types.
Events should be	Specifies whether to include only the selected events, or exclude them. INCLUDED - Show only the selected events in the Event Log. EXCLUDED - Show all events in the Event Log except the selected events.

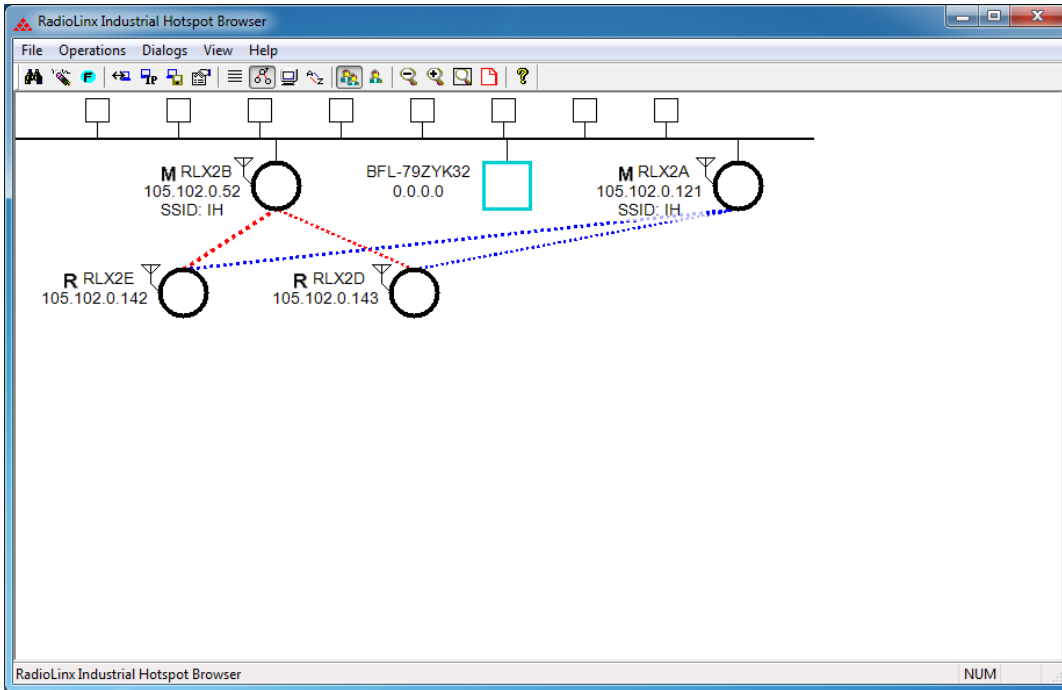
5.9.6 Viewing Parent Radios in the IH Browser

You can show the current Parent radio or all possible alternate Parent radios for the Repeater radios in the *Topology View*.

-  The *Show Selected Parents* button (or from the **VIEW** menu choose **SHOW PARENTS - ONE**) shows the link from Repeater radios to their current Parent radio in red.



-  The *Show All Parents* button (or from the **VIEW** menu choose **SHOW PARENTS - ALL**) shows links to alternate Parent radios in blue (If the Repeater radios can detect other radios in the network). This gives a graphical representation of the number of alternate paths available to a radio should its parent link go down.



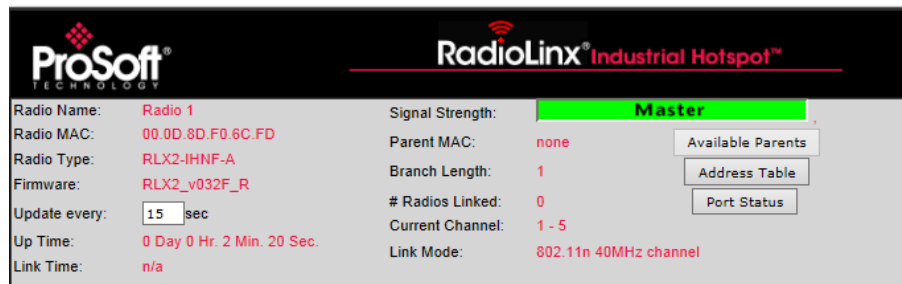
Note: You can also display a detailed list of each of the alternate Parent radios right-clicking a radio and choosing **SCAN LIST**. This list shows the RLX2-IHx series radios in the same network and all 802.11 Access Points on other networks. See *Viewing the Scan List in the IH Browser* (page 138).

6 Diagnostics and Troubleshooting

In This Chapter

- ❖ Checking the Ethernet Cable..... 146
- ❖ LED Display..... 146
- ❖ Resetting a RLX2-IHx series Radio..... 148
- ❖ Unable to scan for AP's error message 149
- ❖ Finding Missing Radios 150

Use the IH Browser's diagnostic and signal strength settings at the top of the *Radio Settings* window to make sure the network is working properly:



- **Signal Strength:** This shows the radio's signal strength.
 - *Master* appears if this is a Master radio.
 - *Scanning* appears if the radio is scanning to find another radio to connect to.
 - *Not Connected* appear If the radio is not connected to a network and not currently scanning.
- **Update every:** Specifies the interval (in seconds) between updates to the display. The default is 15 seconds.
- The other parameters on this display are Read-only, and describe the radio and its current state.

Tip: You can display the help topic for any parameter in the dialog box by clicking the parameter name. The parameter name turns blue when you move the cursor over a parameter with a help topic.

You can perform the following troubleshooting routines:

- Check the Ethernet cable
- Check the LEDs on the radio
- Retrieve the default password by resetting the radio
- View error messages in the IH Browser
- Find missing radios

6.1 Checking the Ethernet Cable

If the radio's Ethernet port is connected to a PC or network, and the Ethernet LED does not light on the radio, there may be a problem with the Ethernet cable. Verify that the cable is plugged into the radio at one end, and to an Ethernet hub, a PC, 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 the switch.

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

6.2 LED Display

The RLX2-IHx series radio front panel includes a set of LEDs that indicate the radio's status.

LED	Description
POWER	<ul style="list-style-type: none"> ● Booting up ● Fully operational <p>This two-color LED turns amber when power is first applied. After power is applied, this LED goes out completely for about four seconds while the internal hardware is initialized. After initialization the power LED turns green, indicating the radio is fully operational.</p>
RF TRANSMIT	● Transmitting data over the wireless interface
RF RECEIVE	● Receiving data over the wireless interface
SERIAL	● Receiving serial data
ETHERNET	<ul style="list-style-type: none"> ● Transmitting Ethernet data over the wireless interface <p>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 on the Ethernet connector indicates traffic over the wired link, while the ETHERNET LED indicates network data sent or received through the wireless link.</p> <p>For example, if the radio is pinged over the wired link, the DATA LED on the Ethernet connector blinks but the ETHERNET LED does not (because the ping packet was not transmitted over the air).</p>
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.

LED	Description
SIGNAL STRENGTH	<p>▶▶▶ Blinks if SD card inserted with new configuration. This is for all radio modes.</p> <p>Radios in Master mode:</p> <ul style="list-style-type: none"> ○ ● ○ No radios linked ○ ● ▶ One or more radios linked (right LED blinking). ▶▶▶ DFS Channel Availability Check in progress (all LEDs blinking Amber) <p>Radios in Repeater or Client mode:</p> <ul style="list-style-type: none"> ○ ○ ○ No Signal ● ○ ○ Radio linked, Poor Signal ● ● ○ Radio linked, Fair Signal ● ● ● Radio linked, Good Signal

The following LEDs should light when you connect the power and Ethernet cables to the radio.

- The POWER LED should turn green.
- The SPEED LED on the Ethernet connector should indicate a valid wired link. This LED is located at the top of the Ethernet RJ-45 connector and is marked SPEED
 - OFF = 10 MB
 - ON = 100 MB
 - BLINK = 1GB.
- The RF TRANSMIT and RF RECEIVE LEDs should start to blink occasionally.

For radios in Repeater or Client mode, all three SIGNAL STRENGTH LEDs blink just after the radio links to the Master radio but before fully authenticating the link. Normally this lasts only a few seconds. If the SIGNAL STRENGTH LEDs blink for longer than a few seconds, or do not stop blinking, it usually means the encryption keys are not correct. The Wireless Security Settings on a Repeater radio must match those on the Master radio. See *Configuring a Radio - Getting Started* (page 44).

6.3 Resetting a RLX2-IHx series Radio

If you lose the password to a radio, you cannot change the radio settings. You can reset the radio to restore the default password, but the radio loses all the configuration settings and returns to the default settings.

6.3.1 Resetting the RLX2-IHNF-W and RLX2-IHNF-WC

These steps resets the radio to its default settings, including the default password.

- 1 Remove power from the radio.
- 2 Press the *Reset* button. The Reset button is located on the front of the unit just under the ProSoft logo.

The Reset button is located under this logo. Press firmly to reset the radio to its default settings.



- 3 While holding down the button, apply power to the radio and continue to hold the button down for 30 seconds.
This resets the radio to its default settings. You can now log in to the *Radio Configuration / Diagnostic Utility* for the radio using the default password: **password**.

6.3.2 Resetting All Other Radios

These steps reset the radio to its default settings, including the default password.

- 1 Remove power from the radio.
- 2 Locate the **Reset** button hole.

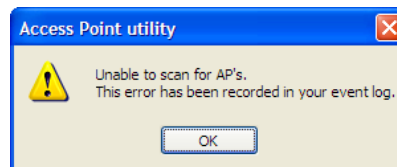


- 3 Insert the end of a paperclip or similar device into the hole to press the reset button.
- 4 While pressing the reset button in with a paperclip, apply power to the radio, and continue to hold down the reset button for 30 seconds.

This resets the radio to its default settings. You can now log in to the *Radio Configuration / Diagnostic Utility* for the radio using the default password: **password**.

6.4 Unable to scan for AP's error message

The *Unable to scan for AP's* error message may appear in the IH Browser when it attempts to scan for radios and no valid network connection exists on the PC (wired or wireless).



To correct this error

- 1 Confirm that the PC has at least one active network (LAN) connection. It could be a wired Ethernet connection or a wireless 802.11 connection.
- 2 Confirm that 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.

6.5 Finding Missing Radios

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

- 1 Refresh the IH Browser display. See Refreshing the Display in the IH Browser (page 42). The IH Browser sends scans as broadcast messages, which can be dropped in RF connections, requiring that you repeat the scan.
- 2 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.
- 3 If these steps do not help, verify that the PC running the IH Browser and the radios are connected to the same local network.
- 4 In the IH Browser, change to the *Topology view*. From the **VIEW** menu, click **TOPOLOGY VIEW**. Any unlinked radios may appear at the bottom of the window. Scroll down to see all the unlinked radios. If you still cannot see the radios in the IH Browser, call ProSoft Technology Technical Support. See Contacting Technical Support (page 211).

7 Appendix A - Adding a Radio to RSLogix 5000

In This Chapter

- ❖ Adding the Radio to RSLogix 5000 152
- ❖ Importing the Add-On Instruction..... 155
- ❖ RLX2 Controller Tags 159

You can use an *Add-On Instruction* (AOI) to add an RLX2-IHx series radio to RSLogix 5000™. You can then extract information from the radio and transfer it to the ControlLogix processor connected by EtherNet/IP™. This allows you to view and use the radio status and diagnostic information in the program on the controller.

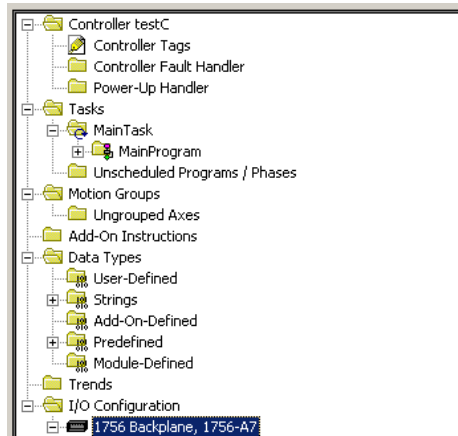
Note: You must download the RLX2-IHx series radio Add-On Instruction from the ProSoft Technology website. Go to www.prosoft-technology.com and search for your radio. From the RLX2-IHx series radio webpage, download the Add-On Instruction.

There are two procedures that you must complete in order to import and use the RLX2-IHx series Add-On Instruction in RSLogix 5000.

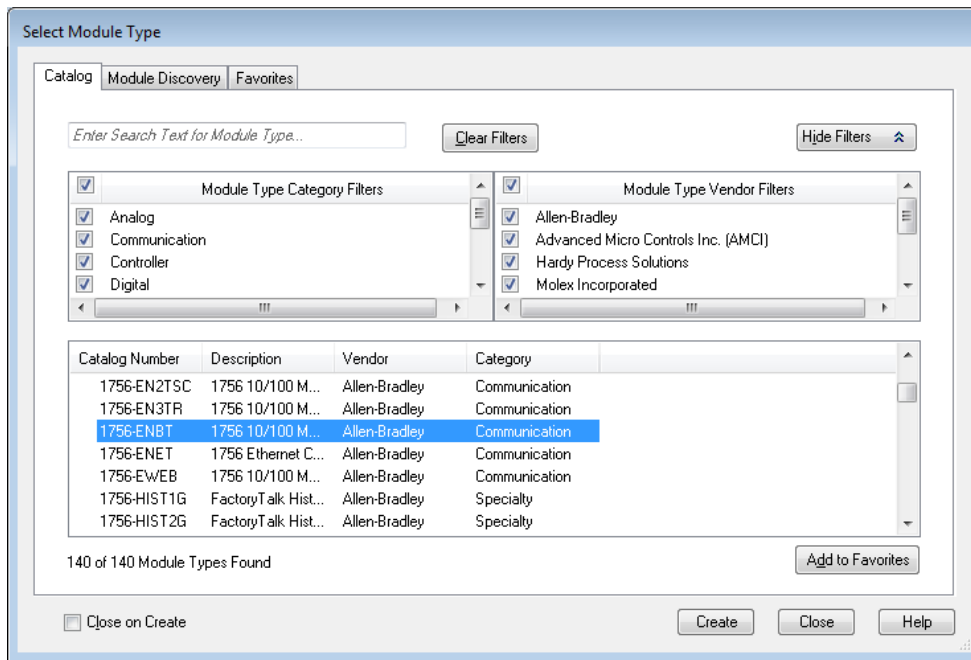
- 1 Add the RLX2-IHx series radio to a project in RSLogix 5000.
- 2 Import the AOI into the MainRoutine ladder logic in the same project.

7.1 Adding the Radio to RSLogix 5000

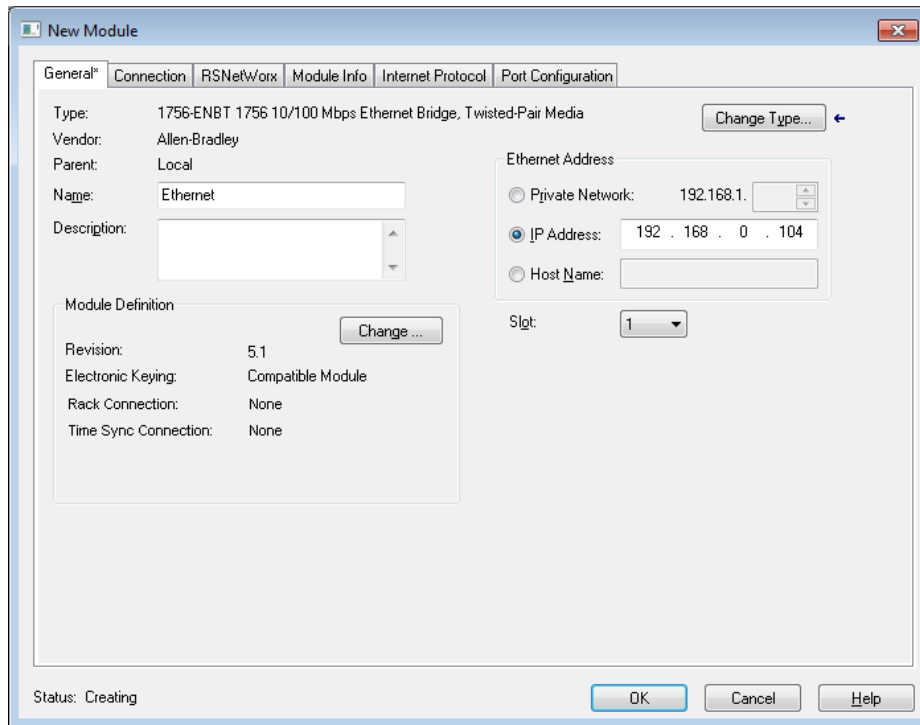
- 1 In RSLogix 5000, open an existing project, or create a new project
- 2 In the *Controller Organizer*, right-click **1756 BACKPLANE, 1756-A7** and then click **NEW MODULE**.



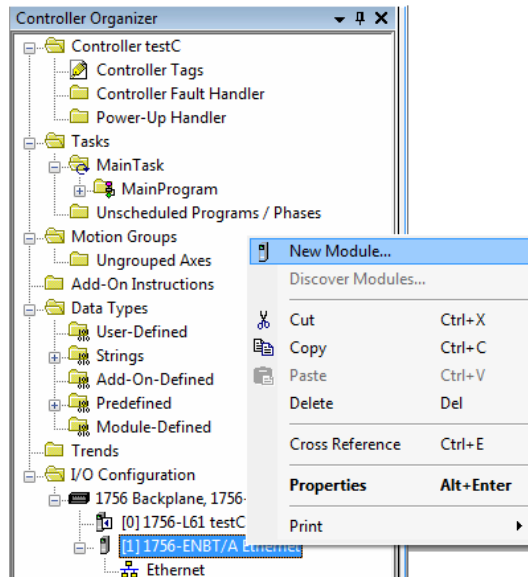
- 3 In the *Select Module Type* dialog box, select the correct Ethernet card (ENBT in this example) and click **OK**.



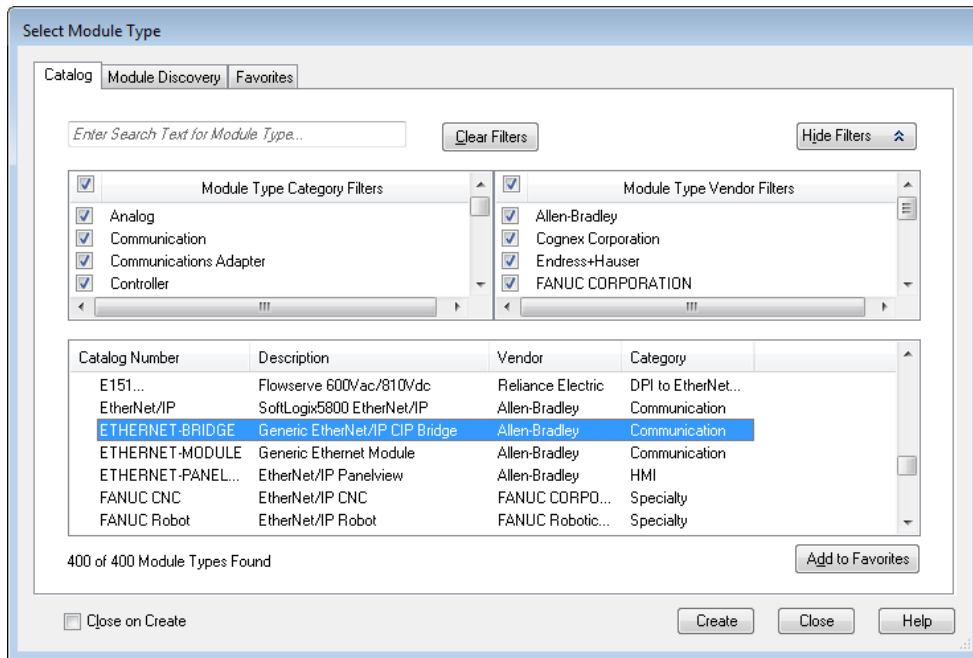
- 4 Enter a name for the card (*Ethernet* in this example) and the **IP ADDRESS** and then click **OK**.



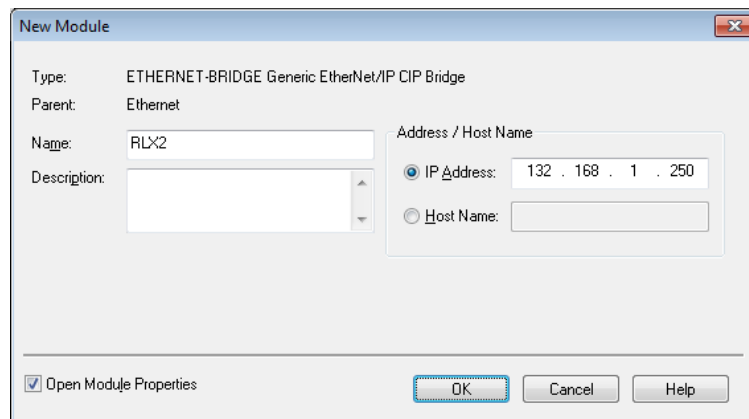
- 5 In the Controller Organizer, right-click the new **ETHERNET** module and then click **NEW MODULE**.



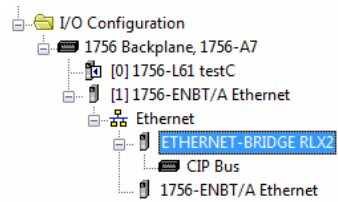
- 6 In the *Select Module Type* dialog box, click **ETHERNET-BRIDGE GENERIC ETHERNET/IP CIP BRIDGE** and then click **OK**.



- 7 In the *New Module* dialog, enter the **NAME** (*RLX2* in this example).
- 8 Select the **IP ADDRESS** radio button and type in the IP address of the RLX2-IHx series radio, and then click **OK**.

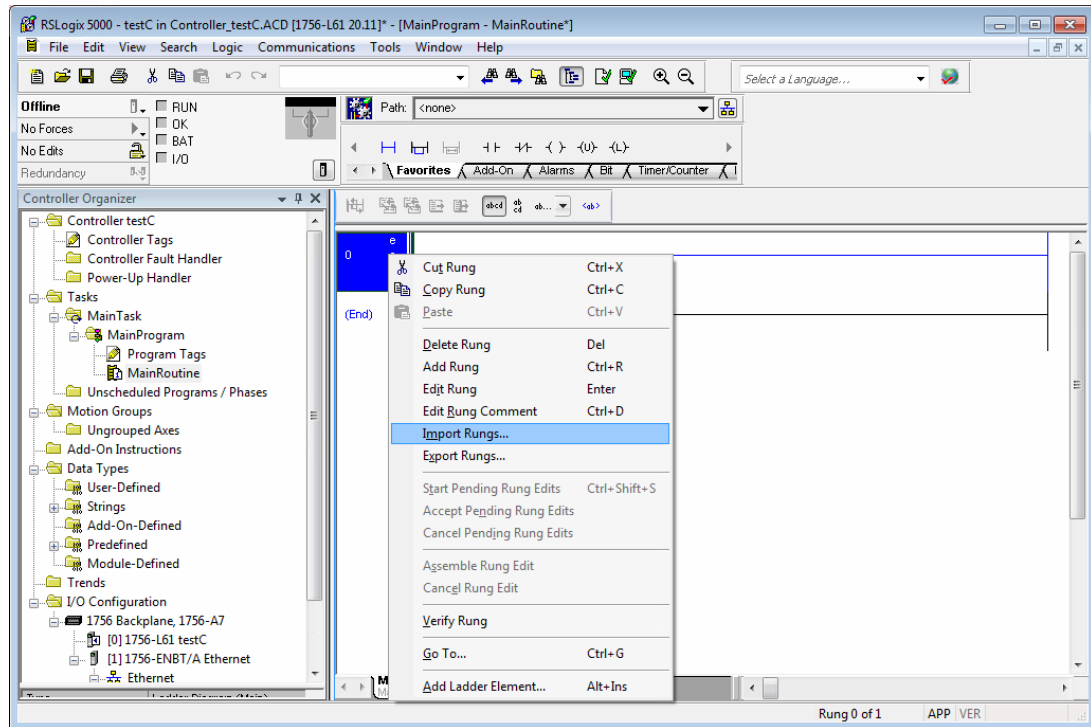


- 9 In the *Module Properties* dialog box, click **OK**. The Ethernet Bridge appears in the *Controller Organizer*.

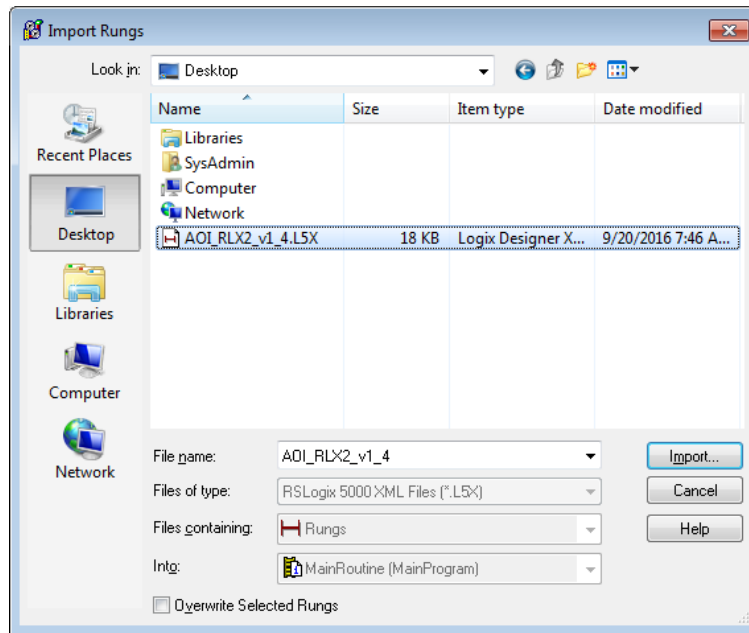


7.2 Importing the Add-On Instruction

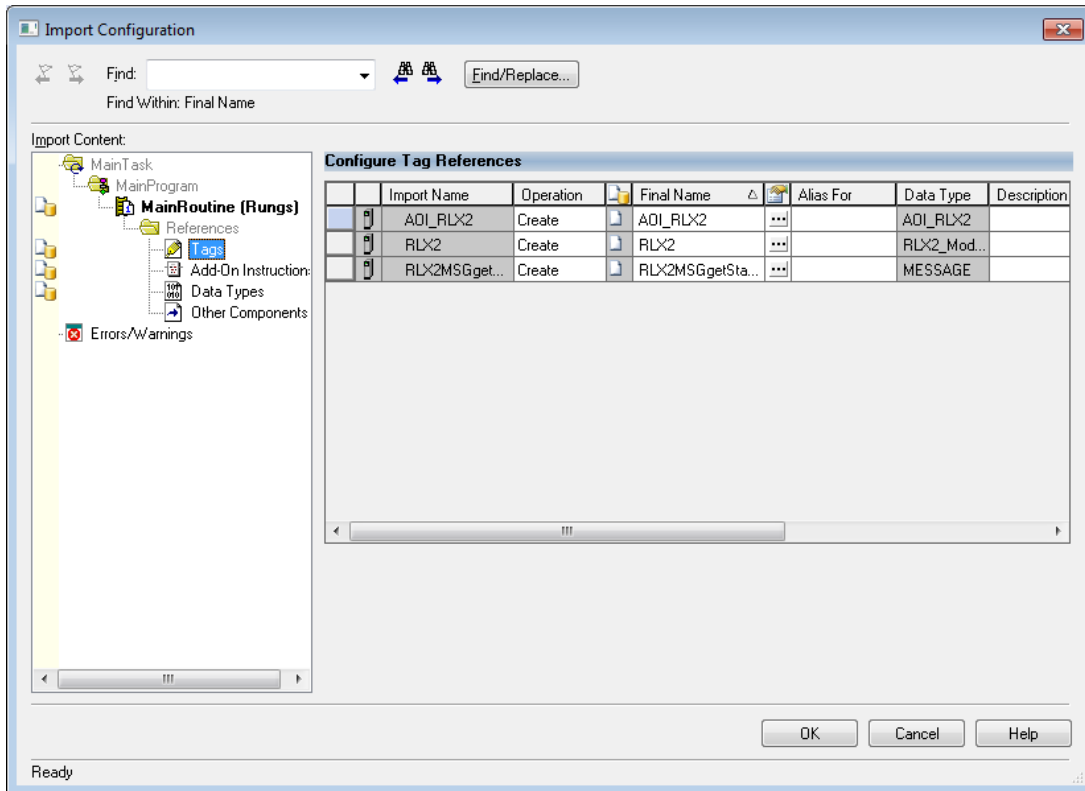
- 1 In RSLogix 5000, in the *Controller Organizer* window, expand the **TASKS** folder until you see the **MAINPROGRAM** folder.
- 2 Under the **MAINPROGRAM** folder, double-click **MAINROUTINE** to open the MainRoutine in the *Ladder Editor*.
- 3 Right-click an empty rung in the routine, and then click **IMPORT RUNG...**



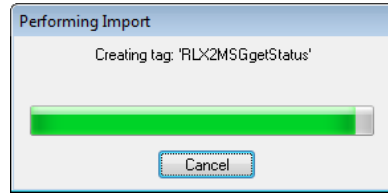
- 4 Navigate to the location on your PC where you saved the Add-On Instruction (for example, Desktop). Select the .L5X file and click **IMPORT**.



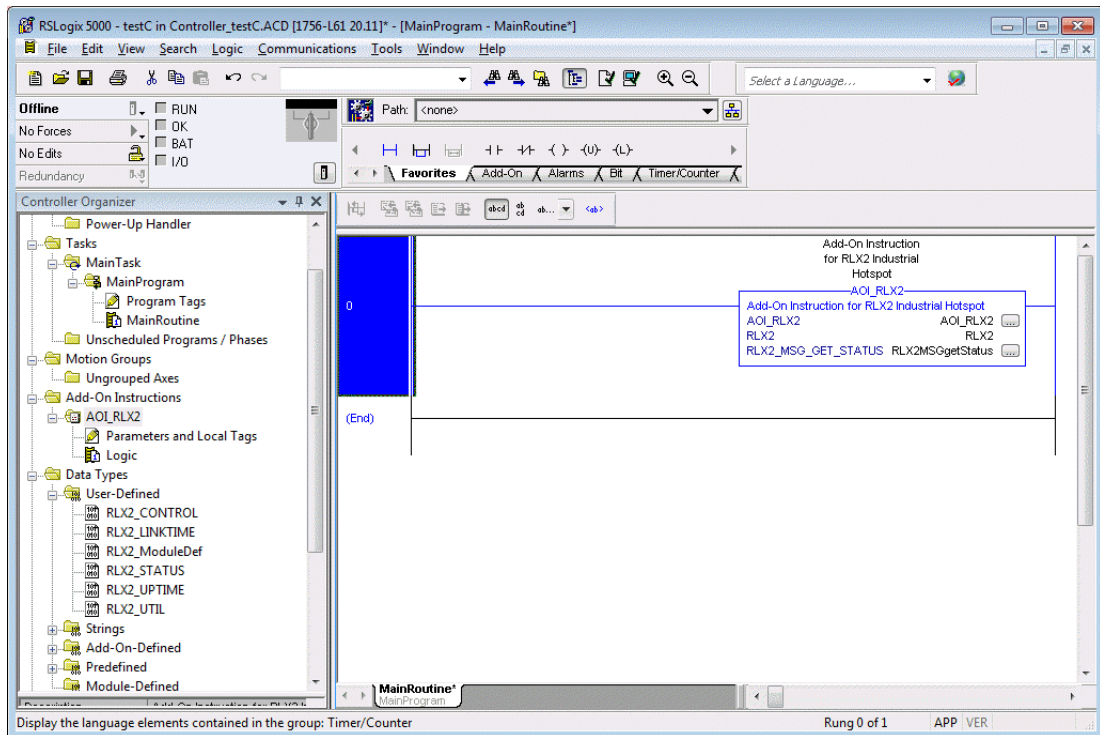
- 5 This opens the *Import Configuration* dialog box. Click **TAGS** to see the controller tags that the Add-On Instruction creates.



- Click **OK** to import the AOI. A progress bar appears during the import.

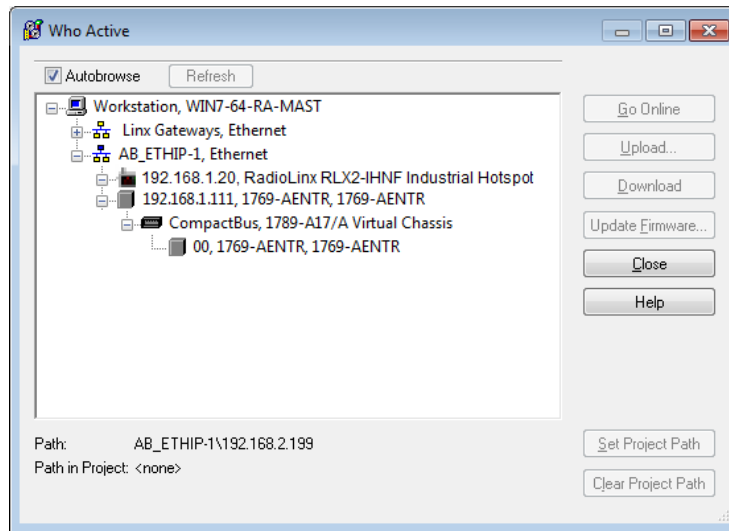


- After the import completes, the new rung with the Add-On Instruction appears in the Ladder editor.



The procedure also imports new User Defined Data Types, Controller Tags, and the Add-On instruction for your project.

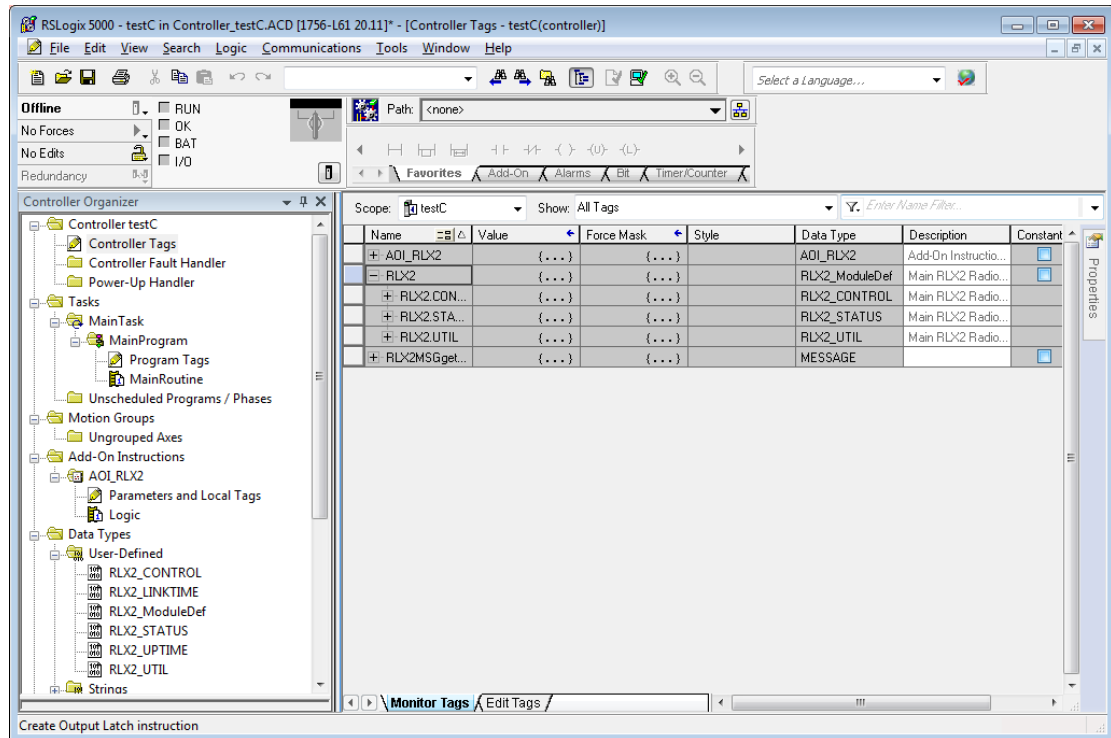
- 8 Ensure that a communications path exists using the *Who Active* dialog as shown.



- 9 Save the project. When ready, download the project to the processor.

7.3 RLX2 Controller Tags

You use the controller tags in RSLogix 5000 to monitor and control elements of the RLX2-IHx series radio from RSLogix 5000. You use only the RLX2.xxx controller tag structure for this purpose.



7.3.1 RLX2.CONTROL

This array contains trigger bits used to request functions from the RLX2-IHx series radio. The description is "Main RLX2 Radio definition Reads status of Diagnostic data from RLX2."

After execution, the bit is reset to 0 to be ready for the next execution.

7.3.2 RLX2.STATUS

This array is populated when the *RLX2.CONTROL.Get_Status_Data* is triggered. The following is the CIP™ object definition to read the RLX2-IHx Diagnostics and Status information.

CIP Data Tag Name	Data Type	Description
RLX2.STATUS.SSID	SINT[32]	Service Set Identifier is a name assigned to the wireless network
RLX2.STATUS.IPAddress	SINT[4]	IP address of RLX2-IHx radio
RLX2.STATUS.MACAddress	SINT[6]	Physical Media Access Control (MAC) address of the device
RLX2.STATUS.NetworkMode	SINT	RLX2 radio network mode (Master= 6 Repeater=7 Client=1)
RLX2.STATUS.ConnectionState	SINT	<p>Connection State of RLX2 radio found at the bit-level (RLX2.STATUS.ConnectionState.x)</p> <p>Bit sequence [yyyy 0001] = 1 = Not connected Bit sequence [yyyy 0010] = 2 = Scanning Not reported = 3 = Locally connected Bit sequence [yyyy 0100] = 4 = Globally connected</p> <p>Where y = RLX2 radio model type: Bit sequence [0001 zzzz] = 802.11g (2.4 GHz) radio Bit sequence [0010 zzzz] = 802.11a (5 GHz) radio Bit sequence [0011 zzzz] = 802.11n radio</p> <p>Example: Bit sequence 0010 0100 = 36 = Globally connected 5 Ghz radio</p>
RLX2.STATUS.SignalStrength	INT	Current Strength of the signal in dBm
RLX2.STATUS.Channel	SINT	Current Channel in which RLX2-IHx is transmitting
RLX2.STATUS.WEP	SINT	WEP encryption key
RLX2.STATUS.Flags	DINT	<p>Flags:</p> <p>Flag [0/1] = Extension channel Flag [2] = SSIDhidden Flag [3] = Allow Children Flag [4/5] = STP/RSTP Flag [6] = TXusingGI</p>
RLX2.STATUS.MasterMACAddress	SINT[6]	MAC Address of Parent Radio in which Repeater or Client is linked
RLX2.STATUS.HopCount	SINT	Number of hops to the master
RLX2.STATUS.PortStatus	SINT	<p>Ethernet Port Status</p> <p>1 = 10 Mb/s 2 = 100 Mb/s 3 = 1000 Mb/s</p>
RLX2.STATUS.Associations	INT	Number of network elements to which radio has wireless connection
RLX2.STATUS.BridgeAssociations	INT	Number of devices to which radio has wireless connection

RLX2.STATUS.TxRadioThroughput	INT	Transmit throughput in kilobits per second
RLX2.STATUS.RxRadioThroughput	INT	Receive throughput in kilobits per second
RLX2.STATUS.Uptime	INT	This is the amount of time the radio has been running since power up (Days/Hours/Minutes/Seconds)
RLX2.STATUS.Linktime	DINT	The time the radio has been linked (Days/Hours/Minutes/Seconds)
RLX2.STATUS.TxPacketRate	DINT	Total number of packets transmitted
RLX2.STATUS.RxPacketRate	DINT	Total number of packets received
RLX2.STATUS.ModuleName	DINT	The name of the radio
RLX2.STATUS.ProductName	SINT[32]	Name of product
RLX2.STATUS.ImageVerStr	SINT[32]	Firmware version loaded in device
RLX2.STATUS.TxGood	SINT[28]	Number of Good Transmitted Frames
RLX2.STATUS.RxGood	DINT	Number of Good Received Frames
RLX2.STATUS.TxBad	DINT	Number of Bad Transmitted Frames
RLX2.STATUS.RxBad	DINT	Number of Bad Received Frames
RLX2.STATUS.TxDirectedFrames	DINT	Number of Transmitted Directed Frames
RLX2.STATUS.TxMulticastFrames	DINT	Number of Transmitted Multicast Frames
RLX2.STATUS.TxBroadcastFrames	DINT	Number of Transmitted Broadcast Frames
RLX2.STATUS.RxDirectedFrames	DINT	Number of Received Directed Frames
RLX2.STATUS.RxMulticastFrames	DINT	Number of Received Multicast Frames
RLX2.STATUS.RxBroadcastFrames	DINT	Number of Transmitted Broadcast Frames
RLX2.STATUS.RxCRCErr	DINT	Number of CRC Errors

8 Appendix B - Radio Hardware

In This Chapter

❖ Radio Power Requirements (RLX2-IHNF-W)	163
❖ Radio Power Requirements (All other radios)	165
❖ Ethernet Cable Specifications	167
❖ Ethernet Cable Configuration	168

8.1 Radio Power Requirements (RLX2-IHNF-W)

These cables are available for purchase from ProSoft Technology:

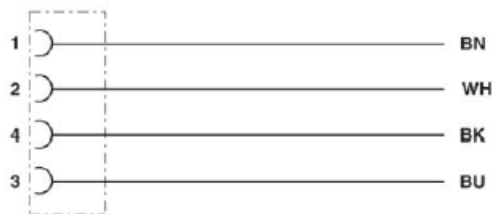
Description	ProSoft Part Number
Power Cable, 3m (7 ft), M12 to un-terminated leads	CULPWR-M12-010
Power Cable, 10m (33 ft), M12 to un-terminated leads	CULPWR-M12-033



The RLX2-IHNF-W and WC radios accept PoE configuration.

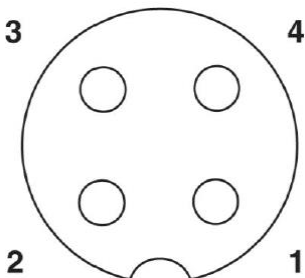
- The RLX2-IHNF-W radio is equipped with a power M12 port (IEC 61076-2-101).
- The RLX2-IHNF-WC Ethernet and PoE cable protrudes from the module. There is no M12 port.

Contact Assignment of the M12 Socket



- BK (Black) and BU (Blue) wires are tied together and connect to "+".
- BN (Brown) and WH (White) wires are tied together and connected to "-".

Pin Assignment M12 Socket, 4-pos, A-coded, View Female Side



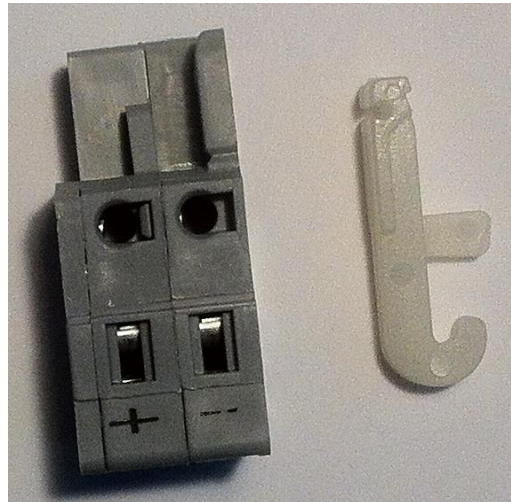
8.2 Radio Power Requirements (All other radios)

Note: The following instructions do not pertain to the RLX2-IHNF-W radio.

The RLX2-IHx series radios accept voltages between 10 and 24 VDC, with an average power draw of less than 8 Watts. A detachable power connector comes with the radio, as shown below. The connector terminals are labeled + (positive DC connection) and - (DC ground connection).

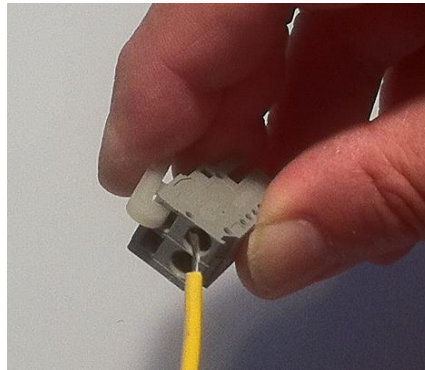
You can use the AC-to-DC power supply adapter supplied with the optional RLX-IHBTB Bench Test Kit to convert the input power. The DC power wires must be less than 3 meters in length to meet regulatory requirements.

Warning: 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 is not covered under the ProSoft Technology warranty.**

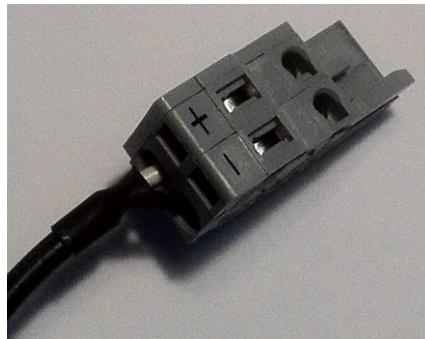


The power connector (ProSoft Technology part number 002-0116) is shown on the left in the photo above. Note the + and – polarity markings. The wire installation tool (ProSoft part number 357-0061) shown on the right is helpful for installing wires into the spring-loaded contacts inside power connector.

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



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



The RLX2-IHx series radios accept power from 802.3af Mode B or passive Power over Ethernet (PoE) sources supplying 48VDC, with an average power draw of less than 8 watts. ProSoft Technology offers the following passive PoE injectors for use with the RLX2-IHx series 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 in 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.

Danger: 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:

- "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.
- You can easily power or 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.
- You can save on the cost of coax cable and reduce RF losses for remote mounted radios.
- Built-in Ethernet surge protection to prevent equipment damage.
- Overload and short circuit protection.

8.3 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 detects the cable type and uses the appropriate pins to send and receive Ethernet signals.
- Ethernet cabling is similar to 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 168) for a diagram of how to configure Ethernet cables.

8.4 Ethernet Cable Configuration

8.4.1 Ethernet Cable Configuration (RLX2-IHNF-W)

The RLX2-IHNF-W weatherproof radio uses cables with M12 connectors on one end and RJ45 connectors on the other. These are Power over Ethernet (PoE) cables that you can purchase directly from ProSoft Technology.

Description	ProSoft Part Number
Network Cable, 2m (7 ft) M12 to RJ45	CURJ45-M12-007
Network Cable, 10m (33 ft) M12 to RJ45	CURJ45-M12-033

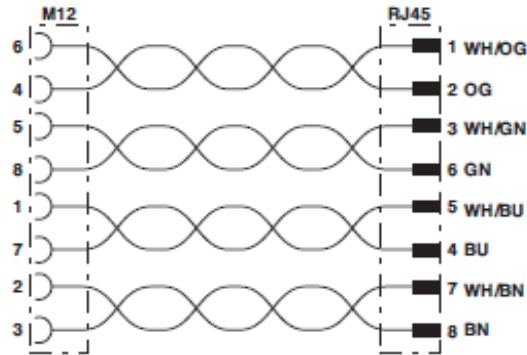


This PoE cable contains an M12 (IP65, IP67) connector on one end that attaches to the radio. The other end contains an RJ45 connector for a network connection or power injector.

Pin Assignments

M12 socket, 8-pos, A-coded, female	
RJ45 pin assignment	

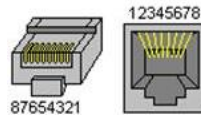
Circuit Diagram



Contact assignment of the M12 and RJ45 plug

8.4.2 Ethernet Cable Configuration (all other radios)

The RLX2-IHx series radios (except the RLX2-IHNF-W weatherproof radio) use Ethernet cable. A diagram of the pin assignments appears below.



Straight-Though Cable

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

Crossover Cable

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

9 Appendix C - RLX2-IHx 5 GHz Radio DFS Support

In This Chapter

- ❖ DFS Radio Operations 171

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

Note: This applies only to radios that can operate at frequencies in the 5 GHz band.

9.1 DFS 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 RLX2-IHx series 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 to 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 Client and Repeater radios in the network. It then 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 radio selects another channel and begins the process again.

If a Client or Repeater radio detects radar, in addition to stopping data transmission, must notify its parent of the presence of radar. Each unit receiving a radar notification from a child unit treats it the same as if it had detected radar itself and acts accordingly. Thus radar notifications always reach the Master radio which causes a channel change order to be issued.

After a Master radio successfully selects a DFS channel, Repeater or Client radios connect to the Master and scan for radar for an additional 60 seconds (*Channel Availability Check Time*). If a chain of Repeater radios ultimately connects to a Master radio using a DFS channel, the time to connect is 60 seconds for **each** Repeater radio in the chain as DFS channels are initially scanned for radar transmissions.

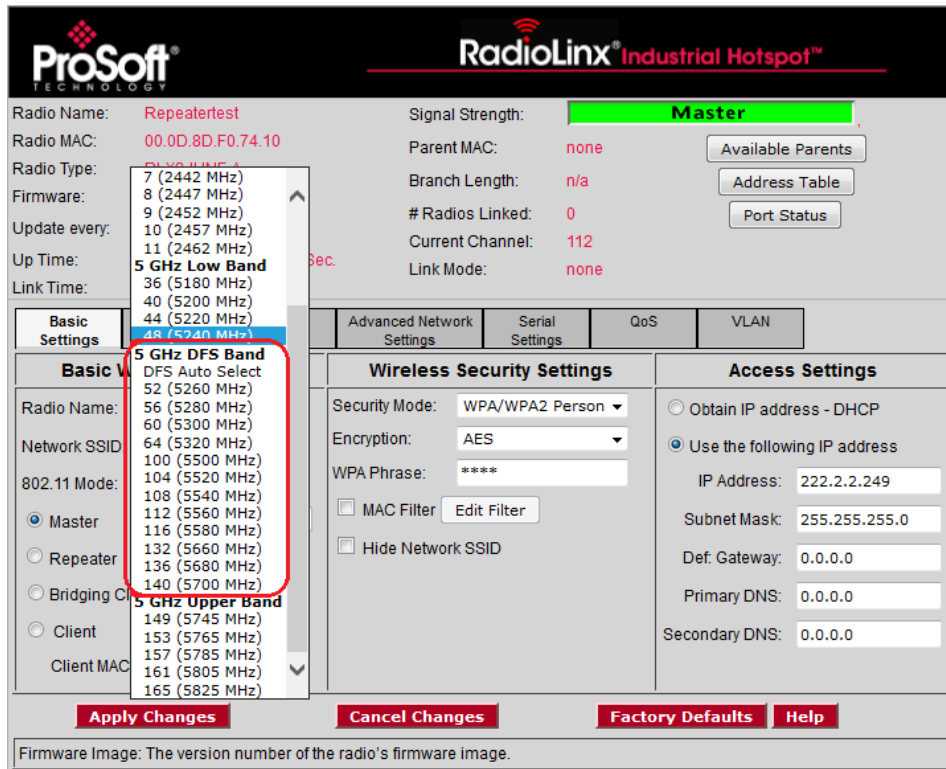
9.1.1 Selecting a DFS 5 GHz Channel

For [ModelNumber] Master radios operating in the 5 GHz band, you can select a DFS channel, or let the radio automatically select the DFS channel. DFS channels are a 5 GHz radio parameter only, and apply to all RLX2-IHx series radios except the RLX2-IHG.

Note: In some cases, the radio may select a channel in the 5 GHz Upper Band if it does not find an open channel in the 5 GHz DFS Band.

To Select a DFS Channel

In the *Radio Configuration / Diagnostic Utility*, on the **BASIC SETTINGS** tab, in the **BASIC WIRELESS SETTINGS** group, select the starting DFS channel. If the radio detects a radar signal on this channel, it changes the channel as described in DFS Radio Operations (page 171).

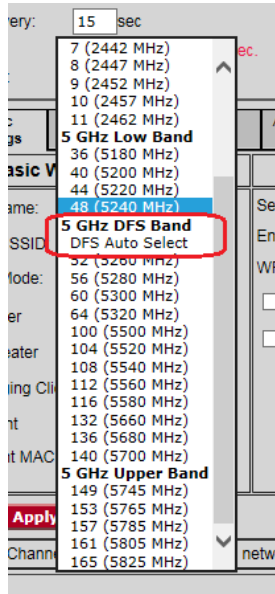


The actual channel in operation is always shown in the **CURRENT CHANNEL** display.

Current Channel: 132

To Use DFS Auto Select

In the *Radio Configuration / Diagnostic Utility*, on the **BASIC SETTINGS** tab, in the **BASIC WIRELESS SETTINGS** group, select the Master radio channel *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.

10 Appendix D - RLX2-IHx series Virtual LAN (VLAN) Functionality

In This Chapter

- ❖ Transparent Support of VLAN Tags (802.1Q) 176
- ❖ Port/Radio-based VLAN Tagging with Managed Switches..... 177
- ❖ Port/Radio-based VLAN Tagging without Managed Switches..... 178

Virtual Local Area Networks (VLANs) are typically used to segment core network components and network access rules. A VLAN provides the equivalent of a wired patch panel through software (packet filtering) rather than hardware (physical wires).

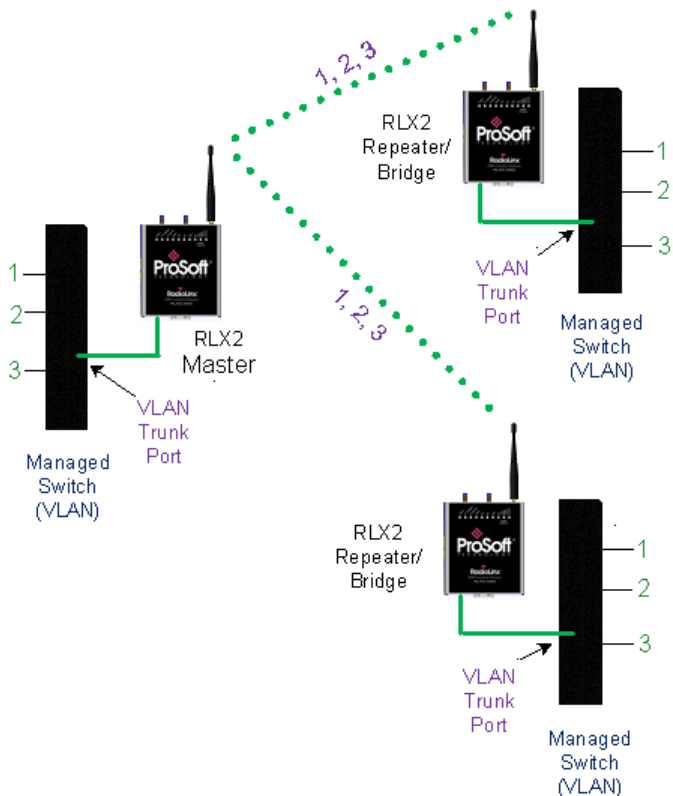
Constraining data to a particular Virtual LAN requires that the radio tag packets with a VLAN identifier. VLAN tagging simply adds extra information in the packet header of Ethernet frames so VLAN-enabled switches know how to pass along the data.

The RLX2-IHx series radios (version 33 and later) provide:

- Transparent support of VLAN tags (802.1Q)
- Port/Radio-based VLAN tagging with Managed Switches
- Port/Radio-based VLAN tagging without Managed Switches

10.1 Transparent Support of VLAN Tags (802.1Q)

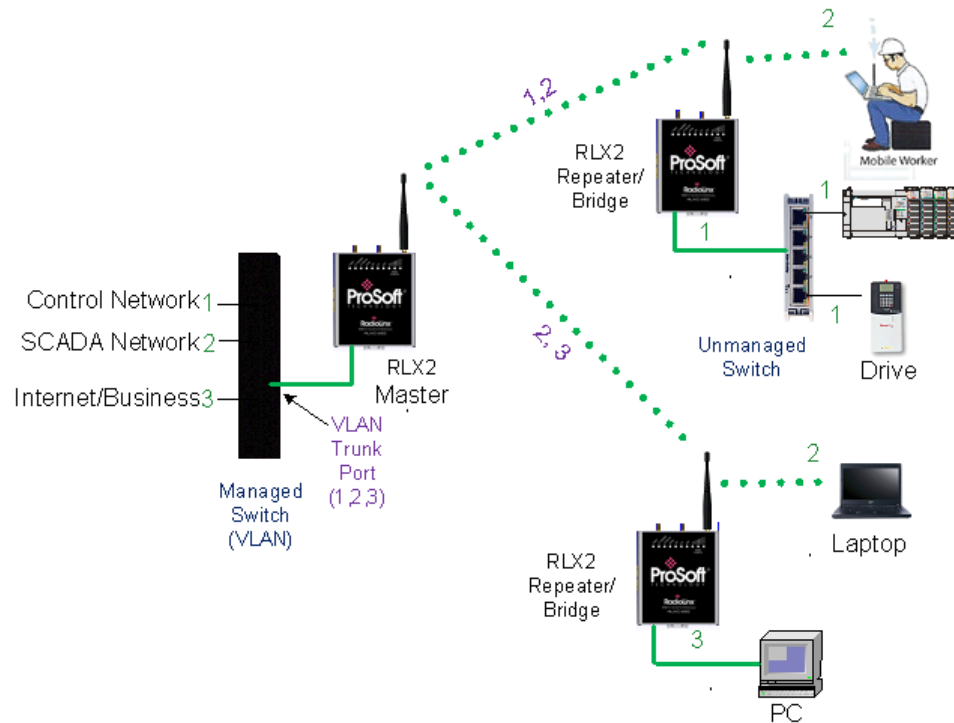
The following provides an example of transparent communication between Managed Switches using VLAN trunking.



10.2 Port/Radio-based VLAN Tagging with Managed Switches

In this example, the network has three VLANs (capacity for 8). Each VLAN has access to a Managed Switch pre-configured to assign each VLAN to a specific port. The Radio supporting the Managed Switch passes on the 802.1Q frames. This example shows support for Radio to Radio VLANs using one or more Trunk Links.

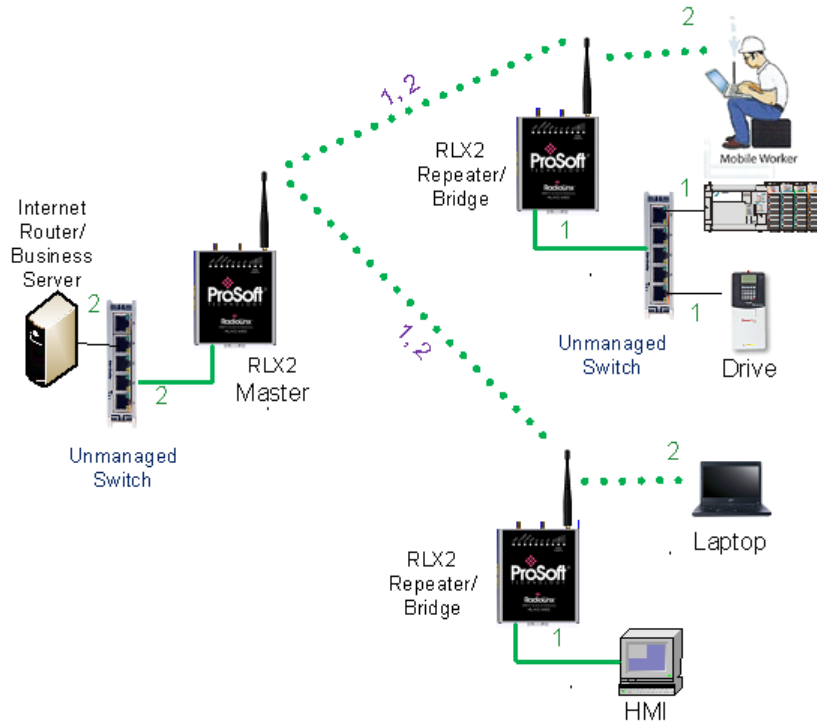
- PLC, Drive, and HMI communicate on VLAN 1 and with the Control Network (same subnet).
- Mobile worker communicates to the SCADA network only (VLAN 2). The laptop communicates to Internet/Business Network only (VLAN 3).



10.3 Port/Radio-based VLAN Tagging without Managed Switches

In the following example, the network has three VLANs (capacity for 8). Each VLAN has access to a specific Radio port. The Radio supporting the Managed Switch passes on the 802.1Q frames. The wireless network also supports Radio to Radio VLANs using one or more Trunk Links.

- PLC, Drive & HMI communicate on one VLAN on the same subnet.
- Mobile Worker/Laptop communicate with a fixed server on VLAN 2 (separate subnet).



11 Appendix E - EtherNet/IP and Modbus TCP/IP Support

In This Chapter

- ❖ Modbus TCP/IP Server Support 179
- ❖ EtherNet/IP™ Server Support 181

You can get diagnostic and status information from the RLX2-IHx series radio by querying the radio using either the Ethernet/IP or Modbus TCP/IP protocols.

11.1 Modbus TCP/IP Server Support

You can use a Modbus TCP/IP client to poll the RLX2-IHx series radio for diagnostic and status information. The Modbus TCP/IP server in the radio monitors port 502 and port 2000, and responds to requests from the port eth0 (Ethernet port) or ppp0 (Point-to-Point Protocol). PPP is a data link layer protocol that establishes a connection between two nodes.

The radio supports up to five concurrent Modbus TCP/IP client connections.

11.1.1 Modbus Memory Map Diagnostic Information

The topic lists the is the Modbus register addresses that you use to read the RLX2-IHx series radio diagnostic and status information.

Name	Data Type	Access	Modbus Register
RLX2_Diag.SSID	SINT[32]	Read	30001 – 30016
RLX2_Diag.IPAddress	SINT[4]	Read	30017 – 30018
RLX2_Diag.MACAddress	SINT[6]	Read	30019 – 30021
RLX2_Diag.NeworkMode	SINT	Read	30022
RLX2_Diag.ConnectionState	SINT	Read	30023
RLX2_Diag.SignalStrength	INT	Read	30024
RLX2_Diag.Channel	SINT	Read	30025
RLX2_Diag.WEP	SINT	Read	30026
RLX2_Diag.Flags	DINT	Read	30027 – 30028
RLX2_Diag.MasterMACAddress	SINT[6]	Read	30029 – 30031
RLX2_Diag.HopCount	SINT	Read	30032
RLX2_DiagStatus	SINT	Read	30033
RLX2_Diag.NumAssociations	INT	Read	30034
RLX2_Diag.NumBridgeAssocs	INT	Read	30035
RLX2_Diag.TxRadioThroughput	INT	Read	30036
RLX2_Diag.RxRadioThroughput	INT	Read	30037
RLX2_Diag.Uptime	DINT	Read	30038 – 30039
RLX2_Diag.LinkTime	DINT	Read	30040 – 30041
RLX2_Diag.TxPktThput	DINT	Read	30042 – 30043
RLX2_Diag.RxPktThput	DINT	Read	30044 – 30045
RLX2_Diag.ModuleName	SINT[32]	Read	30046 – 30061
RLX2_Diag.ProductName	SINT[32]	Read	30062 – 30077
RLX2_Diag.ImageVerStr	SINT[28]	Read	30078 – 30091
RLX2_Diag.tx_good	DINT	Read	30092 - 30093
RLX2_Diag.rx_good	DINT	Read	30094 – 30095
RLX2_Diag.tx_bad	DINT	Read	30096 – 30097
RLX2_Diag.rx_bad	DINT	Read	30098 – 30099
RLX2_Diag.tx_directed_frames	DINT	Read	30100 – 30101
RLX2_Diag.tx_multicast_frames	DINT	Read	30102 – 30103
RLX2_Diag.tx_broadcast_frames	DINT	Read	30104 – 30105
RLX2_Diag.rx_directed_frames	DINT	Read	30106 – 30107
RLX2_Diag.rx_multicast_frames	DINT	Read	30108 – 30109
RLX2_Diag.rx_broadcast_frames	DINT	Read	30110 – 30111
RLX2_Diag.rx_crc_error	DINT	Read	30112 - 30113

Modbus Function Code 4 (Read Input Registers(3X)) is supported.

11.2 EtherNet/IP™ Server Support

The topic lists the is the CIP™ object definition that you use to read the RLX2-IHx series radio diagnostic and status information.

Class ID: 0xA1 (161)

Number of Instances: 1

CIP Data Tag Name	Data Type	Access
RLX2_Diag.SSID	SINT[32]	Read
RLX2_Diag.IPAddress	SINT[4]	Read
RLX2_Diag.MACAddress	SINT[6]	Read
RLX2_Diag.NetworkMode	SINT	Read
RLX2_Diag.ConnectionState	SINT	Read
RLX2_Diag.SignalStrength	INT	Read
RLX2_Diag.Channel	SINT	Read
RLX2_Diag.WEP	SINT	Read
RLX2_Diag.Flags	DINT	Read
RLX2_Diag.MasterMACAddress	SINT[6]	Read
RLX2_Diag.HopCount	SINT	Read
RLX2_Diag.Status	SINT	Read
RLX2_Diag.NumAssociations	INT	Read
RLX2_Diag.NumBridgeAssocs	INT	Read
RLX2_Diag.TxRadioThroughput	INT	Read
RLX2_Diag.Uptime	INT	Read
RLX2_Diag.Linktime	DINT	Read
RLX2_Diag.TxPktThput	DINT	Read
RLX2_Diag.RxPktThput	DINT	Read
RLX2_Diag.ModuleName	DINT	Read
RLX2_Diag.ProductName	SINT[32]	Read
RLX2_Diag.ImageVerStr	SINT[32]	Read
RLX2_Diag.tx_good	SINT[28]	Read
RLX2_Diag.rx_good	DINT	Read
RLX2_Diag.tx_bad	DINT	Read
RLX2_Diag.rx_bad	DINT	Read
RLX2_Diag.tx_directed_frames	DINT	Read
RLX2_Diag.tx_multicast_frames	DINT	Read
RLX2_Diag.tx_broadcast_frames	DINT	Read
RLX2_Diag.rx_directed_frames	DINT	Read
RLX2_Diag.rx_multicast_frames	DINT	Read
RLX2_Diag.rx_broadcast_frames	DINT	Read
RLX2_Diag.rx_crc_err	DINT	Read

12 Appendix F - Master Channel-Frequency Table

The following table shows the channels/frequencies available in each RLX2-IHx series 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 (for example, indoor or outdoor) in some locations.

Channel Number	Center Frequency (MHz)	FCC RLX2-XXX-A versions				ETSI RLX2-XXX-E versions			
		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	✓		✓	✓				

13 Appendix G - Antenna Configuration

In This Chapter

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13.1 Antennas

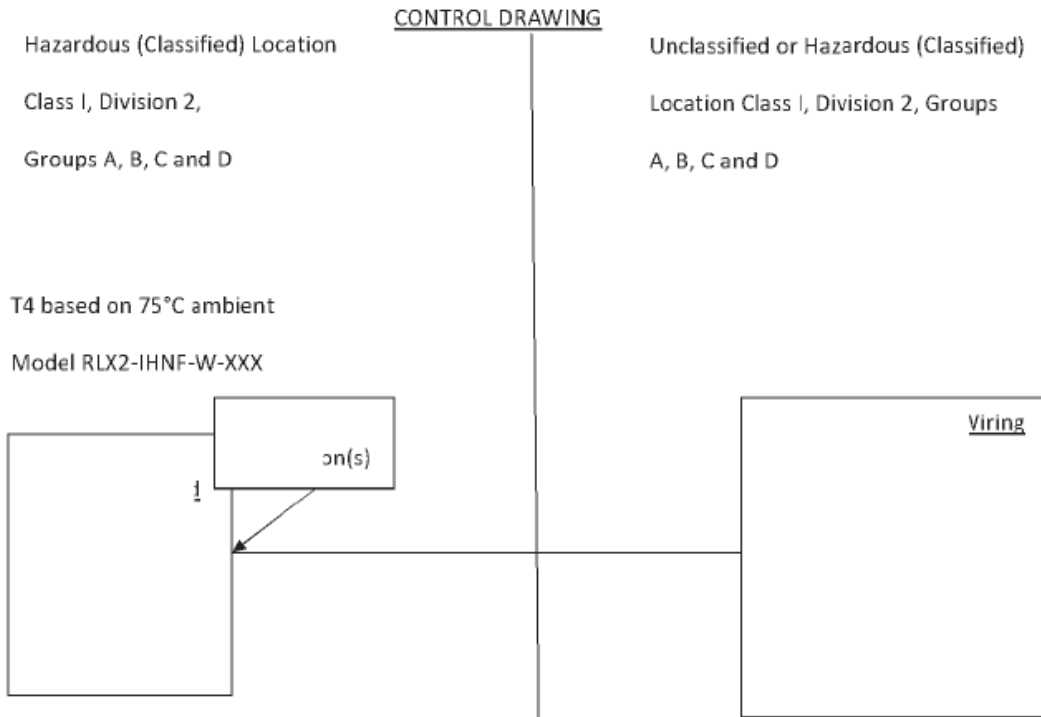
There are several important electrical characteristics that you must consider when selecting antennas for a RLX2-IHx series radio.

- Antenna pattern
- Antenna gain
- Antenna polarity
- Antenna location, spacing, and mounting

13.1.1 Control Drawing

ProSoft Technology Control Drawing # 06/2514

Rev. 0



1. Selected Nonincendive Field wiring apparatus must be third party Listed as nonincendive field wiring apparatus for the application, and have entity parameters conforming with the table above.
2. The associated nonincendive field wiring apparatus may also be connected to simple apparatus as defined in Article 504.2 and installed and temperature classified in accordance with Article 504.10 (B) and 504.10 (D) of the national electrical code (NFPA 70), or other local codes, as applicable.

3. The associated nonincendive field apparatus may be in a Zone 2 location, if so approved.
4. Capacitance and inductance of the field wiring from the nonincendive field wiring apparatus equipment to the associated nonincendive field wiring apparatus shall be calculated and must be included in the system calculation as shown in the above table. Cable capacitance, C_{cable} , plus nonincendive field wiring apparatus capacitance, C_i must be less than the marked capacitance, C_a (or C_o), shown on any associated apparatus used. the same applies for inductance (L_{cable} , L_i and L_a or L_o , respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: $C_{cable} = 60 \text{ pF/ft}$, $L_{cable} = 0.2 \text{ } \mu\text{H/ft}$.
5. The associated apparatus must be connected to a suitable ground electrode per the national Electrical code (ANSI/NFPA 70), the Canadian electrical code or other local installation codes, as applicable the resistance of the ground path must be less than 1 ohm,
6. Where multiple circuits extend from the same piece of associated apparatus, they must be installed in separate cables or in one cable having suitable insulation. Refer to article 504.30 (B) of the National Electrical code (NFPA 70) and Instrument society of America recommended Practice ISA RP12.6 for installing intrinsically safe equipment.
7. This associated apparatus has not been evaluated for use in combination with other associated apparatus

13.1.2 Antenna Pattern

Wireless devices transfer Information using electromagnetic energy radiated by one antenna and received by another antenna. The power radiated by most antennas is not uniform in all directions and has varying intensities. The power radiated by the antenna in various directions is called the *pattern* of the antenna. Mount each antenna so that the direction of strongest radiation points toward the other antenna or antennas with which it will exchange signals.

Complete antenna patterns are three-dimensional. 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 instead of above or below one another. A slice taken in a horizontal plane through the center (or looking down onto the pattern) is called the *azimuth pattern*. A slice taken in a vertical plan from the side is called the *elevation pattern*.

An antenna pattern with equal or nearly equal intensity in all directions is called *omnidirectional*. In two dimensions, an omnidirectional pattern appears as a circle (in three dimensions, an omnidirectional antenna pattern is a sphere, but no antenna has a 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.

13.1.3 Antenna Gain

Antenna gain is a measure of how strongly an antenna radiates in its direction of maximum intensity compared to the strength of the radiation if the same power were applied to an omnidirectional antenna (one that radiated all of its power equally in all directions). In 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, 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, you can make trade-offs between the antennas' gain and transmitting power. For example, doubling the gain of one of the antennas has the same effect as doubling the transmitting power. Doubling the gain for both antennas has the same effect as quadrupling the transmitting power.

13.1.4 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*.

An antenna only receives the portion of the transmitted power that has the same polarization as the receiving antenna polarization. For example:

- If the transmitting antenna polarization is in the vertical direction (vertical polarization), and the receiving antenna also has vertical polarization, the maximum amount of power possible is 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, only half of the possible maximum power is received.

13.2 Antenna Types

Antenna types used with a RLX2-IHx series radio include whip, collinear array, yagi array, and parabolic reflector. See the RLX2-IHx series Approved Antennas (page 191) section for other types of approved antennas.

13.2.1 Whip Antennas

For RLX2-IHx series radios, use a 1/2 wave straight whip antenna or a 1/2 wave articulating whip (2 dBi) antenna. These antennas are the most common type in use today.

- They are approximately 5 inches long, and are likely to be connected directly to the client 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 as shown in the image below.



13.2.2 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. The signal is connected at one end.



- The antenna pattern is torroidal. Its azimuthal beamwidth is 360° (omnidirectional). Its vertical beamwidth depends on the number of elements/length, and more elements produce a narrower beamwidth.
- The antenna gain also depends on the number of elements/length, and more elements produce a higher gain. The typical gain for this antenna is 5 to 10 dBi.
- The antenna polarity is linear, or parallel to the length of the antenna.

13.2.3 Yagi Array Antenna

A yagi array 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 signal is connected to only one of the elements. Elements on one side of the connected 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 (as shown in the image below).



- The antenna pattern 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 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).

13.2.4 Parabolic Reflector Antennas

A parabolic reflector antenna consists of a parabolic shaped dish and a feed antenna located in front of the dish. The feed antenna radiates power toward the reflector. Due to the parabolic shape, the reflector concentrates the radiation into a narrow pattern, resulting in a beam with high gain.



- 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.

13.3 RLX2-IHx series Approved Antennas

If you are located 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-IHx series radios. Contact ProSoft Technology or visit www.prosoft-technology.com for a current list of approved antennas.

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.

13.3.1 Approved Antenna Table

Use the following approved antennas when the RLX2-IHx series radio module is connected directly to an antenna. See Approved Antennas with Power Amp (page 193) 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.

13.3.2 Approved Antennas in Europe/CE

In Europe/CE, the gain of the antenna connected to the RLX2-IHx series radio 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 on the radio 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.

13.3.3 Approved Antennas in Mexico

The gain of the antenna connected to the RLX2-IHx series radio 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.

13.3.4 Approved Antennas with Power Amp

When the RLX2-IHx series 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.

13.4 Antenna Location, Spacing, and Mounting

Consider the following points regarding RLX2-IHx series radio 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 contains obstructing terrain or structures, mount the antenna on a tower or rooftop to provide a line-of-sight path. This line-of-sight consideration becomes more important as the transmission path becomes longer.
- Mount the antennas as high off the ground as is practical for greater range.
- Mount the antennas away from massive structures. For example, radio signals bounce off metal walls, which can compromise a clear signal.
- Mount the antennas and install radios away from sources of RF interference.
- Use the shortest possible antenna cable length. Signals lose power over the length of the cable.
- Choose antennas that are appropriate for the network's intended function.
- If antennas are on radios on the same network, mount them with matching polarity. If the antennas are on separate networks, mount them with 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 radio 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.

14 Appendix H - FCC Emission Regulations

In This Chapter

- ❖ 2.4 GHz Band, Point-To-Multipoint..... 195
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- ❖ 5 GHz Bands, Point-To-Multipoint..... 196
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The charts in this section 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.

14.1 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

14.2 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.

14.3 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, 48	Indoor Only	16	40	22	160
UNII-2	5.25 – 5.35	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

14.4 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, 48	Indoor Only	16	40	22	160
UNII-2	5.25 – 5.35	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

15 Appendix I - Compatibility with ProSoft RLXIB Series Radios

The RLX2-IHx 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-IHx series radios to their existing networks without any reconfiguration of existing assets or problems with obsolescence. The main differences in the RLX2-IHx series radios are the following improvements:

- Different enclosure size for more efficient heat dissipation
- Faster, more efficient electronics that consume less power
- Gigabit Ethernet
- MicroSD memory cards for configuration data storage
- Internal temperature sensor

The RLX2-IHx series radios will acquire additional functionality as new firmware features are added. These new features will not be added to the RLXIB radios, but the RLX2-IHx series 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 or Master radio 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-IHx series radio products are not listed.

	RLXIB-IHA	RLX2-IHA	RLXIB-IHG	RLX2-IHG	RLXIB-IHW	RLX2-IHW	RLX2-IHNF
Dimensions	4.5/115 W x 4.6/117 H x 1.75/45 D (inches/mm)	5.82/148 W x 4.64/118 H x 1.48/38 D (inches/mm)	4.5/115W x 4.6/117H x 1.75/45 D (inches/mm)	5.82/148W x 4.64/118H x 1.48/38D (inches/mm)	4.5/115W x 4.6/117H x 1.75/45 D (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-IHx series Firmware Image		✓		✓		✓	✓

16 Appendix J - Detailed Radio Specifications

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16.1 RLX2-IHA Detailed Specifications

RLX2-IHA 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)	23 dBm (200 mW)
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 (H x W x D)	14.8 x 11.8 x 3.8 cm 5.82 x 4.64 x 1.48 in
Shock	IEC 60068 2-6 (20g, 3-Axis)
Vibration	IEC 60068 2-27 (5g, 10Hz to 150Hz)
Ethernet Ports	(1) 10/100/1000 Base-T, RJ45 connector
Serial Port	(1) DB9 female (serial tunneling & encapsulation)
Antenna Port	(1) RP-SMA connector
Weight	1.1 lbs (499g)

Environmental

Operating Temperature	-40°C to +75°C (-40°F to +167°F)
Humidity	Up to 100% RH, with no condensation
External Power	10 VDC to 24 VDC
Power over Ethernet	802.3af Compliant
Peak Power Consumption	< 7W

16.1.1 Agency Approvals & Certifications

Wireless Approvals

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

Hazardous Locations	Regulatory
UL/cUL; Class1, Div 2	CSA/CB Safety
Ex Certificate (ATEX Directive, Zone 2)	CE Mark
	FCC/IC
	ETSI

16.2 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	802.11b, 802.11g, 802.11i
Transmit Power (Programmable) (varies by country)	Up to 24 dBm (250 mW)
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 Enterprise – 802.11i AES w/RADIUS [PEAP, TTLS, TLS, EAP] WPA2 Personal – 802.11i AES w/Passphrase Legacy WPA TKIP, WEP support

Physical

Enclosure	Extruded aluminum with DIN and panel mount
Size (H x W x D)	14.8 x 11.8 x 3.8 cm 5.82 x 4.64 x 1.48 in
Shock	IEC 60068 2-6 (20 g, 3-Axis)
Vibration	IEC 60068 2-27 (5 g, 10 Hz to 150 Hz)
Ethernet Ports	(1) 10/100/1000 Base-T, RJ45 connector
Serial Port	(1) DB9 female (serial tunneling & encapsulation)
Antenna Port	(1) RP-SMA connector

Environmental

Operating Temperature	-40°C to +75°C (-40°F to +167°F)
Humidity	Up to 100% RH, with no condensation
External Power Power over Ethernet	10 VDC to 24 VDC 802.3af Compliant
Peak Power Consumption	< 7W

16.2.1 Agency Approvals & Certifications

Wireless Approvals

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

Hazardous Locations	Regulatory
UL/cUL; Class1, Div 2	CSA/CB Safety
Ex Certificate (ATEX Directive, Zone 2)	CE Mark
	FCC/IC
	ETSI

16.3 RLX2-IHNF, -W, -WC Detailed Specifications

Radio

Specification	Frequency	Channel	
Frequency Band (Varies by country)	2.412 GHz to 2.462 GHz (FCC)	1 to 11	
	2.412 GHz to 2.472 GHz (ETSI)	1 to 13	
	5.150 GHz to 5.250 GHz (FCC/ETSI)	36 to 48	
	5.260 GHz to 5.580 GHz (FCC/ETSI)*	52 to 116*	
	5.660 GHz to 5.700 GHz (FCC/ETSI)*	132 to 140*	
	5.725 GHz to 5.850 GHz (FCC/ETSI Series C only)	149 to 165	
	* DFS channels with RADAR detection		
Wireless Standards	802.11n, 802.11a, 802.11g, 802.11h (DFS), 802.11i (Security), 802.11e (QoS) 802.112Q (VLAN), 802.113af (PoE), IGMPv2		
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 2 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
	6.5 Mbps	13.5 Mbps	MCS0 1 Stream
	65 Mbps	150 Mbps	MCS7
	13 Mbps	27 Mbps	MCS8 2 Streams
	130 Mbps	300 Mbps	MCS15
802.11b 802.11a/g	11, 5.5, 2, 1 Mbps 54, 48, 36, 24, 18, 12, 11, 9, 6, 5.5, 2, 1 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/Enterprise – 802.11i AES WPA2 Personal – 802.11i AES w/ Passphrase Legacy WPA TKIP, WEP support MAC ID filter		

Physical

Enclosure	Extruded aluminum with DIN rail mount (RLX2-IHNF) Die-cast Aluminum with Pole Mount (RLX2-IHNF-W and RLX2-IHNF-WC)
Size (H x W x D)	14.8 x 11.8 x 3.8 cm (RLX2-IHNF) 5.82 x 4.64 x 1.48 in 29.2 x 17.8 x 7 cm (RLX2-IHNF-W and WC) 11.5 x 7 x 2.75 in
Shock	IEC 60068 2-6 (20G, 3-Axis)
Vibration	IEC 60068 2-27 (5G, 10 to 150 Hz)
Ethernet Port	(1) 10/100 Base-T connector, shielded RJ45 IEEE 802.3, 802.3u, 802.3x Water/Dust Tight M12 Connector (RLX2-IHNF-W) 10/100/1000 Base-T connector, shielded RJ45 IEEE 802.3, 802.3u, 802.3x, 802.3af, Passive PoE Not 802.3at/PoE+ compatible Water/Dust Tight (RLX2-IHNF-WC) 10/100/1000 Base-T connector, shielded RJ45 IEEE 802.3, 802.3u, 802.3x, 802.3af
Antenna Port	(3) RP-SMA connector (3) N-Type Connectors (RLX2-IHNF-W and WC)
Personality Module	Industrial SD Memory Module No Personality Module on RLX2-IHNF-W or WC
Weight	1.1 lbs (499 g) (RLX2-IHNF) 3 lb 9 oz, 1.6Kg – less cables and pole mounting bracket (RLX2-IHNF-W or WC)

Environmental

Operating Temperature	-40°F to +167°F (-40°C to +75°C) -40°F to +158°F (-40°C to +70°C), RLX2-IHNF Series B and C only
Humidity	Up to 100% RH, with no condensation
External Power PoE Injector	10 to 24 VDC 802.3af PoE Powered Device The RLX2-IHNF-WC has a 6-foot attached cable and a 6-foot attached CAT6 cable for PoE applications
Peak Power Consumption	< 9W (Series B), < 8W (Series C)

16.3.1 Agency Approvals & Certifications

Wireless Approvals

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

Hazardous Locations	Regulatory
	ANATEL (Brazil)
UL/cUL; Class I, Div 2	CSA/CB Safety
Ex Certificate (ATEX Directive, Zone 2)	CE Mark
	FCC/IC
	ETSI
	MIC (Japan)
	NCC (Taiwan)
	NTRA (Egypt)

16.4 RLX2-IHW Detailed Specifications

Radio

Frequency Band (Varies by country)	2.412 GHz to 2.462 GHz (FCC) 2.412 GHz to 2.472 GHz (ETSI) 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)	2.4 GHz: Up to 100 mW (20 dBm) 5 GHz: Up to 64 mW (18 dBm)
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 (H x W x D)	14.8 x 11.8 x 3.8 cm 5.82 x 4.64 x 1.48 in
Shock	IEC 60068 2-6 (20g, 3-Axis)
Vibration	IEC 60068 2-27 (5g, 10Hz to 150Hz)
Ethernet Ports	(1) 10/100/1000 Base-T, RJ45 connector

Serial Port	(1) DB9 female (serial tunneling & encapsulation)
Antenna Ports	(2) RP-SMA connectors (1 trans/rec, 1 rec only)

Environmental

Operating Temperature	-40°C to +75°C (-40°F to +167°F)
Humidity	Up to 100% RH, with no condensation
External Power	10 to 24 VDC
PoE (Power over Ethernet)	802.3af Compliant
Peak Power Consumption	< 6W

16.4.1 Agency Approvals & Certifications

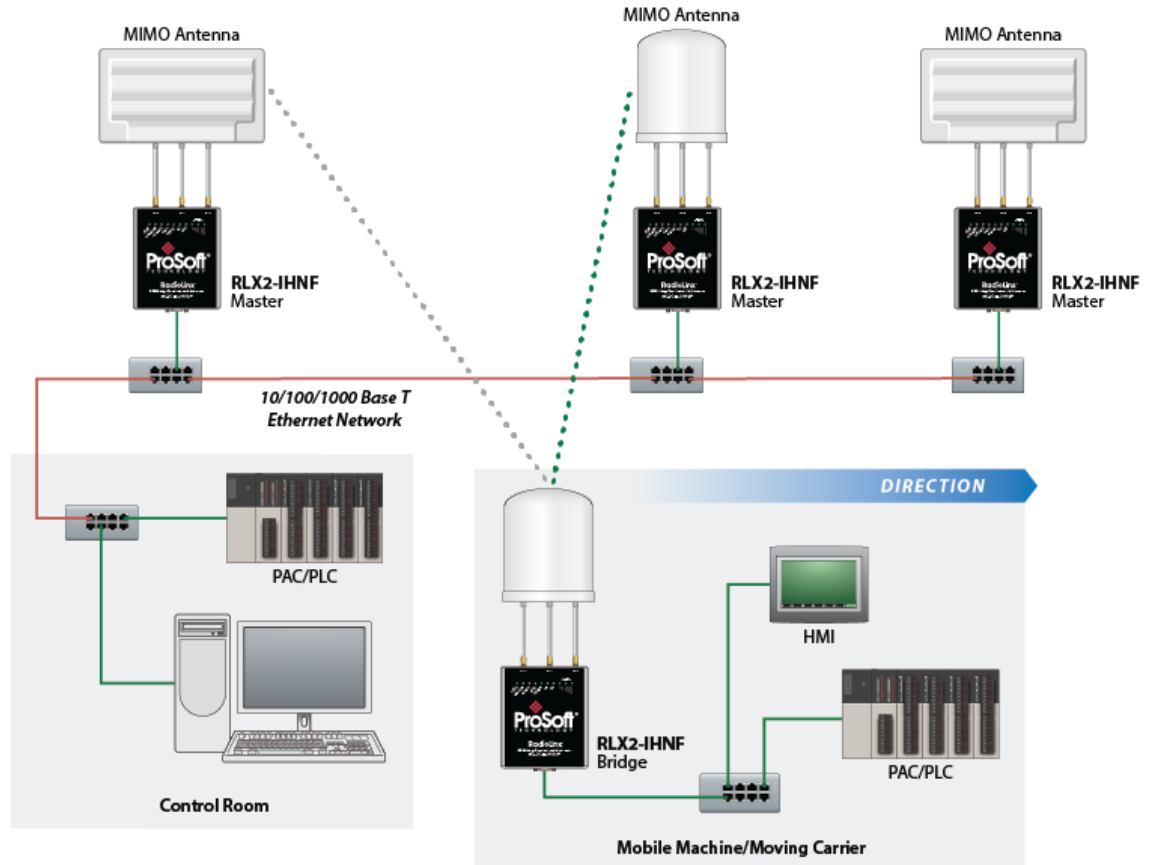
Wireless Approvals

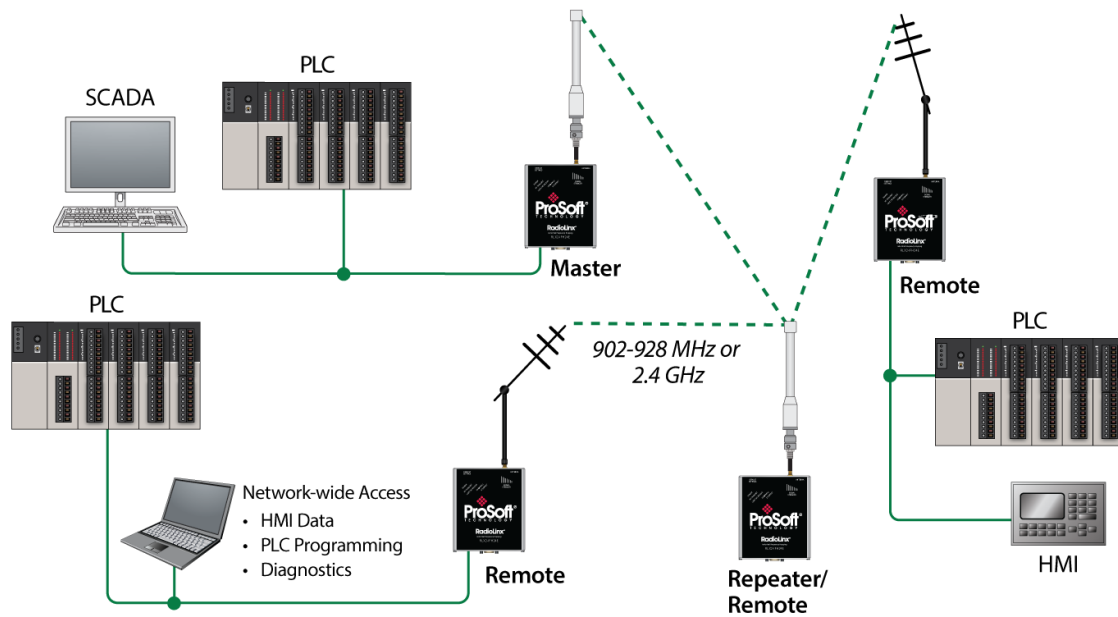
Visit www.prosoft-technology.com for current wireless approval information.

Hazardous Locations	Regulatory
UL/cUL; Class1, Div 2	CSA/CB Safety
Ex Certificate (ATEX Directive, Zone 2)	CE Mark
	FCC/IC
	ETSI

17 Appendix K - Application Examples

This chapter provides example applications using RLX2-IHx series radios.





18 Support, Service & Warranty

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18.1 Contacting Technical Support

ProSoft Technology, Inc. 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, ProSoft's 24/7 after-hours phone support is available for urgent plant-down issues. Detailed contact information for all our worldwide locations is available on the following page.

Internet	Website: www.prosoft-technology.com E-mail address: support@prosoft-technology.com
Asia Pacific (location in Malaysia)	Tel: +603.7724.2080 E-mail: asiapc@prosoft-technology.com Languages spoken include: Chinese, English
Asia Pacific (location in China)	Tel: +86.21.5187.7337 x888 E-mail: asiapc@prosoft-technology.com Languages spoken include: Chinese, English
Europe (location in Toulouse, France)	Tel: +33 (0) 5.34.36.87.20 E-mail: support.EMEA@prosoft-technology.com Languages spoken include: French, English
Europe (location in Dubai, UAE)	Tel: +971-4-214-6911 E-mail: mea@prosoft-technology.com Languages spoken include: English, Hindi
North America (location in California)	Tel: +1.661.716.5100 E-mail: support@prosoft-technology.com Languages spoken include: English, Spanish
Latin America (Oficina Regional)	Tel: +1-281-2989109 E-Mail: latinam@prosoft-technology.com Languages spoken include: Spanish, English
Latin America (location in Puebla, Mexico)	Tel: +52-222-3-99-6565 E-mail: soporte@prosoft-technology.com Languages spoken include: Spanish
Brasil (location in Sao Paulo)	Tel: +55-11-5083-3776 E-mail: brasil@prosoft-technology.com Languages spoken include: Portuguese, English

18.2 Warranty Information

For complete details regarding ProSoft Technology's TERMS & CONDITIONS OF SALE, WARRANTY, SUPPORT, SERVICE AND RETURN MATERIAL AUTHORIZATION INSTRUCTIONS, please see the documents at: www.prosoft-technology/legal

Documentation is subject to change without notice.

19 Glossary of Terms

Symbols & Numeric

802.11

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

802.11a

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

802.11b

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

802.11g

Similar to 802.11b but supports signaling rates of up to 54 Mbit/sec using OFDM modulation. Operates in the heavily used 2.4 GHz ISM band.

802.11i

Sometimes called Wi-Fi Protected Access 2 (WPA 2). WPA 2 exclusively uses the 128-bit and above Advanced Encryption Standard (AES), along with 802.1x authentication and key management features.

802.11n

Uses higher modulation rates and packet aggregation 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 (clients) to a wired network. Some access points (APs) can also bridge to other APs.

Ad hoc Mode

Wireless network framework in which devices can communicate directly with one another without using an accesspoint or a connection to a regular network. RLX2-IHx series 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 that increases the signal strength and amplifies 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 the same 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)

Bridging Client, Radio Mode

A radio in *Bridging Client* mode can connect to any Access Point, and can support one multiple Ethernet device but can only bridge IP-based traffic. See also *Repeater, Radio Mode*.

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.

D

dB_i

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

dB_m

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

A modulation mechanism that spreads the signal for a wide band, allowing reception even for overlapping data signals. 802.11b uses DSSS modulation.

Directional Antenna

Transmits and receives radio waves in a single direction.

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 frequency bands. 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.

F

Firmware

Firmware is the embedded software code that runs in hardware containing a CPU (similar to the BIOS in a personal computer). This is distinguished from the IH Browser software that is installed on the Configuration PC.

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, Antenna

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 and access to a Wide Area network (WAN), Internet or other main network.

Guard Interval (GI)

An interval of time between data symbols during transmission. 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 sending, the other must be receiving 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 from 40 to as much as 256 bits in size) 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

Local Area Network. 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.

M

MAC ID

Media Access Control address. Every device has its own MAC address which is a unique identifier used to unambiguously identify the source and destination of any packet on the network.

Mbps

Megabits per second, or a million bits per second. A measure of data rate.

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 or altered.

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 knows its device address, recognizes a message addressed to it, determines the kind of action to be taken, and extracts any data or other information contained in the message. If a reply is required, the controller constructs the reply message and sends it using Modbus protocol.

Modem

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 DTE 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-to-Multipoint

A wireless network in which one device (the access point or Master Bridge) serves multiple other devices associated to it.

Point-to-Point Network

A network consisting of a single Master radio and a single Remote radio.

Poll

A method of electronic communication.

Power Supply

A 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 several miles.

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 can receive and re-transmit the signal.

Repeater, Radio Mode

A RLX2-IHx series radio in *Repeater* mode can only connect to other ProSoft radios, but can bridge any number of Ethernet network devices attached to it. It also simultaneously functions as an access point, allowing other wireless devices to associate to it. See also *Client, Radio Mode*.

RS-232

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

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 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 (dB). Also referred to as gain loss.

Signal Strength

The strength of the radio waves received at a wireless device.

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.

SSID

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 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. A wireless security encryption mechanism in Wi-Fi Protected Access (WPA).

U

UART

Universal Asynchronous Receiver/Transmitter

W

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 original 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

A 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

A network of connected 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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