Wireless menu

Choose one of the options from the Wireless *menu:*

- *If you choose* Configuration, *you will be able to set the following radio parameters: SSID, wireless mode, channel, signaling rate, turbo mode, Tx power and preamble. For more information, see Configuration, page 3-44 for more details.*
- *If you choose* Tx Retries, *you will be able to set the Transmit Retry Limit and Signaling Rate Fallback. For more information, see Max Tx Retries and Signaling Rate Fallback, Chapter 3.*
- *If you choose* Max Throughput, *you will be able to set the Max Transmit Data Rate in Kb/s. For more information, see Max Throughput (Regulating Bandwidth), Chapter 3.*
- *If you choose* RTS/CTS *and enable RTS/CTS for a particular node, it will refrain from sending a unicast data frame until the node completes the "RTS/CTS handshake" with the receiving node. For more information, see Request to Send (RTS) / Clear to Send (CTS), page 4-5.*
- *If you choose* Rx Threshold, *you will be able to set the threshold for each mesh router on the network. For more information, see Receive (Rx) Threshold Parameter, page 4-6 for details.*
- *If you choose* Blocked Links, *you will be able to block or unblock mesh routers. For more information, see Blocked Links, page 4-8 for more details.*
- *If you want to enter the number of times that a neighbor node can fail to reply to a neighbor discovery probe before it is declared unreachable, see Link Expiration, page 4-9.*

Request to Send (RTS) / Clear to Send (CTS)

RTS/CTS allows you to fine-tune the operation of your wireless LAN. RTS/CTS will help minimize collisions between transmissions from hidden nodes on the wireless network.

When you enable RTS/CTS for a particular node, it will refrain from sending a unicast data frame until the node completes the "RTS/CTS handshake" with the receiving node.

Here is how the process works:

Node A transmits a RTS frame. Node B, on the receiving end, retrieves the RTS and sends a response with a CTS frame. Before Node A sends the data frame, it must receive a CTS frame from Node B. Both the RTS and CTS frames contain the length of the data frame to

alert other nodes to wait to access the network, while the node initiating the RTS sends its data.

To enable RTS/CTS, choose RTS/CTS *from the* Wireless *menu. The following screen will appear.*

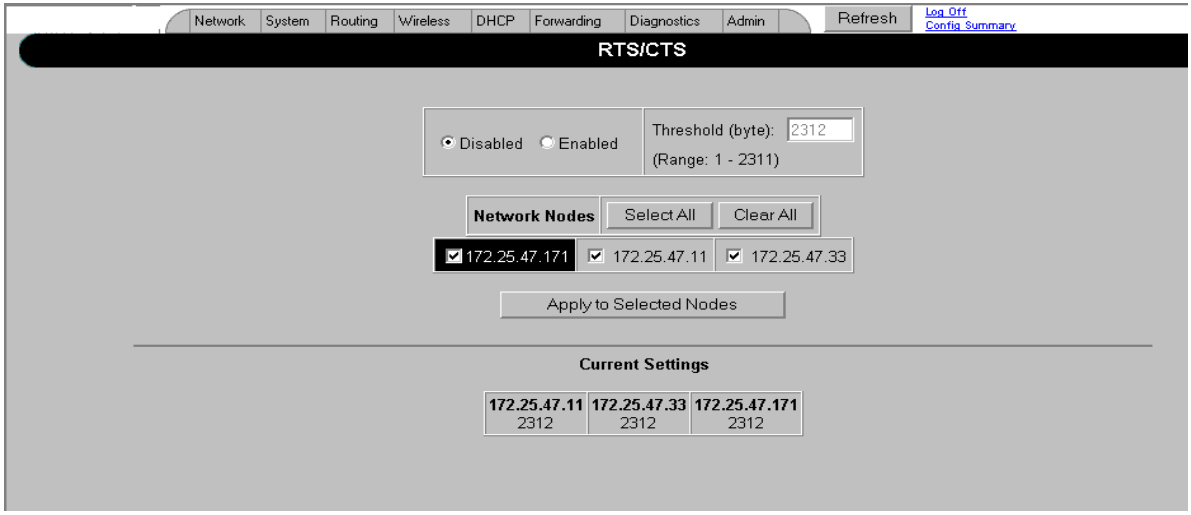


Figure 4-4: RTS/CTS

- *To turn on RTS/CTS, click the* Enabled *option.*
- *To turn off RTS/CTS, click the* Disabled *option.*
- Threshold: *The minimum size (in bytes) of unicast data frames whose transmission will be preceded by a RTS/CTS handshake. The effective range is* 50 *through* 1500. *The optimal value depends on many factors, but a starting value of 100 is recommended. (The factors include the number of hidden nodes, the statistical distribution of frame lengths, and the amount of retransmissions caused by RF interference.)*
- *Select those nodes for which you want to enable RTS/CTS and click the* Apply to Selected Nodes *button.*

Receive (Rx) Threshold Parameter

From a single mesh unit connected to a mesh network, you can set the receive threshold (given in dBm), for every mesh router in the network. The receive threshold specifies the minimum acceptable receive level for a datagram (defined for signaling rates, depending on the Wireless Mode you selected on the Wireless Configuration page). Any datagrams

received below these levels will be discarded. This will provide better network stability for networks containing marginal links, since link state changes (and the corresponding routing changes) will be avoided for marginal links which are not capable of consistent communication.

By clicking the Defaults *button, the values will go to their default values. If you enter a value of* 0 *(zero), you are turning the receive threshold parameter off.*

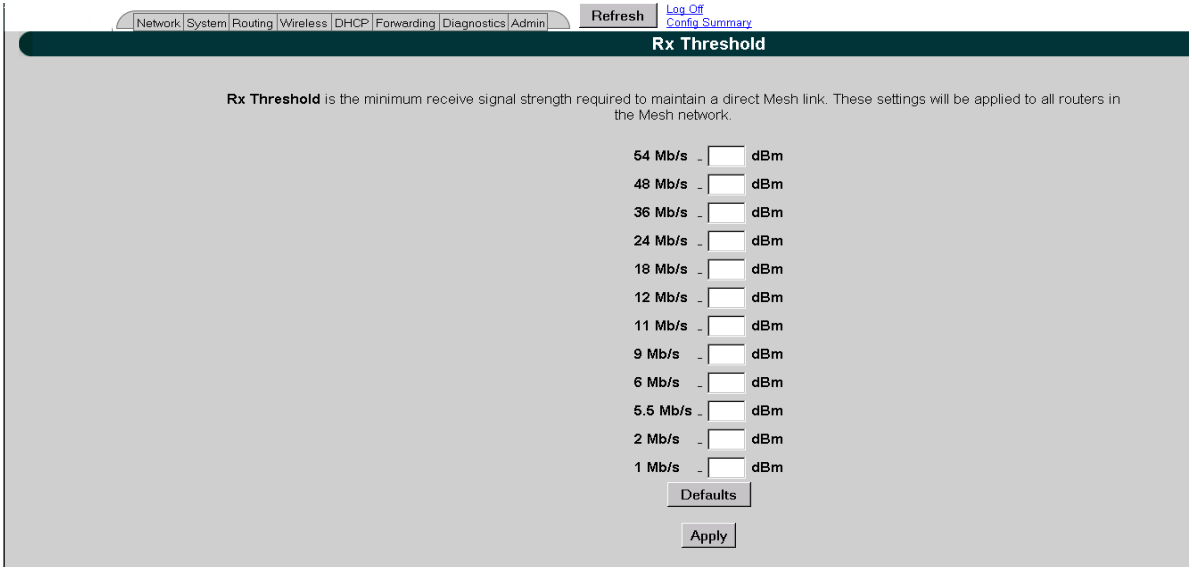


Figure 4-5: Rx Threshold page

The current Rx thresholds for your wireless mesh router(s) are listed in the Current Rx Thresholds section. Their signaling rates are also listed, as described above.

If you click Default, *it will load the current default setting for the Configurator. Click* Apply *when finished.*

Blocked Links

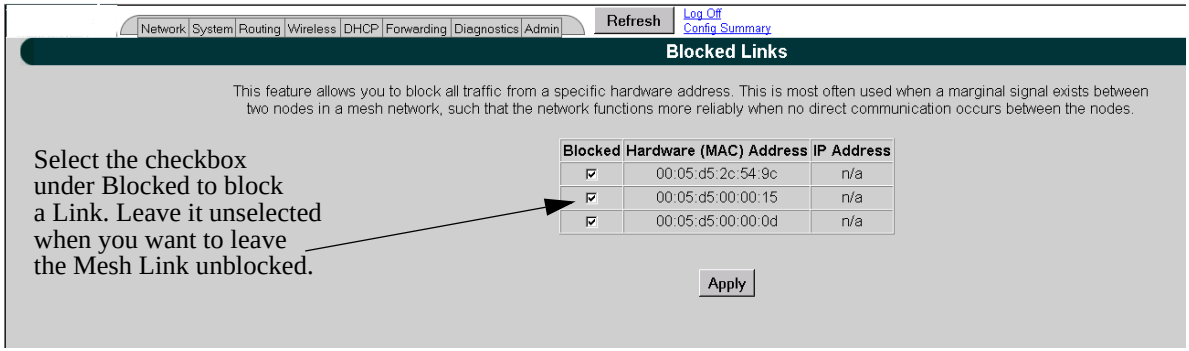


Figure 4-6: Blocking Mesh Routers

This feature allows you to block all traffic from a specific hardware address. This is most often used when a marginal signal exists between two nodes in a mesh network, such that the network functions more reliably when no direct communication occurs between the nodes. To completely block a link you must perform the same action on the remote node.

Note: *If you blocked a mesh Link, the next time it is rebooted it will remain blocked. If you want to unblock the Link, make sure that the* Blocked *check box is not selected.*

Note: *Click* Apply *when finished.*

Link Expiration

This page is only available for mesh routers.

To use this feature, choose Link Expiration *from the* Wireless *menu. The following page will appear:*

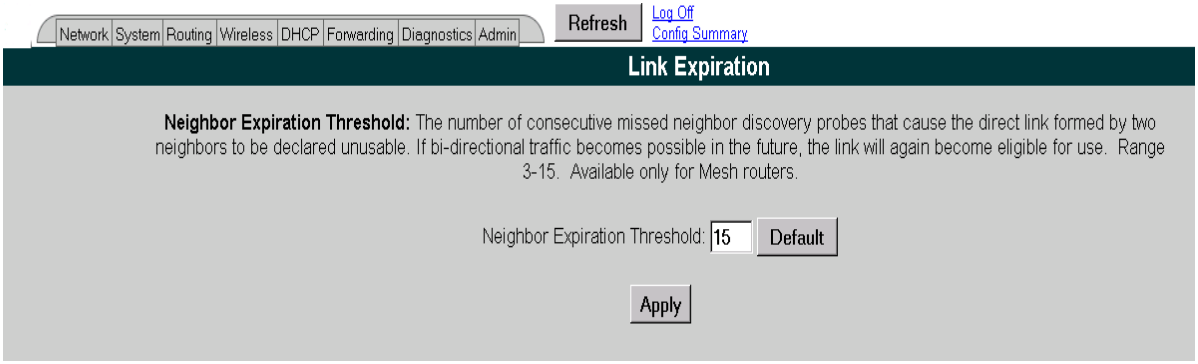


Figure 4-7: Link Expiration

Neighbor Expiration Threshold: *The number of consecutive missed neighbor discovery probes that cause the direct link formed by two neighbors to be declared unusable. If bi-directional traffic becomes possible in the future, the link will again become eligible for use. The range for this parameter is 3-15. The default is 7.*

After selecting a value for the parameter described above, select the nodes to which this value will be sent (via the Select All *or* Apply to Selected Nodes *buttons).*
Then, click Apply.

Admin Menu

Remote Control

To remotely reboot or turn off the SPEEDLAN 9200 mesh routers, choose Remote Control *from the* Admin *menu. The following page will appear.*

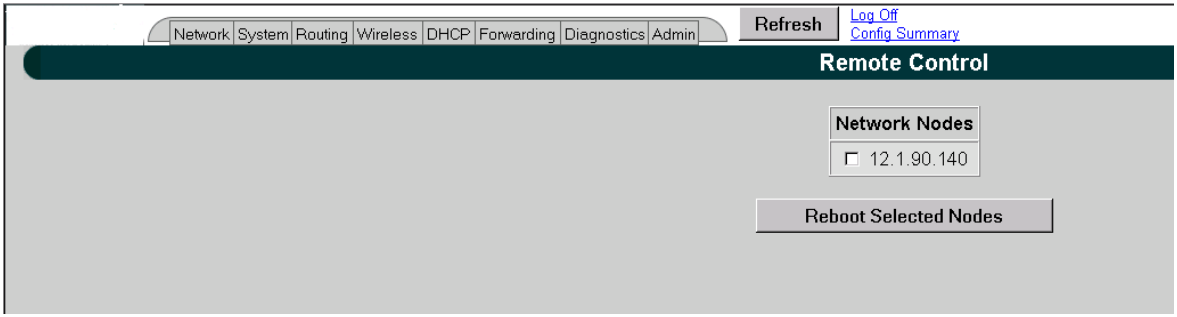


Figure 4-8: Remote Control for mesh mode

Select the mesh routers you want to reboot and click Reboot Selected Nodes. *If there are remote nodes, select them and click* Select All *or* Clear All.

Software Update

Note: *The Software Update zip file (found on www.wavewireless.com > click on Products > SPEEDLAN 9200 > SPEEDLAN 9200 Download) will contain a document describing the recent changes and any other additional information needed to perform the update. The zip file will also include the update (.wwn) file to perform the update. After you have unzipped the file, make sure you extract the update file (.wwn) file to your desktop. Then, follow the directions below.*

To update the software on the local router and/or on remote mesh routers, choose Software Update *from the* Admin *menu. The Software Update page will appear.*

Updating the Local Router

If you only need to update the software on a local router, choose Local *(under the* Software Update *submenu).*

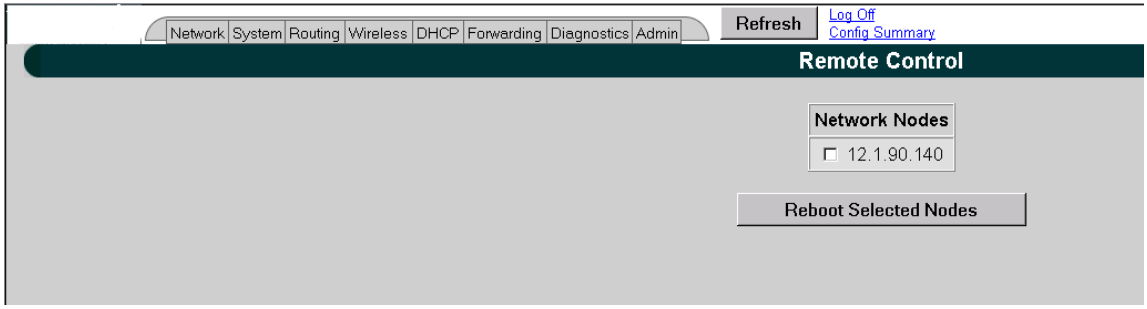


Figure 4-9: Updating the software for mesh local router

This operation is a two-step process:

1. *Upload the Software Update file. Locate the latest software file (by clicking* Browse*) and click* Upload Software Update File.
2. *Install the Software Update.*

Note: *All units are automatically rebooted after a successful upgrade.*

Updating the Software on a Local Router and Remote Router(s)

To update the software on a location router and on a remote router, choose it under the Software Update *submenu (e.g., MeshNet).*

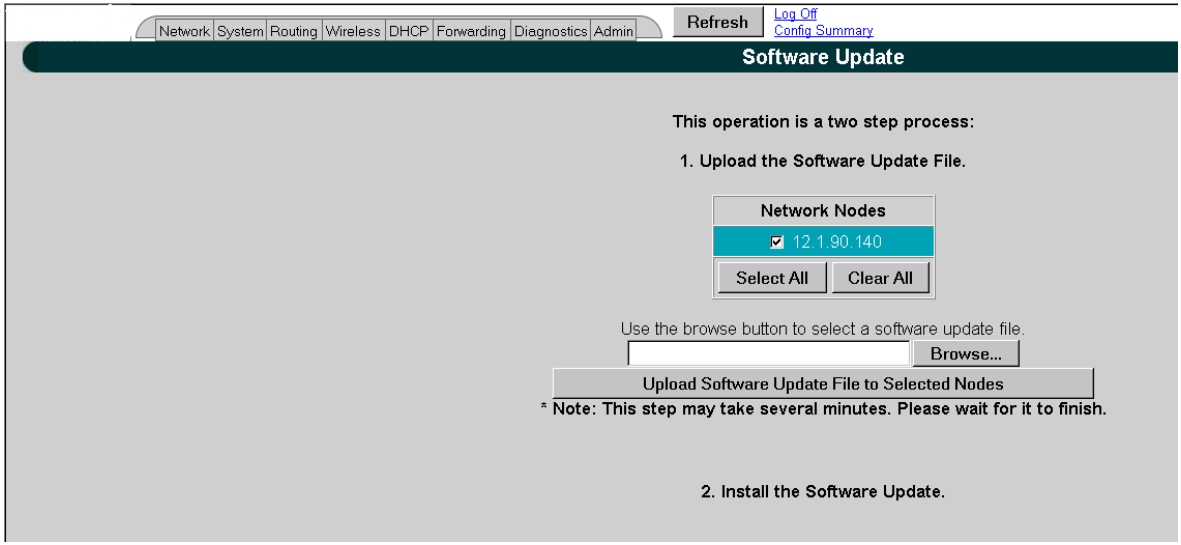
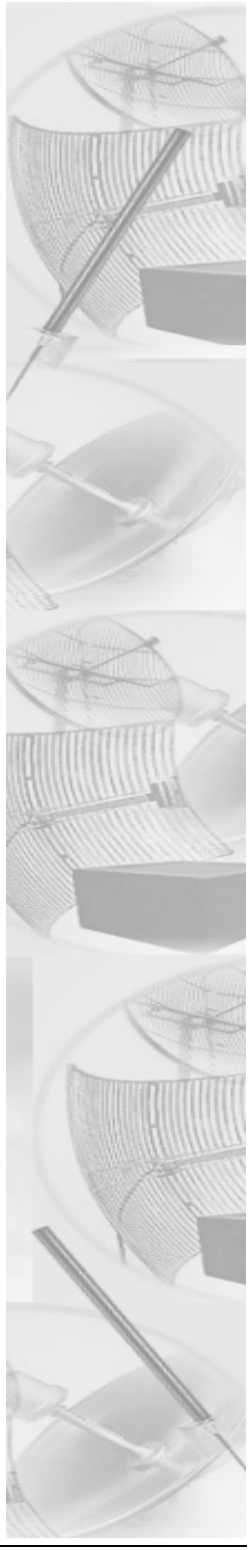


Figure 4-10: Updating the software for a local mesh and remote router

This operation is a two-step process:

1. *Select the remotes where you want to update the software. (The IP addresses that are selectable are active. If only a MAC address is listed, or a bunch of zeros, then these represent inactive devices.*
2. *Upload the Software Update file. Locate the latest software file (by clicking* Browse*) and click* Upload Software Update File to Selected Nodes.
3. *Install the Software Update.*

Notes:



Chapter 5
Using the Configurator to Set Up Special Parameters for a Star Base Station

This chapter covers only those special parameters needed to set up a base station, such as:

- *Network menu: Interfaces for Base Mode, page 5-2; Access Control List (ACL) ;Per CPE Settings, Page 5-4*
- *Admin menu: Updating the Software on a Base Station and CPE, page 5-6*

For other common configuration, see Overview of the SPEEDLAN 9200 Configurator General Main Menu, Chapter 3.

Network Menu

- *To enter the interface (router) type and network name of the interface(s), choose* Interfaces *from the* Network *menu.*
- *To define what CPE routers are participating in the network, choose* ACL Configuration
  from the Network *menu. and If you clicked Per CPE Settings Button..., page 5-8.*

Interfaces for Base Mode

The Network Interfaces page will appear when you choose Interfaces *under the* Network *menu. This is where you enter the interface type and network name of the interface or the router.*

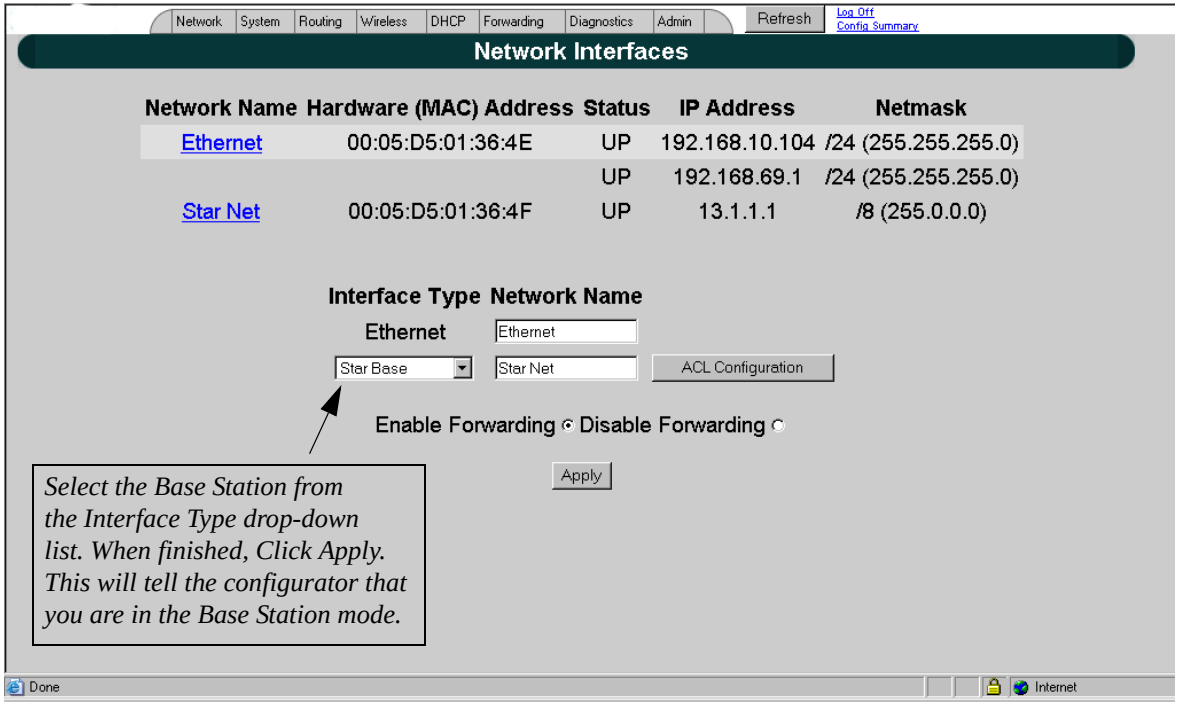


Figure 5-1: Selecting base station mode

- Network Name: *This is the fixed or wireless interface (e.g., base station).*
- Hardware Address: *In a LAN environment each network interface contains its own Medium Access Control (MAC) address which is the embedded and unique hardware number.*

- Status: *This is the state of the interface. Up - ready to pass packets; Down - cannot pass packets.*
- IP Address: *This address tells the network how to locate the computers or network equipment connected to it.*
- Netmask: *The netmask is a 4-byte number that masks the network part of the Internet Protocol IP address, so only the host computer part of the address remains.*
- Interface Type: *Select the interface (e.g., base station) from this drop-down list. (This will tell the configurator that you are in base station mode.)*
- Network Name: *The type of network for the wireless or fixed router.*
- Enable Forwarding: *Select the* Enable Forwarding *option to enable the forwarding of IP packets from the wired interface to the wireless interface and vice-versa.*
- Disable Forwarding: *Select the* Disable Forwarding *option to disable the forwarding of IP packets from the wired interface to the wireless interface and vice-versa.*
- Apply: *Click after making changes.*
- ACL Configuration: *Click to define what CPE routers are participating in the star network. When you click this button, a new page will appear as follows:*

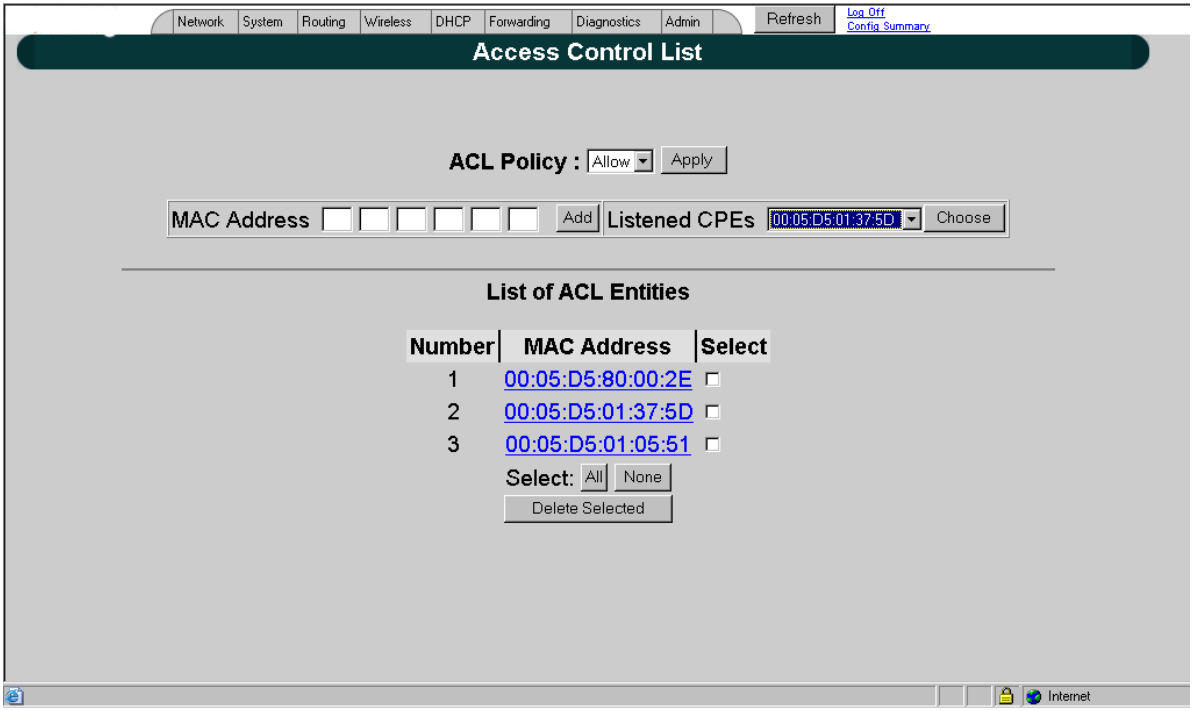


Figure 5-2: Access Control List

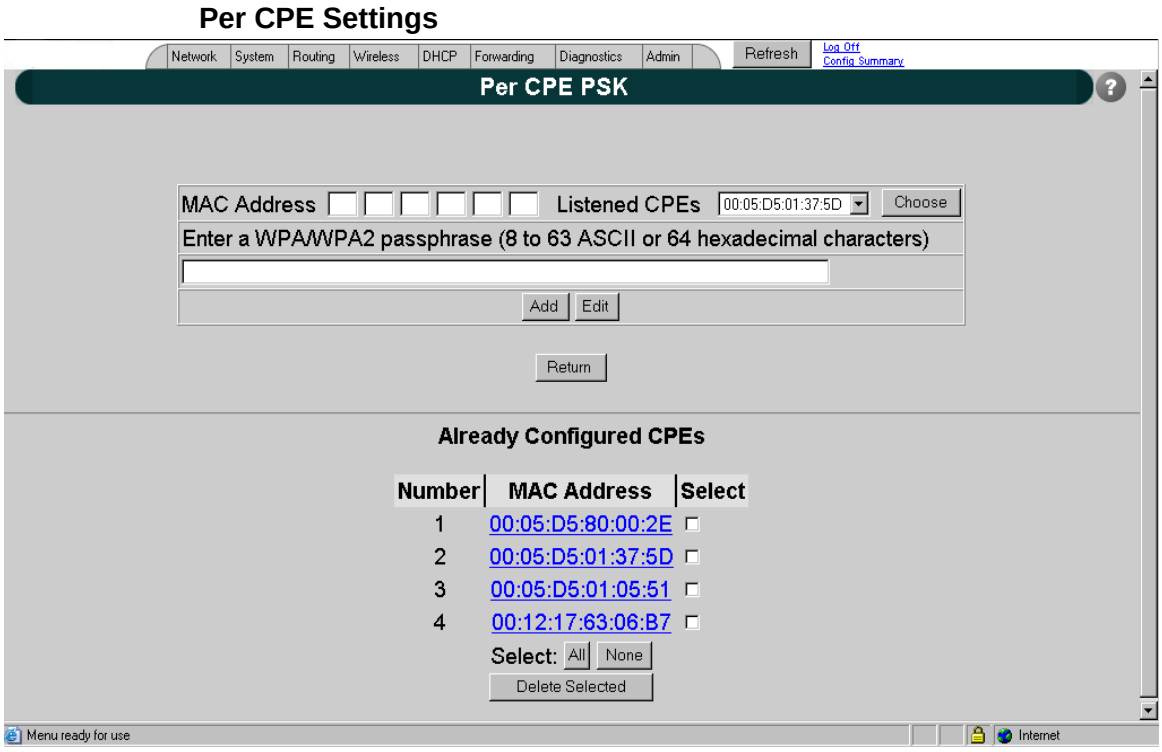


Figure 5-3: Per CPE Settings page

1. *On the top half of the page: You have to authenticate an IP address for each CPE so it is listed in the routing table. To do this, enter the hardware address of the CPE in the* Hardware (MAC) Address *text box. The IP addresses will not be active until the user logs on the particular CPE router.*
2. *Click* **Edit** *to change an existing pass phrase that was set for a given CPE. Click* Add *if the pass phrase has not been set for a given CPE.*

Note: *You can configure a base station router on this page if you delete the existing one by clicking* Delete.

Other elements on the Per CPE Settings page:

- Delete: *Click to remove the hardware address.*

Admin Menu

Remote Control

To remotely reboot or turn off the SPEEDLAN 9200 base stations, choose Remote Control *from the* Admin *menu. The following page will appear.*

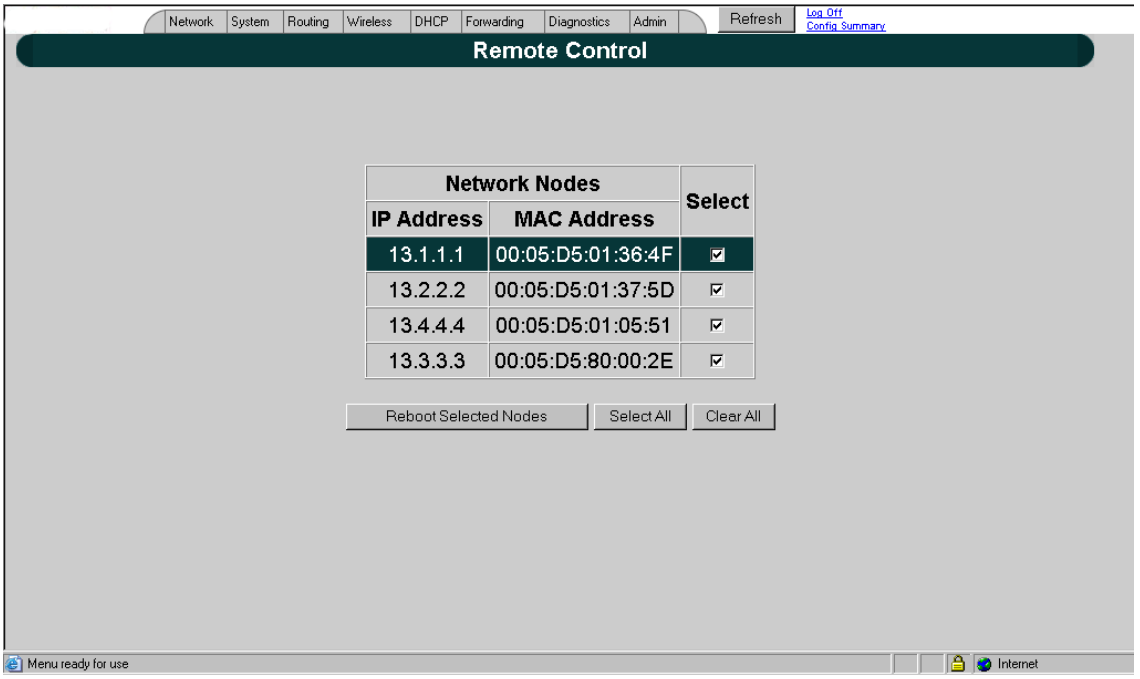


Figure 5-4: Remote Control for base mode

Select the base stations you want to reboot and click Reboot Selected Nodes.

Software Update

To update the software on the local base station or on the remotes (e.g., CPE, Ethernet, etc.), choose Software Update *from the* Admin *menu. The Software Update page will appear (for Local or Star Net).* Note: *The Software Update zip file (found on www.wavewireless.com/support + Firmware link) will contain a document describing the recent changes and any other additional information needed to perform the update. The zip file will also include the update (.wwn) file to perform the update. After you have unzipped the file, make sure you extract the update file (.wwn) file to your desktop. Then, follow these directions:*

Updating the Software on a Base Station and CPE

To update the software on a base station and on a CPE, choose Software Update from Admin tab

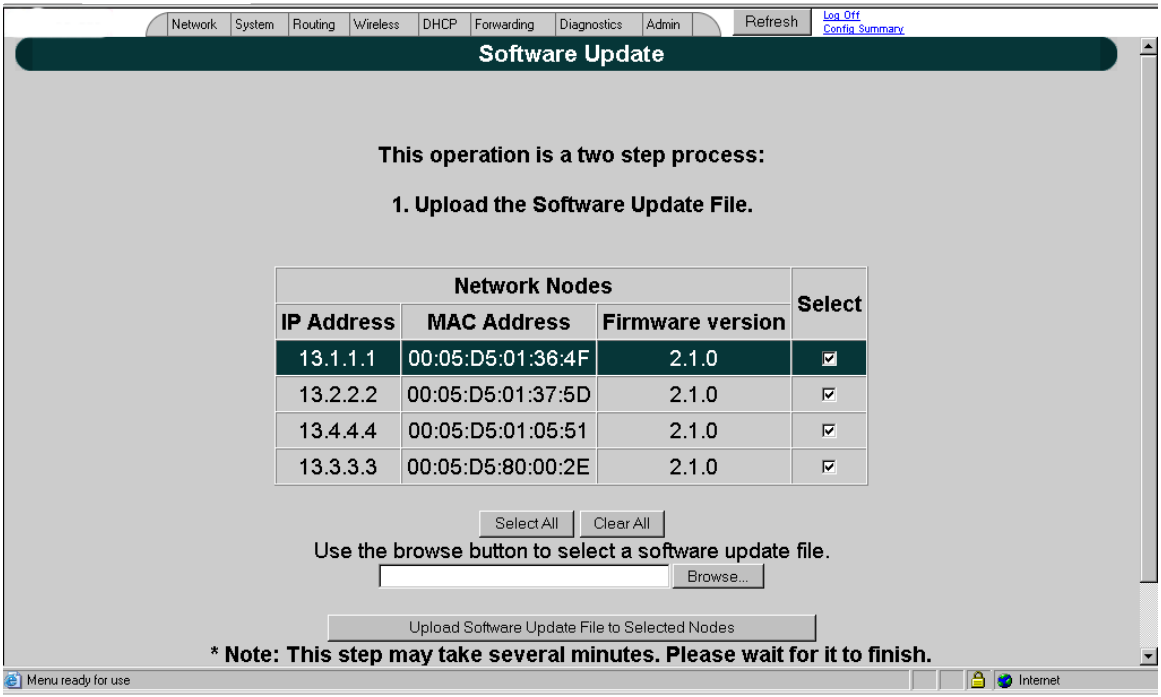
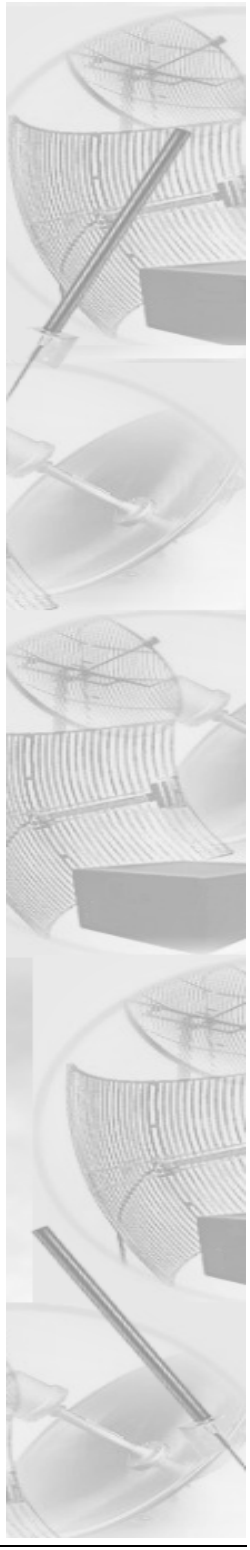


Figure 5-5: Updating software on a base station and CPE

This operation is a two-step process:

1. *Select the remotes (CPE routers) where you want to update the software. (The IP addresses that are selectable are active. If only a MAC address is listed, or a bunch of zeros, then these represent inactive devices.*
2. *Upload the Software Update file. Locate the latest software file (by clicking* Browse*) and click* Upload Software Update File to Selected Nodes.
3. *Install the Software Update.* Note: *When you updated your network in the past, the remotes would not be rebooted until the final step. This step happened after you clicked the* Reboot Updated Nodes *button. Now the remotes are automatically rebooted after a successful upgrade. The local or connected router is not rebooted until you click the* Reboot Updated Nodes *button at the end of the upgrade.*

Notes:



Chapter 6
Using the Configurator to Set Up Special Parameters for CPE Routers

This chapter covers only those special parameters needed to set up the Customer Premise Equipment (CPE), such as:

- *Network menu: Interfaces for CPE Mode, page 6-2; Base Station Information, page 6-3*
- *Admin menu: Software Update, page 6-4*

For other common configuration, see Overview of the SPEEDLAN 9200 Configurator General Main Menu, Chapter 3.

Network Menu

Interfaces for CPE Mode

The Network Interfaces page will appear when you choose Interfaces *under the* Network *menu. This is where you enter the interface type and network name of the interface or the router.*

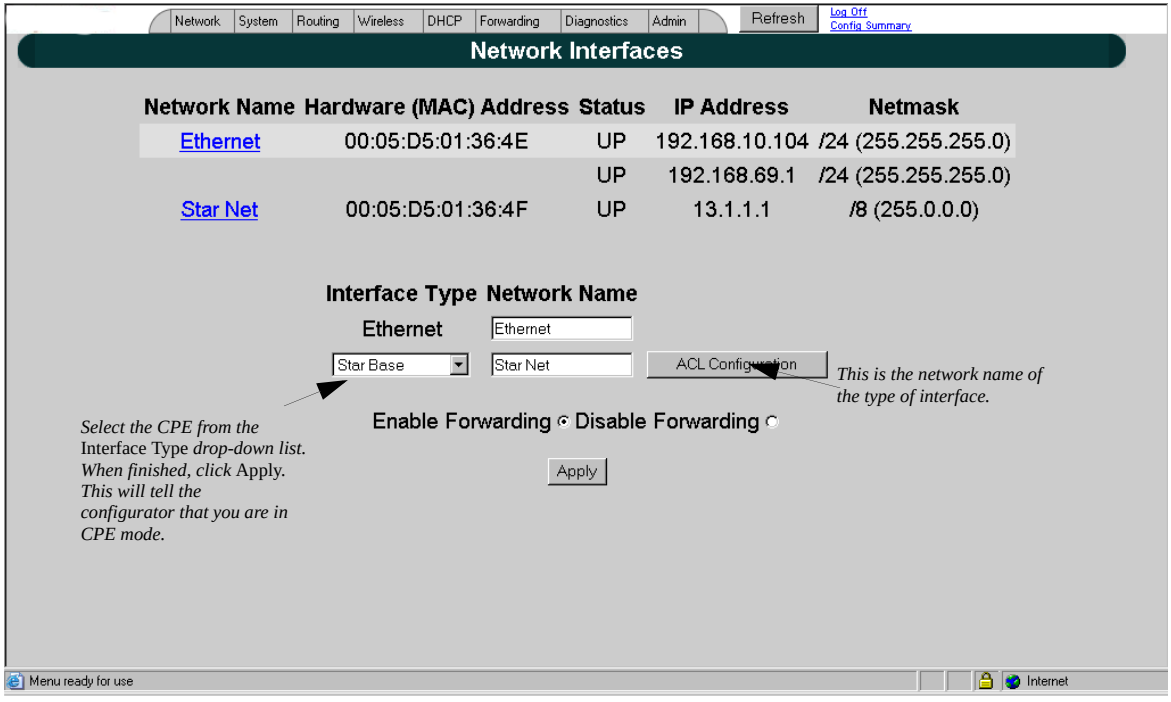


Figure 6-1: Selecting CPE mode

- Network Name: *This is the fixed or wireless interface (e.g., CPE).*
- Hardware Address: *In a LAN environment each network interface contains its own Medium Access Control (MAC) address which is the embedded and unique hardware number.*
- Status: *This is the state of the interface. Up - ready to pass packets; Down - cannot pass packets.*
- IP Address: *This address tells the network how to locate the computers or network equipment connected to it.*

- Netmask: *The netmask is a 4-byte number that masks the network part of the Internet Protocol IP address, so only the host computer part of the address remains.*
- Interface Type: *Select the CPE from the* Interface Type *drop-down list. When finished, click* Apply. *This will tell the configurator that you are in CPE mode.*
- Network Name: *The type of network for the wireless or fixed router.*
- Enable Forwarding: *Select the* Enable Forwarding *option to enable the forwarding of IP packets from the wired interface to the wireless interface and vice-versa.*
- Disable Forwarding: *Select the* Disable Forwarding *option to disable the forwarding of IP packets from the wired interface to the wireless interface and vice-versa.*
- Apply: *Click after making changes.*

Base Station Information

To see if a CPE is connected to the base station, choose Base Station Info *from the* Network *menu. The following page will appear. Note: If there is no connection to the base station, a message will appear confirming that the CPE is not connected to the base station.*

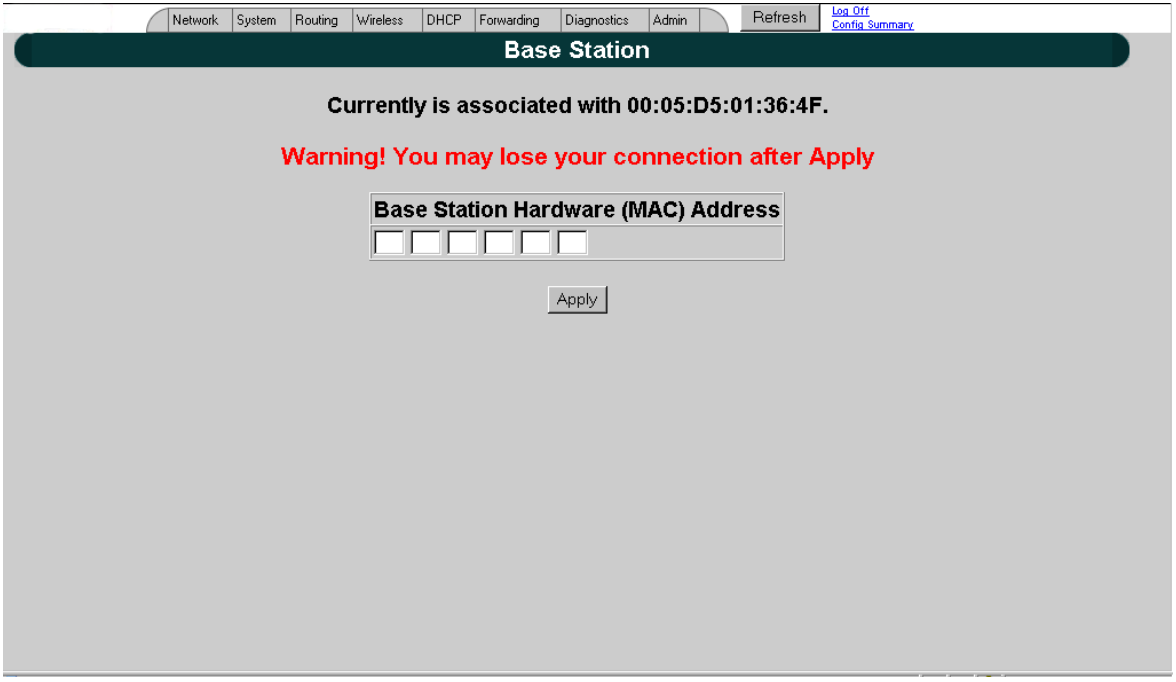


Figure 6-2: Base Station Information (for CPE mode)

Admin Menu

Software Update

Note: *The Software Update zip file (found on www.wavewireless.com/support under the Support + Firmware link) will contain a document describing the recent changes and any other additional information needed to perform the update. The zip file will also include the update (.wwn) file to perform the update. After you have unzipped the file, make sure you extract the update file (.wwn) file to your desktop. Then, follow the directions below.*

To update the software on a CPE, choose Software Update *from the* Admin *menu. The following page will appear.*

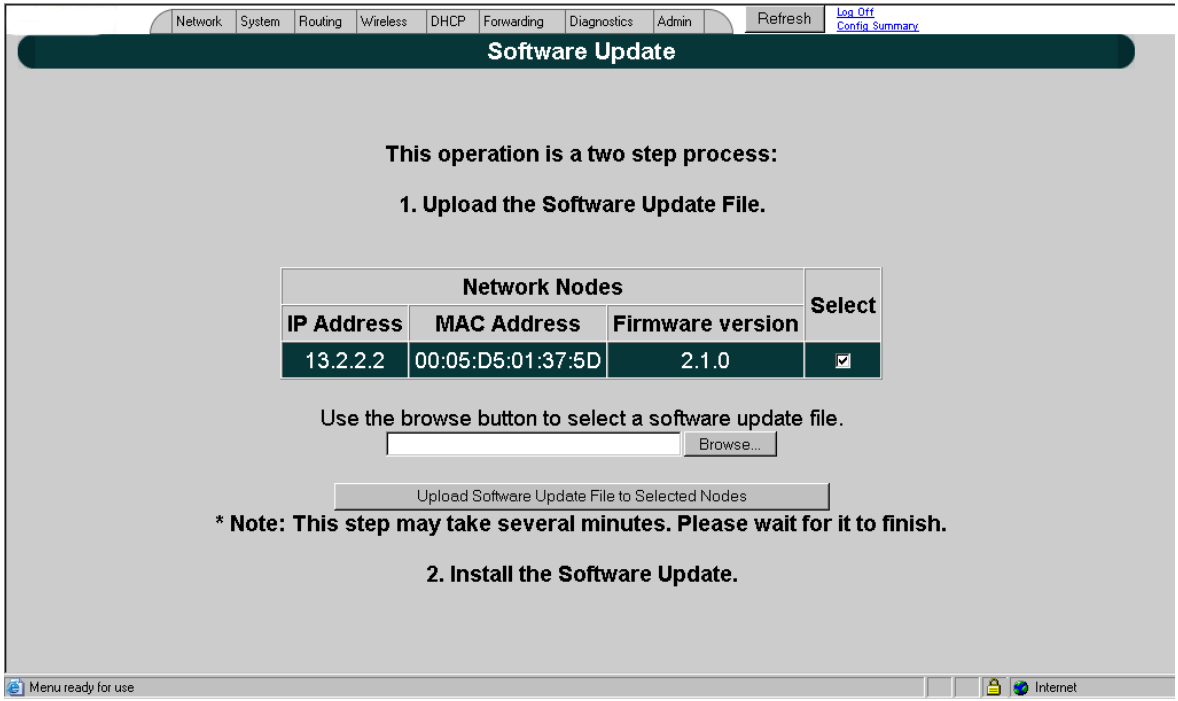


Figure 6-3: Updating the software on the CPE

If you obtain a software update file from Wave Wireless Networking you can use this page to update software on one or more SPEEDLAN 9200 routers.

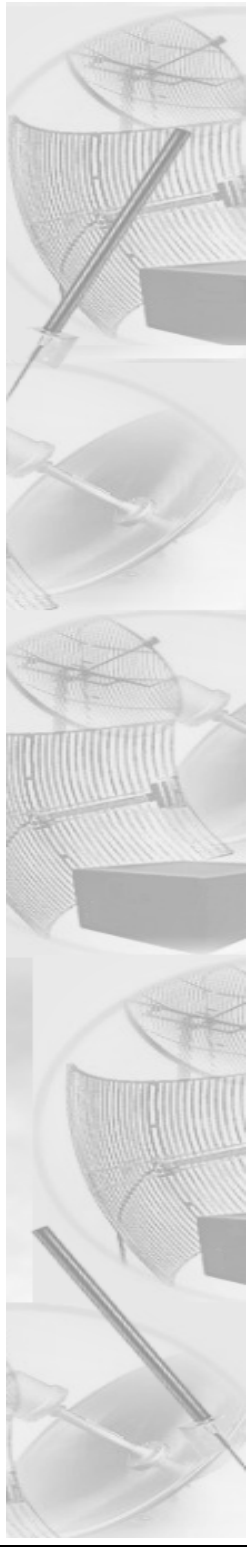
This operation is a two-step process:

This operation is a two-step process:

1. *Upload the Software Update file. Locate the latest software file (by clicking* Browse*) and click* Upload Software Update File.
2. *Install the Software Update.*

Note: *All units are automatically rebooted after a successful upgrade.*

Notes:



Chapter 7
Using the Configurator to Set Up Special Parameters for Point-to-Point Routers

This chapter covers only those special parameters needed to set up the point-to-point primary and secondary routers, such as:

- *Network menu: Interfaces for Point-to-Point Mode, page 7-2; Point-to-Point Settings, page 7-3;*
- *Admin: Remote Control for Point-to-Point Primary Routers, page 7-6; Software Update for Point-to-Point Primary or Secondary Routers, page 7-6; and Updating the Software on a Local Router and Remote Router: Primary Mode Only, page 7-7*

For other common configuration, see Overview of the SPEEDLAN 9200 Configurator General Main Menu, Chapter 3.

Network Menu

Interfaces for Point-to-Point Mode

The Network Interfaces page will appear when you choose Interfaces *under the* Network *menu. This is where you enter the interface type (or router) and network name of the interface (or the point-to-point primary or secondary router).*

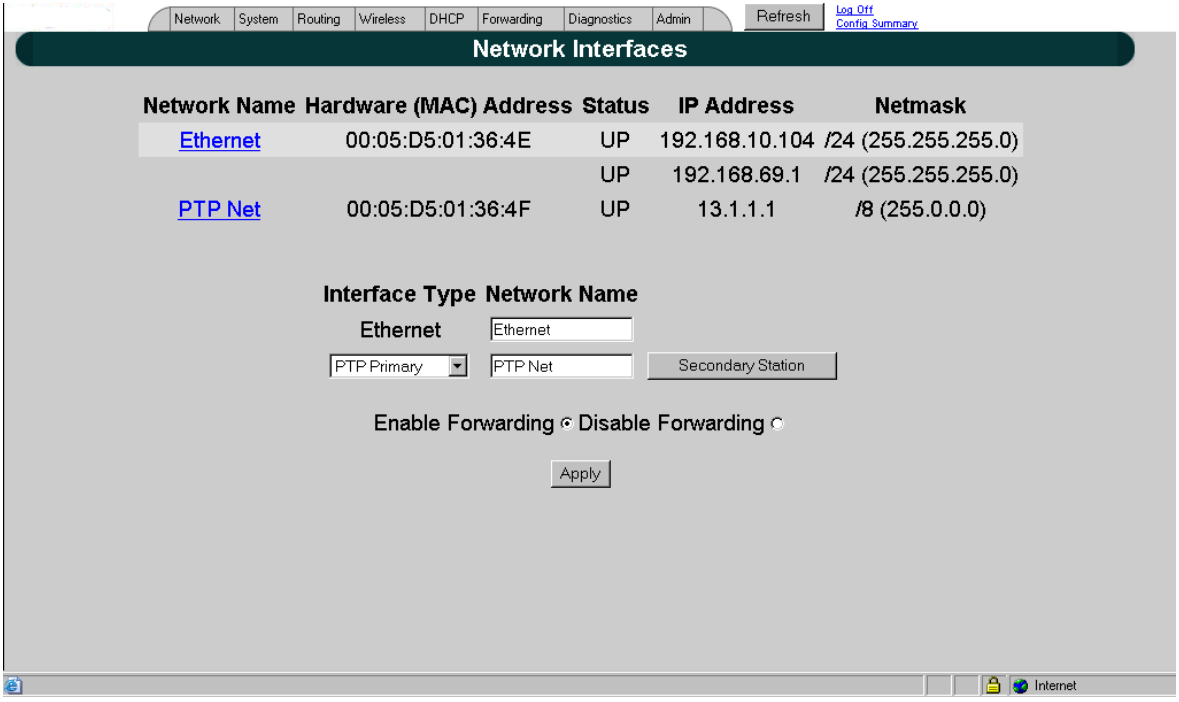


Figure 7-1: Selecting point-to-point primary or secondary mode

Important Note: *The "Pt to Pt Configure" button is only accessible in point-to-point primary mode.*

- Network Name: *This is the fixed or wireless interface (e.g., pt to pt: primary or pt to pt: secondary).*
- Hardware Address: *In a LAN environment each network interface contains its own Medium Access Control (MAC) address which is the embedded and unique hardware number.*
- Status: *This is the state of the interface. Up - ready to pass packets; Down - cannot pass packets.*

- IP Address: *This address tells the network how to locate the computers or network equipment connected to it.*
- Netmask: *The netmask is a 4-byte number that masks the network part of the Internet Protocol IP address, so only the host computer part of the address remains.*
- Interface Type: *Select the point to point router (primary or secondary) from the* Interface Type *drop-down list. When finished, click* Apply. *This will tell the configurator that you are in point to point (primary or secondary) mode.*
- Network Name: *The type of network for the wireless or fixed router.*
- Enable Forwarding: *Select the* Enable Forwarding *option to enable the forwarding of IP packets from the wired interface to the wireless interface and vice-versa.*
- Disable Forwarding: *Select the* Disable Forwarding *option to disable the forwarding of IP packets from the wired interface to the wireless interface and vice-versa.*
- Apply: *Click after making changes.*

Point-to-Point Settings

To set up your point-to-point primary or secondary routers (that is, if you are in primary mode), choose Secondary Station *from the* Network *menu. The following default page will appear. An alternative is to also click* Secondary Station *on the* Network Interfaces *page*

.

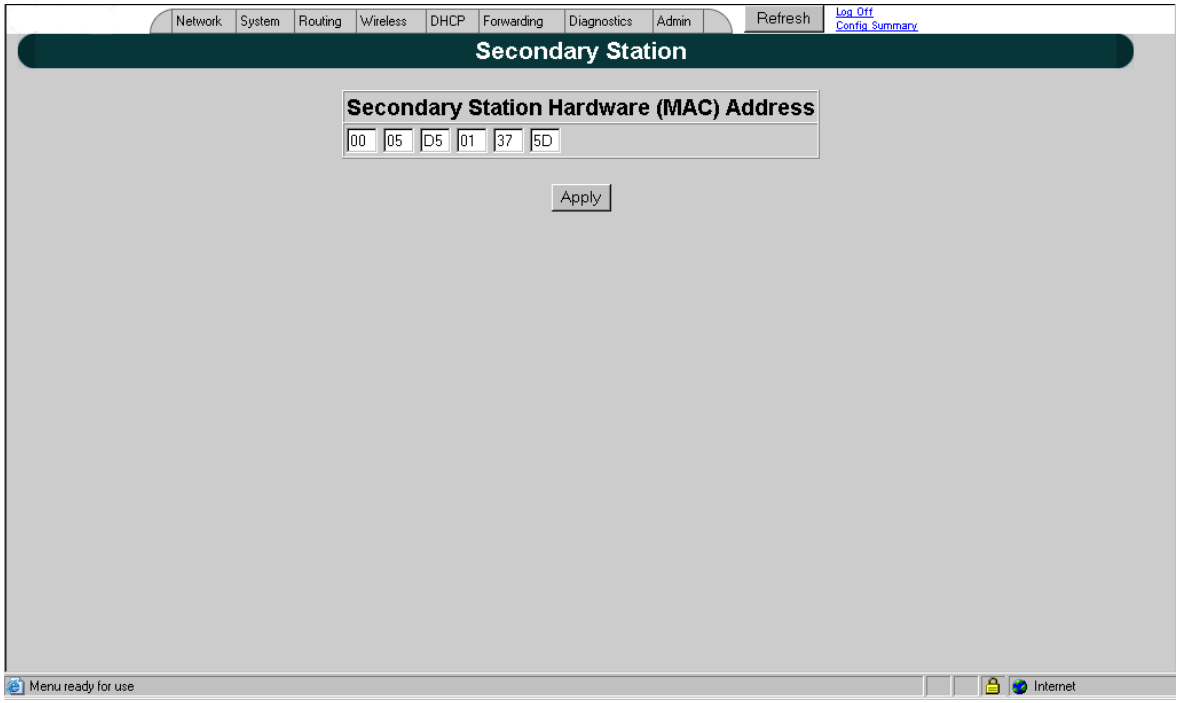


Figure 7-2: Configuring Secondary Point-to-Point Settings (if in Primary mode)

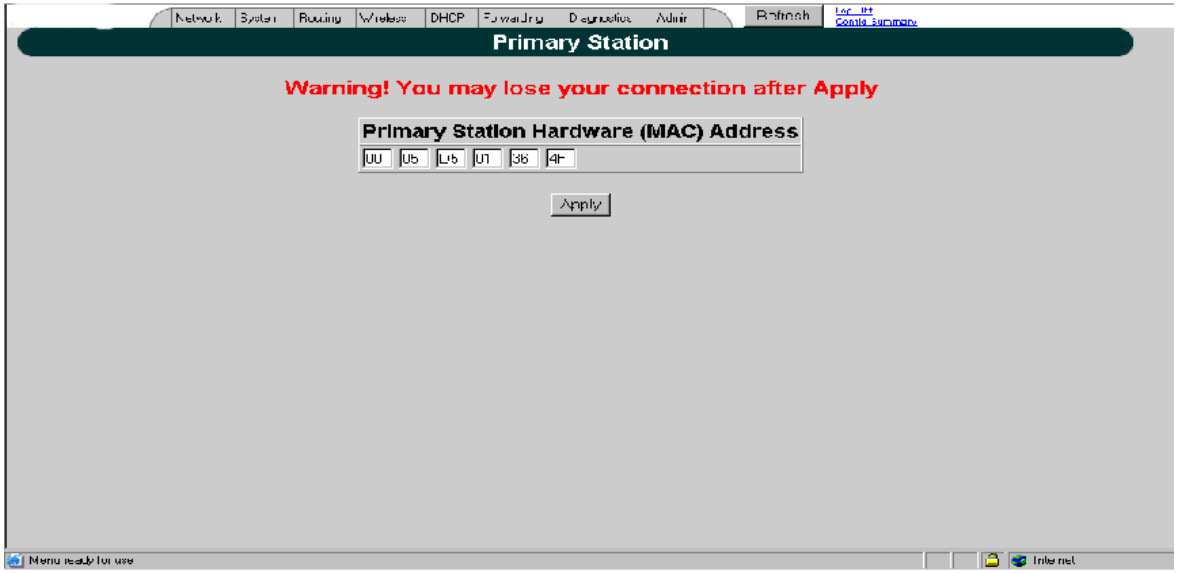


Figure 7-3: Configuring Primary Node Settings (in Secondary mode)

Activation Primary and Secondary Routers

- Activating Primary Router: Enter the PTP Net MAC address for the Secondary router. This Number is given in the Network Interface screen of the Secondary router. Then, clickApply to Activate selection
- Activating Secondary Router: Enter the PTP Net MAC address for the Primary router. This Number is given in the Network Interface screen of the Primary router.
- Then, click Apply to Activate selection

Admin Menu

Remote Control for Point-to-Point Primary Routers

To remotely reboot or turn off the SPEEDLAN 9200 point-to-point primary routers, choose Remote Control *from the* Admin *menu. The following page will appear.*

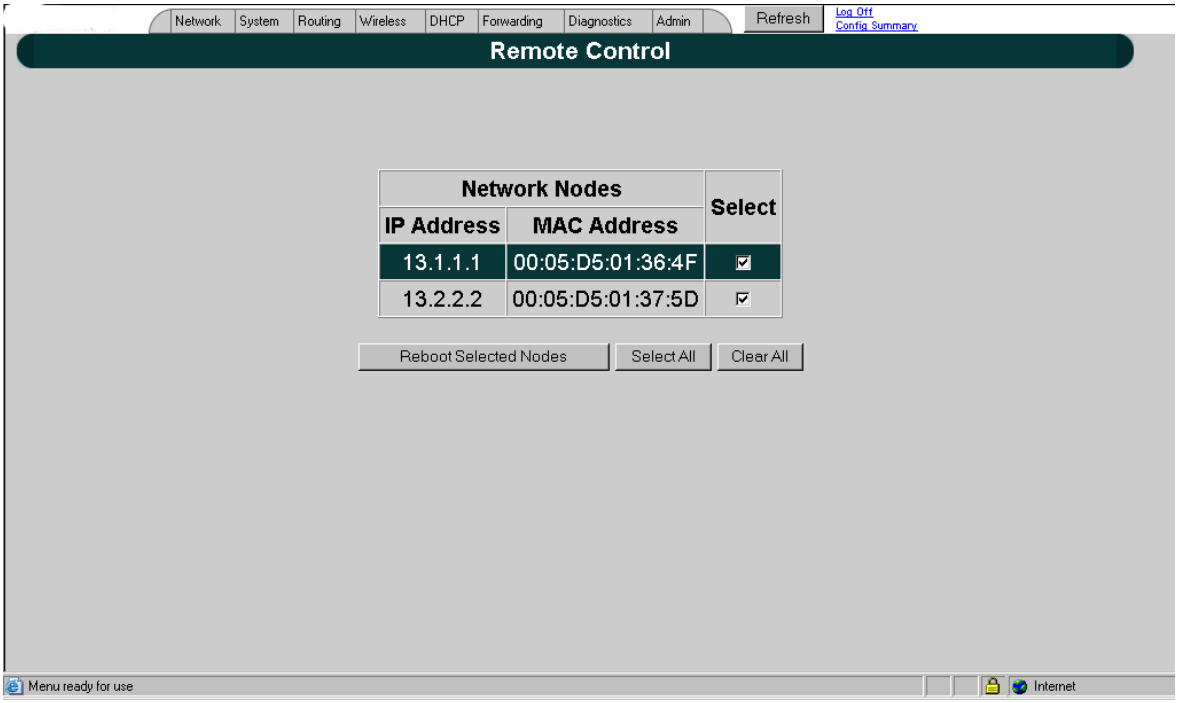


Figure 7-4: Remote Control for point-to-point primary mode (in Primary mode)

Select the primary point-to-point routers you want to reboot and click Reboot Selected Nodes.

All other common configuration information can be found in General Functions of the Configurator, Chapter 3.

Software Update for Point-to-Point Primary or Secondary Routers

Note: *The Software Update zip file (found on www.wavewireless.com/support + Firmware link) will contain a document describing the recent changes and any other additional information needed to perform the update. The zip file will also include the update (.wwn) file to perform the update.*

After you have unzipped the file, make sure you extract the update file (.wwn) file to your desktop. Then, follow the directions below.

To update the software on the local router or on the remote point-to-point routers, choose Software Update *from the* Admin *menu. The Software Update page will appear.*

Updating the Software on a Local Router and Remote Router: Primary Mode Only

To update the software on a location router and on a remote point-to-point primary router, choose it under the Software Update *submenu.*

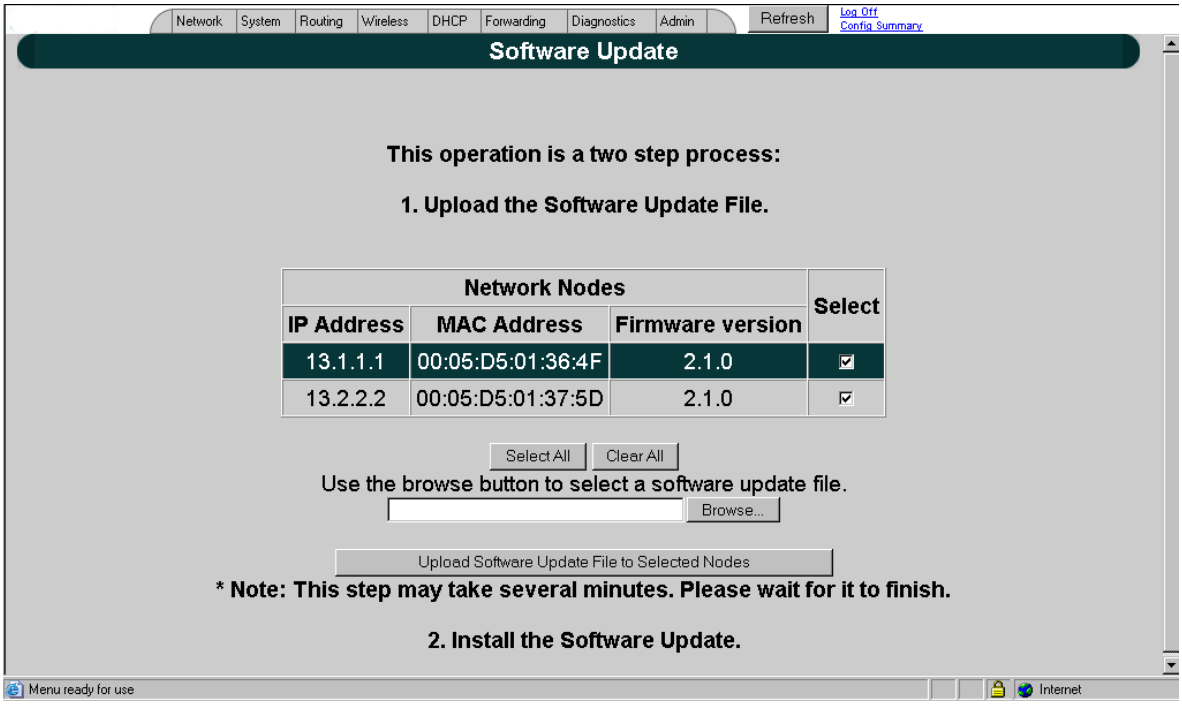


Figure 7-5: Updating the software for a point-to-point primary router (in Primary mode only)

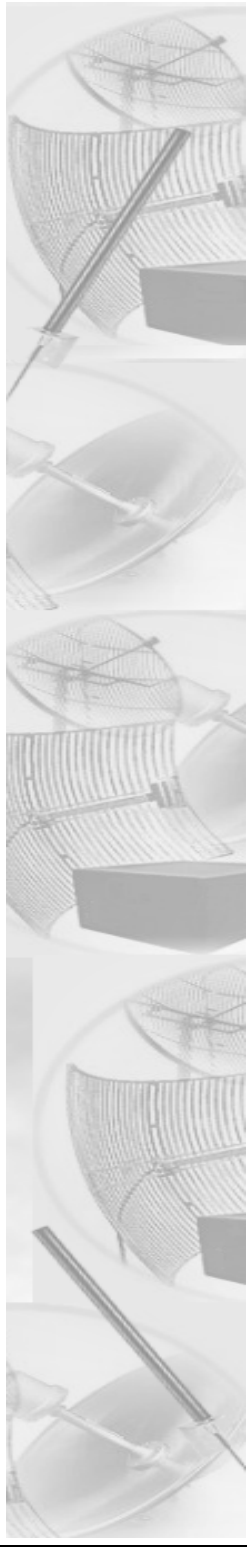
This operation is a two-step process:

1. *Select the point-to-point routers where you want to update the software. (The IP addresses that are selectable are active. If only a MAC address is listed, or a bunch of zeros, then these represent inactive devices.*
2. *Upload the Software Update file. Locate the latest software file (by clicking* Browse*) and click* Upload Software Update File to Selected Nodes.

3 *Install the Software Update.* All other common configuration information can be found in *General Functions of the Configurator, Chapter 3*.

Notes:_____

_____



Chapter 8
Configurating Security Parameters

This chapter covers those parameters needed to set up Security

INTRODUCTION

Our previous 9200 products supported AES [advanced encryption standard] encryption used a single static key for all links in the mesh and all type of traffic over them. The new release adds support to WPA with TKIP & MIC and WPA2 with AES-CCMP which include a dynamic key management system. The new design also allows "Per Group" encoding of unicast and multicast packets as well as simultaneous and independent "Per Link" encoding of unicast packets in each link in the network.

Wireless Security in SPEEDLAN 9200 units provide the following types of security:

- *WEP*
- *WPA*
- *WPA2 (RSN)*
- *WPA/WPA2*

WPA and WPA2 are supported in SPEEDLAN Phase2 Release to provide the security for SPEEDLAN units in Mesh, Star, and PTP Network Topologies.

WPA is a subset of the IEEE 802.11i specification. It replaces WEP with a strong new encryption technology Temporal Key Integrity Protocol (TKIP) with Message Integrity Check (MIC). It also provides a authentication scheme using either IEEE 802.1x or pre-shared key (PSK) technology.

Like WPA, WPA2 supports IEEE 802.1x or PSK technology. It also includes a new advanced encryption mechanism Advanced Encryption Standard (AES) using the Counter-Mode/CBC-MAC Protocol (CCMP).

There are 2 modes of WPA and WPA2 certification - Enterprise and Personal. Table below lists the authentication scheme and Encryption method used in each certification mode.

Table 1: Modes of Certification

	WPA	WPA2
Enterprise Mode	Authentication IEEE 802.1 X/EAP Encryption: TKIP/MIC	Authentication IEEE 802.1X/EAP Encryption: AES-CCMP
Personal Mode	Authentication: PSK Encryption: TKIP/MIC	Authentication: PSK Encryption: AES-CCMP

WPA ad WPA2 Personal Mode certification is supported in SPEEDLAN 9200 Phase2 to provide per-link, per-packet encryption via TKIP with WPA or AES with WPA2.

PSK Authentication

PSK based authentication is supported in all three Network Topologies - Mesh, Star and Point to point (PTP). Using PSK authentication scheme, user configures a pre-shared key on both supplicant and authenticator SPEEDLAN units. This pre-shared key is used as the Pairwise Master Key (PMK) to derive four separate keys that will be used in protecting the link between two SPEEDLAN units. The collection of all four keys together is referred to as the pairwise transient key (PTK).

Table below lists the authenticator and supplicant in each Network Topology.

Table 2: PSK Authentication

	Mesh	Star Base	Star CPE	PTP Primary	PTP Secondary
Authenticator	**X**	**X**		**X**	
Supplicant	**X**		**X**		**X**

Cipher Suites and Key Management

Cipher suites are sets of encryption and integrity algorithms designed to protect radio communication on wireless LAN, and they are:

- *WEP (Wired Equivalent Privacy) - a 802.11 standard encryption algorithm originally designed to provide your wireless LAN with the same level of privacy available on a wired LAN. However, the basic WEP construction is flawed, and an attacker can compromise the privacy with reasonable effort.*
- *TKIP (Temporal Key Integrity Protocol) - a suite of algorithms surrounding WEP that is designed to achieve the best possible security on legacy hardware built to run WEP.*
- *CCMP (Counter Mode-CBC MAC) - an AES based cipher; which yields the high level of data privacy required by some enterprises, government agencies and other organizations. CCMP support is mandatory in both the 802.11i specification and WPA2. Pre-authentication will be optional for both 802.11i and WPA2.*

WPA replaces WEP with TKIP. WPA2 includes the advanced encryption mechanism AES into the support.

SPEEDLAN unit uses the following cipher suites to protect unicast messages in Mesh, Star, and PTP networks, and the multicast/broadcast messages in Star, and PTP networks:

- *CCMP;*
- *TKIP;*
- *WEP-64, WEP-128 and 156.*

SPEEDLAN9200 unit uses the following cipher suites to protect multicast/broadcast messages in Mesh network:

CCMP with Static key and hardware decryption (weak security, higher performance);

CCMP with software decryption (strong security, lower performance).

CONFIGURATIONS

SPEEDLAN 9200 supports four security types - WEP, WPA, WPA2, and WPA/WPA2.

Table below lists the authentication scheme and Encryption method for each security type:

WPA, WPA2, WPA/WPA2

Table 3: Security Types for Authentication and Encryption

	Authentication	Encryption
WEP	N/A	WEP
WPA	PSK	TKIP
WPA2	PSK	AES
WPA/WPA2	PSK	TKIP or AES

Path to access the Security Page from Web Configurator is: Main Page->Network-> Security.

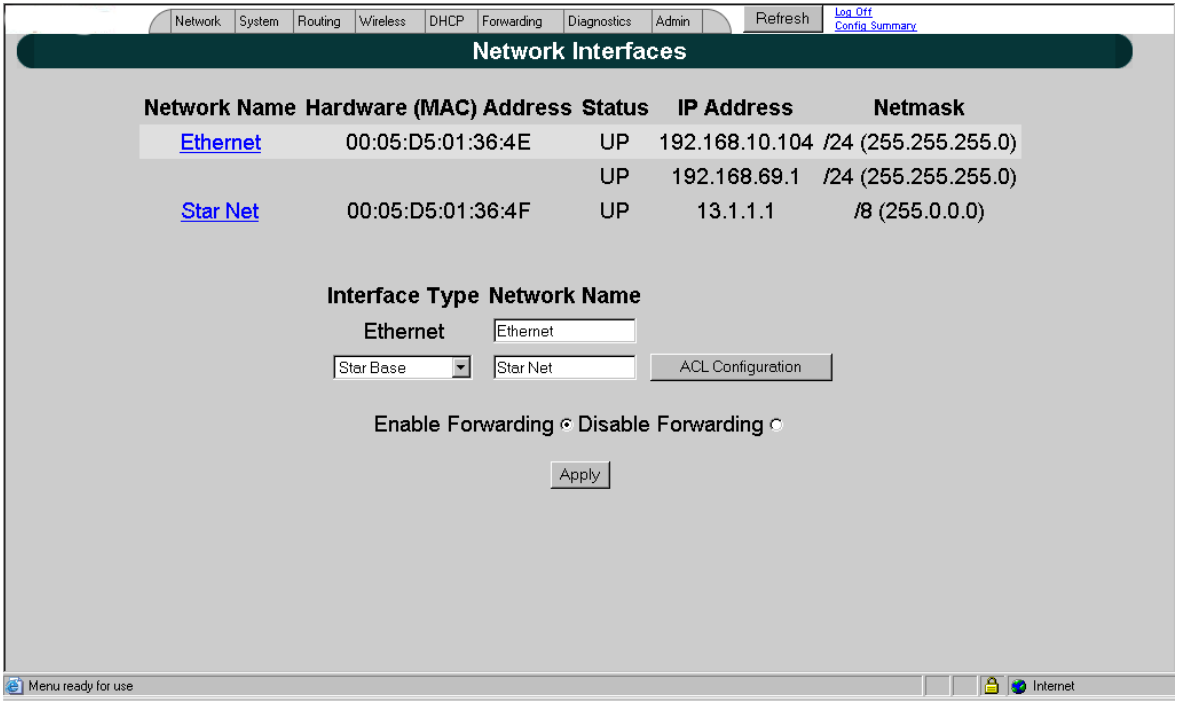


Figure 8-1: Network Security-Interfaces

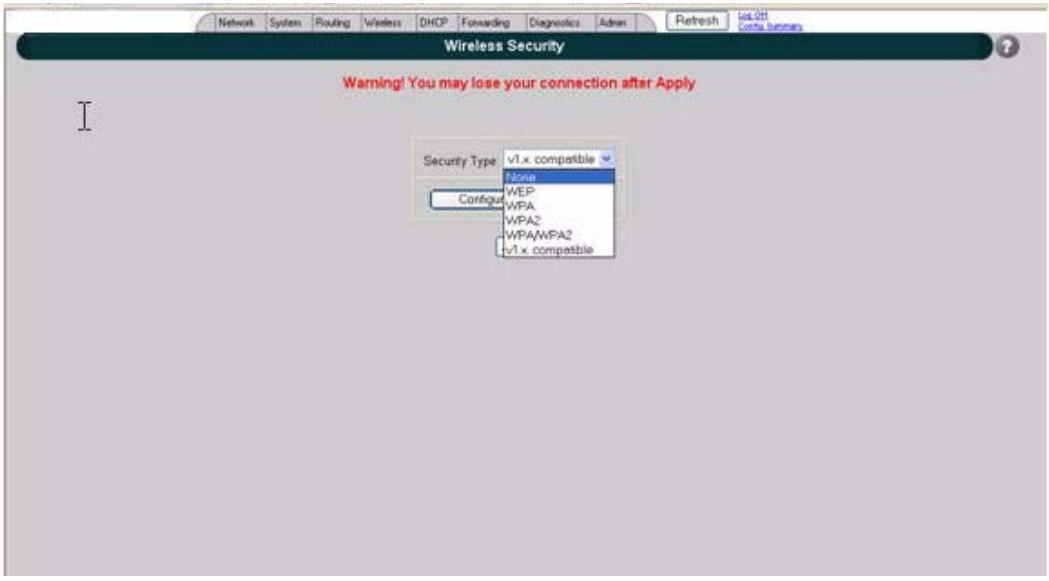
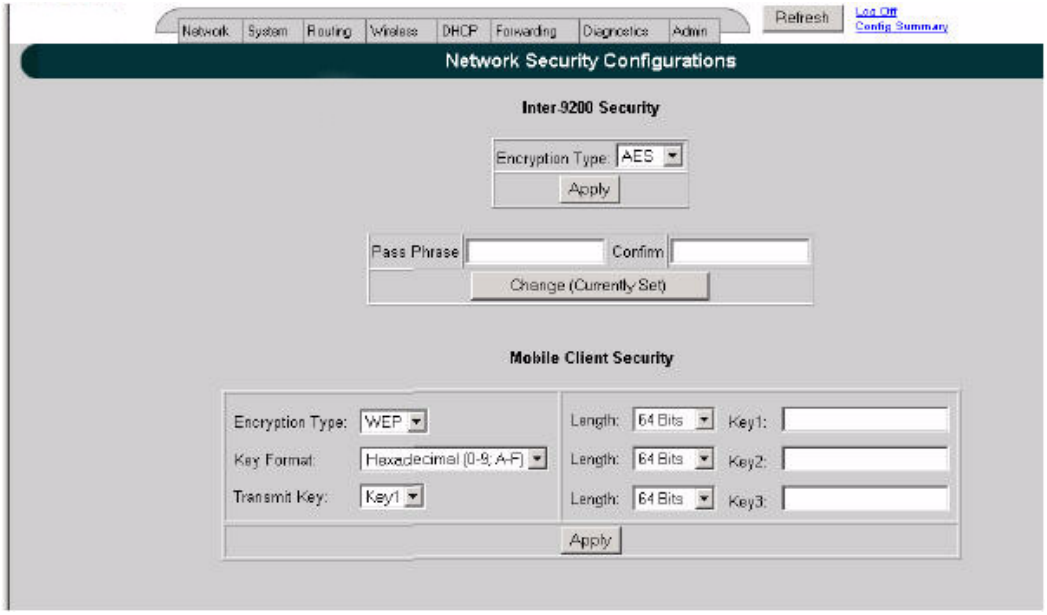


Figure 8-2: Network Security-Star Base Mode

This screen appears if "v1.x compatible" is selected from the above screen.



If one or more routers in your network is operating with Firmware version 1.0.8 or older, then some security options are not available on the older routers. However, you can select "v1.x compatible" from the drop-down menu titled ***Security Type*** *on the Wireless Security screen, which will allow the newer routers to operate with AES encryption, which all older versions are already equipped with.*

Please contact sales or customer service to request a Firmware upgrade for your routers operating with an older Firmware version than is listed as the most current release in the Fimware History section of this manual.

Star Base Mode

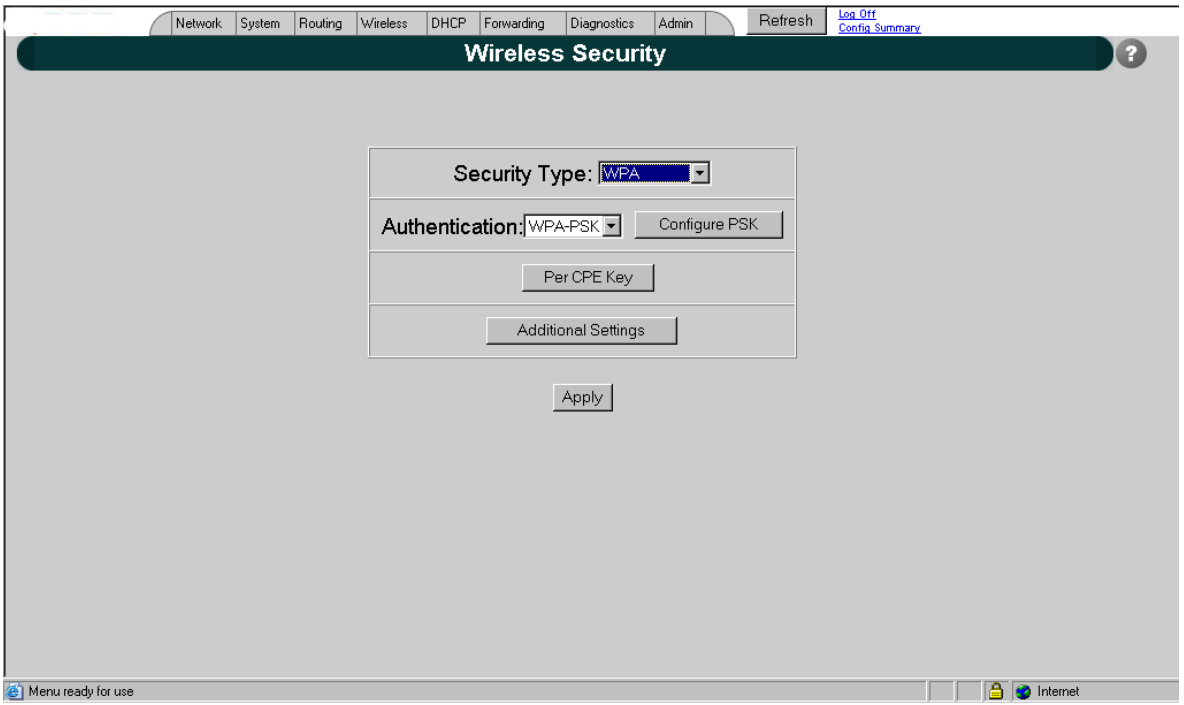


Figure 8-3: Network Security-Wireless Security

Security Type	WPA, WPA2, WPA/WPA2, or V.1X Compatible
Authentication	WPA-PSK
Configure PSK	to access the "WPA Pre-shared Key" Page to Configure the PSK.
Per CPE Key	to access "Per CPE PSK" Page.
Additional Settings	to access the "Additional Settings" Page.
Apply	changes are taken effect when this button is entered.

Per CPE Key

When PSK is used in a Star network, CPEs can negotiate a pairwise cipher. However, any CPE can derive the pairwise keys of any other that uses the same PSK by capturing the first two messages of the 4-Way Handshake. This provides malicious insiders with the ability to eavesdrop as well as the ability to establish a man-in-the-middle attack.

To prevent such kind of attacks, SPEEDLAN9200 supports per station PSK.

The "Per CPE PSK" configuration page is used to configure a unique PSK for each CPE.

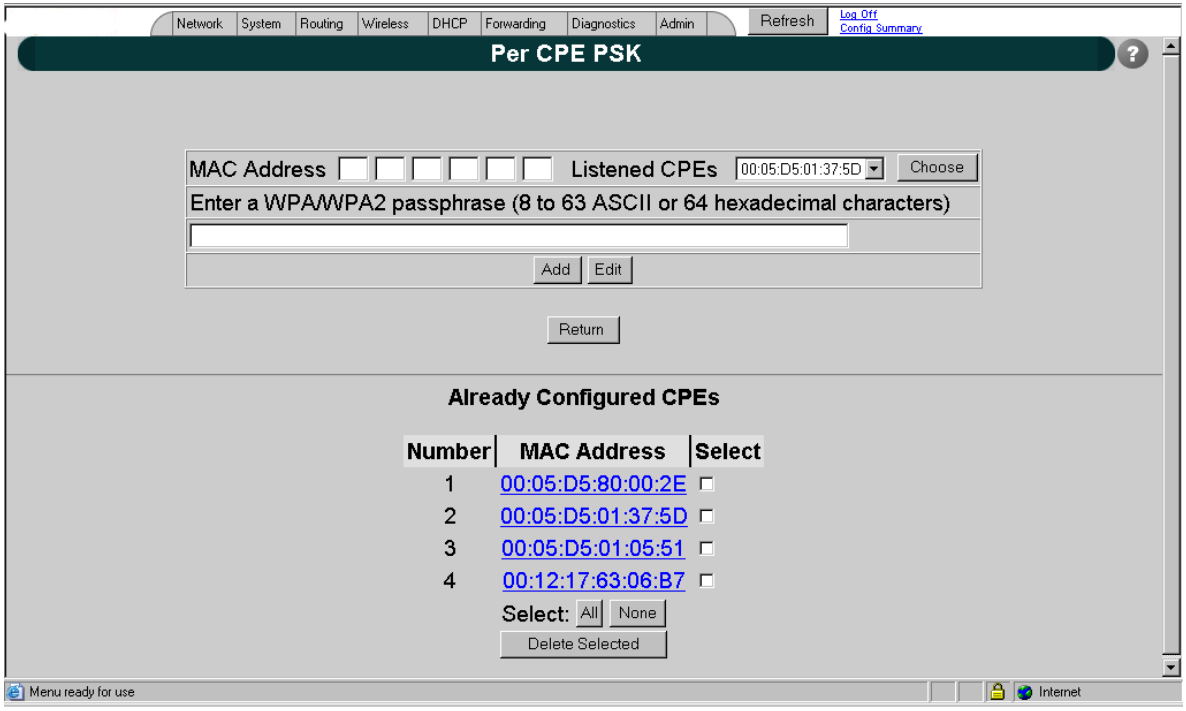


Figure 8-4: Network Security-Per CPE PSK

MAC Address	*MAC Address of the remote CPE.*
WPA/WPA2 Passphrase	*passphrase for the PSK*
Already Configured CPEs	*CPEs' MAC Address list*

Additional Security Settings

Figure 8-5: Network Security-Additional Security Settings

GTK update interval (sec)	*Specify the time interval (in seconds) for re-keying GTKs (Group Transit Key) GTK is the encryption keys for Broadcast/Multicast frames. The Star Base unit generates and*

distributes a new group key on the regular basis.

GMK update interval (sec) *Specify the time interval (in seconds) for re-keying GMK (Group Master Key). GMK is used internally to generate GTKs.*

Star CPE Mode

Security Type *WPA, WPA2 or WPA/WPA2*

Authentication *WPA-PSK*

Configure PSK *to access the "WPA Pre-shared Key" Page to configure the PSK.*

Apply *changes are taken effect when this button is entered.*

Figure 8-6: Network Security-Star CPE Mode

Mesh Mode

Security Type	*WPA, WPA2 or WPA/WPA2*
Authentication	*WPA-PSK*
Configure PSK	*to access the "WPA Pre-shared Key" Page to configure PSK*
Enable Per Node Security	*enable/disable Per Node Security*
Per Node Key	*to access "Per Node PSK" Page*
Additional Settings	*to access the "Additional Settings" Page.*
Apply	*changes are taken effect when this button is entered.*

Figure 8-7: Network Security-Per Node Key

Security Type	*WPA, WPA2 or WPA/WPA2*
Authentication	*WPA-PSK*
Configure PSK	*to access the "WPA Pre-shared Key" Page to configure PSK*
Enable Per Node Security	*enable/disable Per Node Security*
Per Node Key	*to access "Per Node PSK" Page*
Additional Settings	*to access the "Additional Settings" Page.*
Apply	*changes are taken effect when this button is entered*

Per Node PSK

SPEEDLAN9200 supports per link PSK for stronger security. The "Per Node PSK" configuration page is used to configure a unique PSK for the link between this unit and any one of the remote units.

Figure 8-8: Network Security-Per Node PSK

Additional Settings

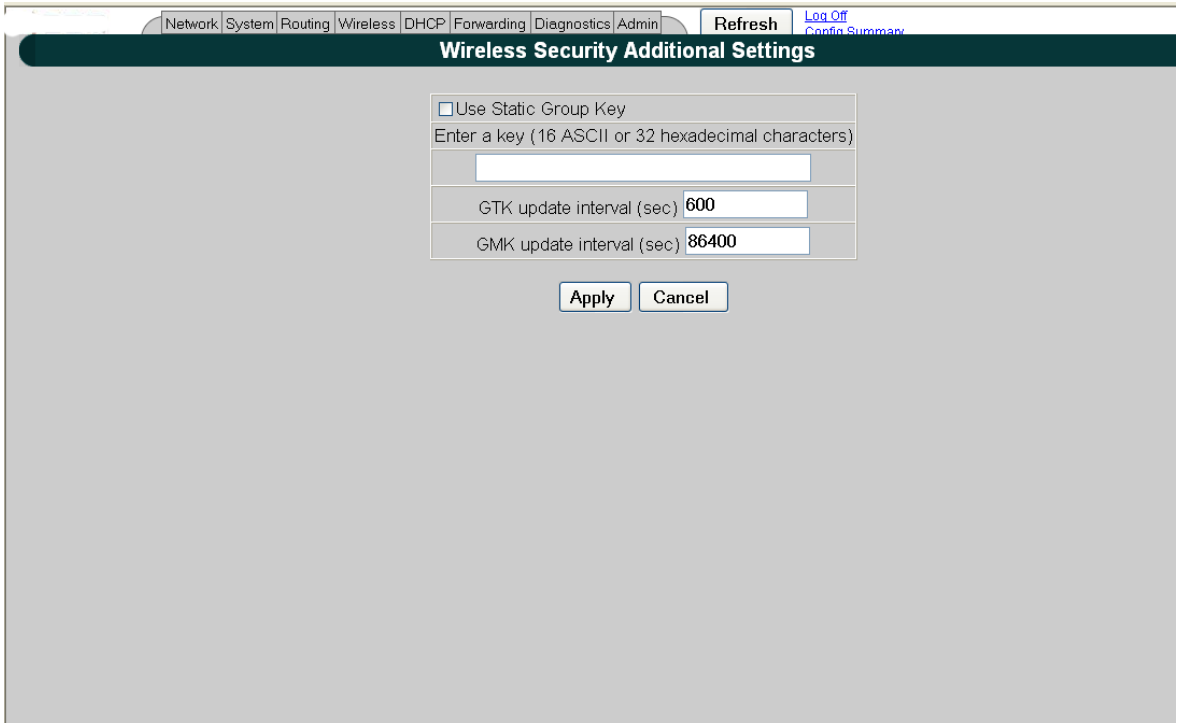


Figure 8-9: Network Security-Additional Settings

Use Static Group Key	*enable/disable the use of the static group key. The static group key is used by AES-CCMP cipher to protect multicast/broadcast in ad-hoc network only. The decryption of frames is handled with on-chip cipher.*
Static Group Key	*specify static group key to protect multicast/ broadcast frames.*
GTK update interval (sec)	*Specify the time interval (in seconds) for re-keying GTKs (Group Transit Key).The GTK*

is the encryption keys for Broadcast/ Multicast frames.

GMK update interval (sec) *Specify the time interval (in seconds) for re-keying GMK (Group Master Key). GMK is used internally to generate GTKs.*

WEP Security

There are two different approaches to using keys when WEP security is configured:

- *Base unit and all CPE(s) units in Star network or all the units in Mesh network use a single set of keys.*
- *The key used between each CPE and Base or the key used between two Mesh nodes is specific to that connection and not known to other CPE(s)/Mesh node.*

This section describes the WEB Configurator Pages used to configure both default and per-CPE/per-Node WEP keys.

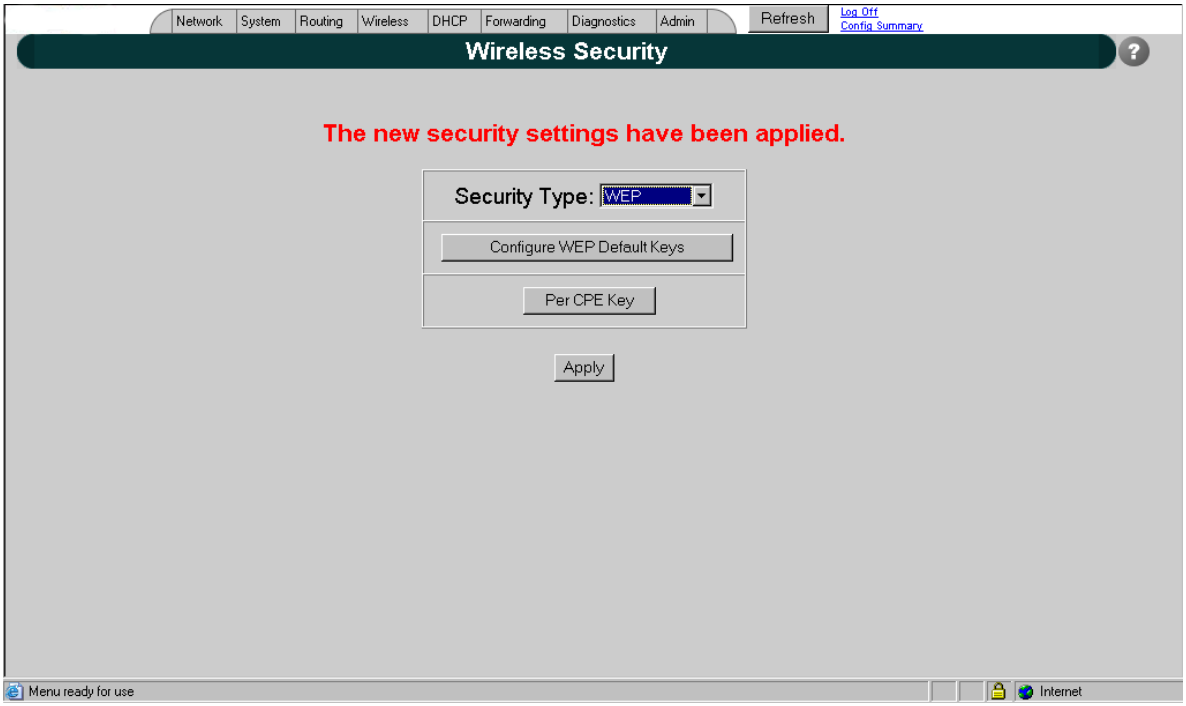


Figure 8-10: Network Security-WEP (Per CPE Key)

Figure 8-11: Network Security-WEP (Per Node Key)

The Per CPE Key Configuration page is used to configure unique keys for each CPE.

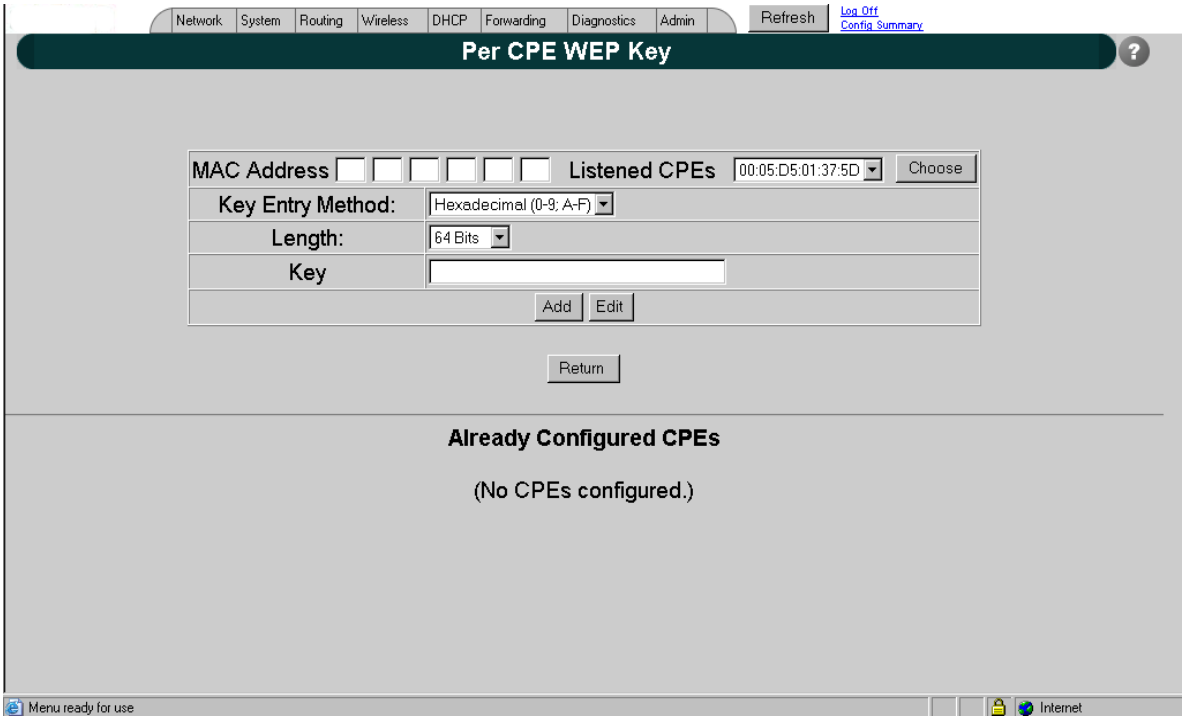


Figure 8-12: Network Security-WEP (Per CPE Key) part 2

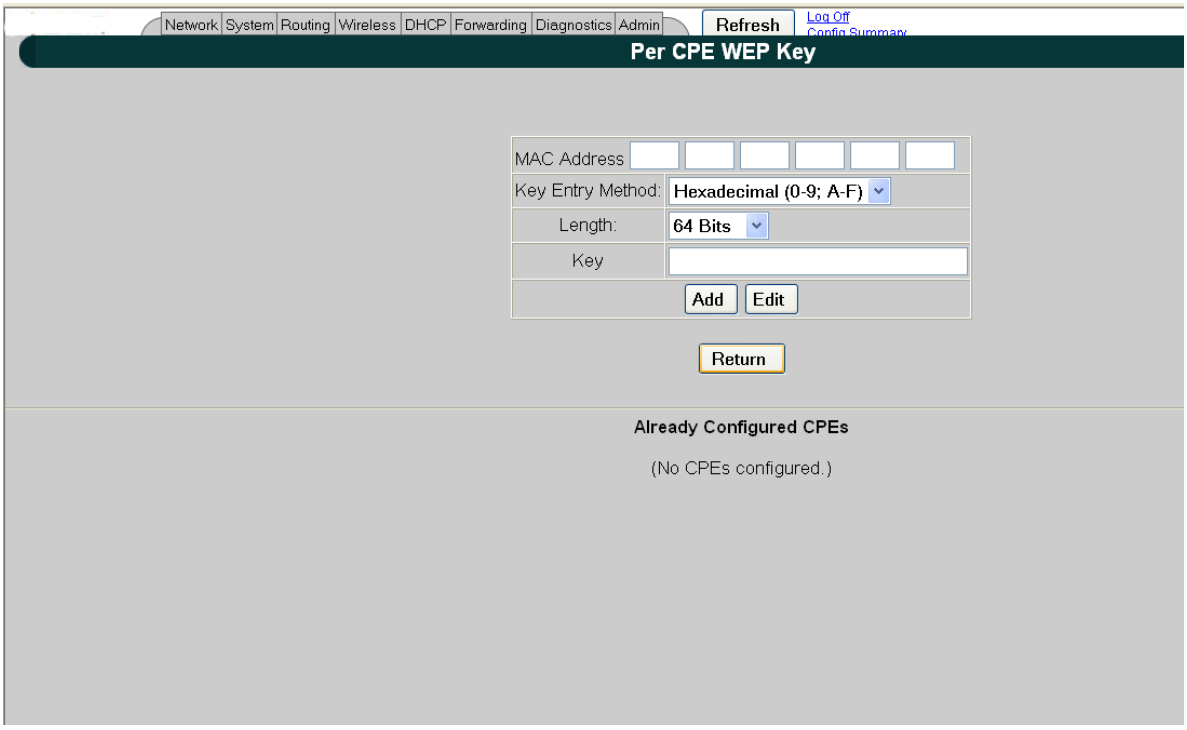


Figure 8-13: Network Security-WEP (Per CPE Key) part 3

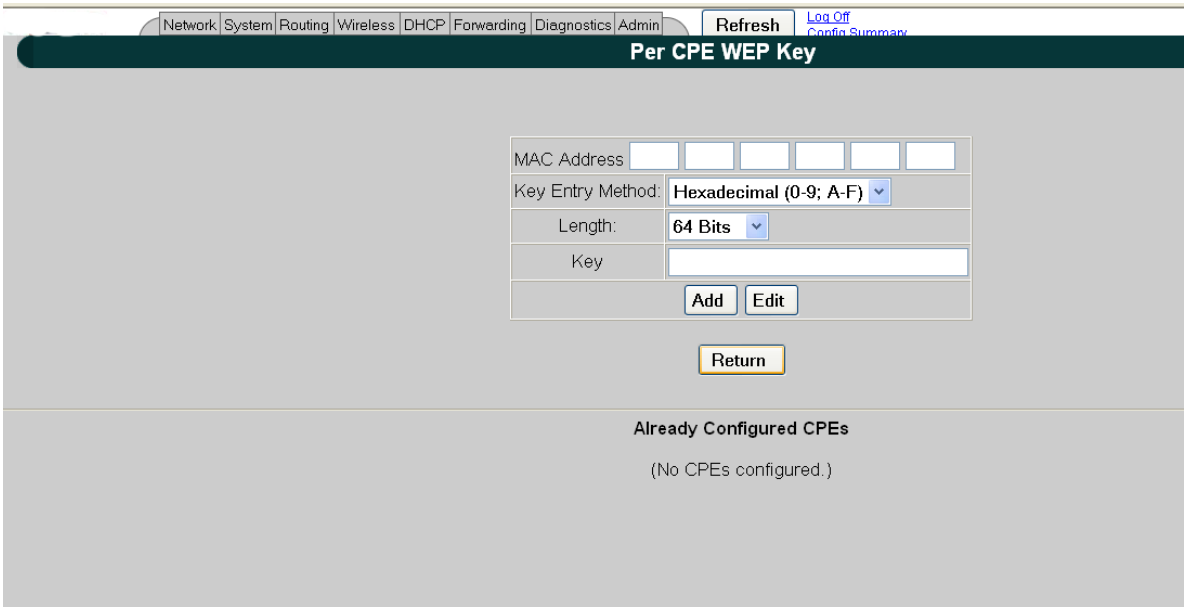


Figure 8-14: Network Security-WEP (Per CPE Key) part 4

MAC Address	*Specify the MAC address of CPE to provide a unique WEP key.*
Key Entry Method	*Specify key entry method: hexadecimal or ASCII*
Key Length	*Specify the length of the encryption key. Allowed lengths are 64, 128 and 152 bits.*
Key	*Specify the encryption key*
Add	*Add the encryption key to the configured CPEs list*
Edit	*edit the selected CPE from the already configured CPEs list*

Enabling WEP Security Between a SPEEDMesh-Enabled Client and SPEEDLAN 9200

In a SPEEDLAN 9200 network, you can authenticate a SPEEDMesh-enabled client (PDA or laptop) with a standard security called Wired Equivalent Privacy (WEP). WEP encrypts data that is being transmitted over the wireless LAN. WEP protects the wireless links between clients and SPEEDLAN 9200 routers.

Note: *WEP is an encryption scheme used to protect wireless data communications. WEP uses 64-bit, 128-bit or 152-bit key sizes to provide access control to wireless network and encryption security for each data transmission. To decode a data transmission, each point in a network must use an identical 64-bit, 128-bit or 152-bit key.*

To enable WEP security, do the following:

1. *If the Network Security Configurations page is not displayed on your screen, choose* Security *from the* Network *menu. On the bottom section of the Network Security Configurations page, choose* WEP *from the* Encryption Type *drop-down list. "None" is selected by default. (If you select* None, *encryption is disabled.)*
2. *Choose* Hexadecimal *or* ASCII Text *from the* Key Format *drop-down list.*
   - *"Hexadecimal" is a Base-16 numbering system. The means the 16 sequential numbers are used as a base unit (i.e., "0-9" and "A-F").*
   - *In ASCII text, each numeric, alphabetic or special character is represented with a 8-bit binary number (i.e., a consecution of eight 0s or 1s).*
3. *Select Key 1-3 from the* Transmit Key *drop-down list.*
4. *Select the length for the Transmit key by choosing either* 64 Bits,128 Bits *or* 152 Bits *from the* Length *drop-down list.*

Note: *40-bit WEP and 64-bit WEP are two different names for the same encryption method. This level of WEP encryption has been called "40-bit" because it uses a 40-bit secret key along with a 24-bit initialization vector (i.e., 40 + 24 = 64). The same is true for 104-128 bit and 128-152 bit WEP.*

5. *In the "Key1-3 text" boxes, enter the key value. For hexadecimal: a maximum of "10 "characters for 64 bits, "26" characters for 128 bits and 32 characters for 152 bits). For ASCII: a maximum of "5 characters for 64 bits, "13" characters for 128 bits and 16 characters for 152 bits.)*
6. *Click* Apply *to implement your changes.*

Note: *To enable the SPEEDMesh client, you must select the* Enable Mobile Client *check box. For more information, see Enabling/Disabling the SPEEDMesh-Enabled Client, page 4-6.*

If WEP encryption is enabled, then:

- *All frames are WEP-encrypted, regardless of the packet's destination address in the case if AES encryption is disabled, and*
- *All non-unicast frames are WEP-encrypted, regardless if AES is enabled or disabled.*

Configuring of WEP Default Keys - Shared keys

The WEP keys are used when static WEP cipher suit is selected to protect unicast or/and broadcast/multicast frames. To configure static WEP keys the "WEP Shared Keys" page is used (see figure below).

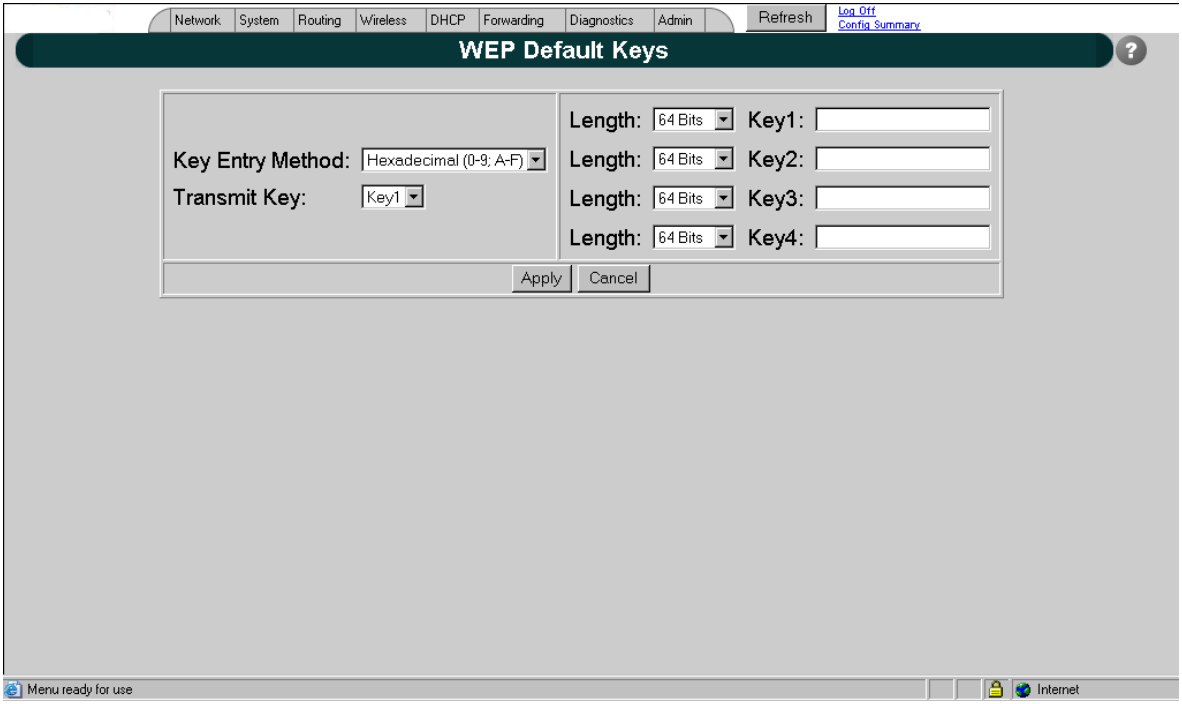
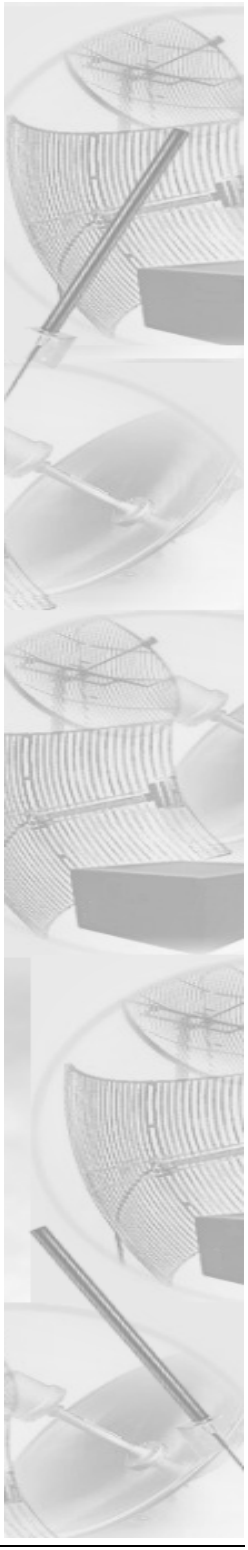


Figure 8-15: Network Security-WEP Default Keys

Key Entry Method	*Select the method for WEP keys: hexadecimal (0-9, A-F), or ASCII text (all keyboard characters except spaces).*
Transmit Key	*Specify the default key index used for encryption outgoing packets.*
Length	*Specify the length for one of the four keys. Allowed values Are 64, 128 and 152.*
Key(1/4)	*Specify one of the four default WEP keys.*

Notes:



Chapter 9
Basics of IP Addressing

Main sections in this chapter:

Basics of IP Addressing

IP Addressing is important because it tells the network how to locate the computers or network equipment connected to it. IP addresses are given so each computer or equipment on the network has a unique routable address. IP addressing provides the following information:

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

What is an IP address?

An IP address is a unique 32-bit identifier that contains:

- *Four octets (e.g., decimal 192.0.2.56).*
- *Two sections: the network address and the node address (also known as the host address).*

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

- *Hexadecimal (82.39.1E.38)*
- *Binary (10000010.00111001.00011110.00111000).*

Internet Address Classes

Understanding this methodology is difficult; therefore, let's explain this in easier terms. The first octet(s) defines the "class" of the address, which is the only method to tell the size of the network (how big) and where the internet address belongs.

There are three main classes:

- *Class A: 35*.0.0.0
- *Class B: 128.5*.0.0
- *Class C: 192.0.2*.0

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

This specification simplifies the way routers handle the messages (packets) and speed up the forwarding process.

In fact, IP defines five classes:

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

- Class B *addresses uses 2 octets for the network portion and 2 octets for the node (or host) section of the address. This provides up to 16,384 networks with 64,534 nodes for each network.*
  - *First 2 octets are assigned as network address*
  - *Remaining octets used for node addresses*
  - *Format: network, network, node, node*
  - *In IP address 130.57.30.56, "130.57" is the network address, and "30.56" is the node address*
  - *Maximum of 65,534 node addresses*

- Class C *addresses use 3 octets for the network portion and 1 octet for the node (or host) section of the address. This provides 16.7 million networks with 256 nodes for each network.*
  - *First three octets are assigned as network address*
  - *Remaining octet used for node address*
  - *Format: network, network, network, node*
  - *In IP address 192.0.2.102, "192.0.2" is the network address, and "102" is the node address*
  - *Maximum of 28 or 254 node addresses*

- Class D
  - *Range is 224.0.0.0 to 239.255.255.255*
  - *Used for multicast packets (i.e., host sends out router discovery packets to learn all of the routers on the network)*
  - *Netmask = /32*

- Class E
  - *Range is 240.0.0.0 to 255.255.255.255*
  - *Reserved for future use*

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

Note: *Public addresses can include a network address assigned from the network administrator or from the IP provider. Also, there is one network in each class that is defined for private use, allowing the creation of internal networks. These addresses are Class A: 10.0.0.0, Class B:172.6.0.0, and Class C: 192.168.0.0.*

Subnetting a Network

The increasing number of hosts and networks make large impractical address blocks that are not smaller than 255. In order to keep the IP address block small, so routers can manage them more efficiently, a smaller network definition is created. This is called a subnet. Subnets are intended to:

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

Default Subnet masks

- *Class A:* 255.*0.0.0.*
- *Class B:* 255.255.*0.0.*
- *Class C:* 255.255.255.*0.*

Note: *Subnet mask is bolded and corresponds to the network portion of the IP address.*

What is a Subnet?

A subnet allows you to create multiple networks within one Class A, B, or C network. Each subnet contains a netmask that helps routers identify the subnet beginning and size.

What is a Subnet Mask?

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

For more information on subnetting, see the example below and Diagram of Subnetting a Network, page 9-6.

Example of Subnetting:

For example, a Class C network contains three masked octets (255.255.255). The last octet (0) identifies nodes (i.e., computers).

If Router D is reading IP Addresses 192.0.2.1 (let's call this IP Address 1) and 192.0.2.64 (let's call this IP Address 2) on this Class C network, it would send IP Address 1 to Subnet

A and IP Address 2 to Subnet B. The remaining nodes in each subnet (A through D) on this network can contain up to 254 pieces of network equipment (computers, printers, fax machines, bridges or routers, etc.).

Diagram of Subnetting a Network

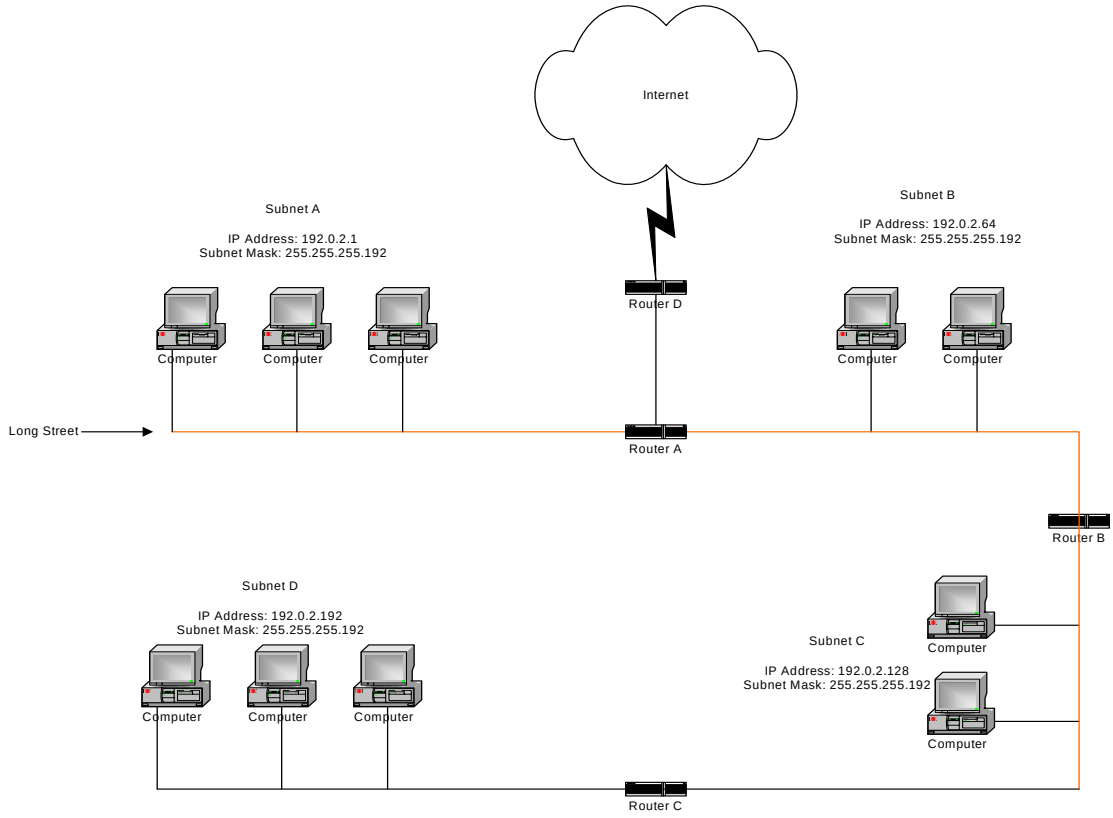


Figure 9-1: Subnetting diagram

Still confused?

An easier method to explain this concept is to use the classic "mailing" analogy used in IP addressing. Consider that this network, called Long Street, is four blocks long. There are 254 houses on Long Street, and each block contains 64 houses. Houses 1 to 63 reside on Block A. Houses 64 to 127 reside on Block B. Houses 128 to 191 reside on Block C. Houses 192 to 254 reside on Block D. Think of each block as a subnet. This means that Blocks A, B, C, and D are all part of Long Street, which is also known as the network in this example. The mailman would organize the letters (or IP addresses for network

equipment) by creating four piles (one for each block, or subnet). As soon as the mailman picks up pile A in his hand, he knows which block to turn on. This same reasoning applies to piles B, C, and D as well. Router D knows exactly which subnet to transfer (or turn) the packets to by reading its IP and subnet mask address. Note that each subnet on this network is 255.255.255.192. Why is 192 the last octet in the subnet mask and not 64? The last octet, 192, is the mask that allows 64 "houses" to reside on the street.

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

How does a network administrator assign an IP address?

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

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

- Manual (static) Addressing - Is ’Manually Configure’ option on Interfaces Parameters page of *SPEEDLAN 9200* Configurator
  Each device connected to the Internet must have its own unique IP address. Also, if a computer is being used as a server, you will assign it a permanent IP address. This enables other computers to connect to it. Static addressing is also beneficial to users that need to maintain a "constant" connection to the Internet. This will enable users to easily access the IP address.
- Automatic (dynamic) Addressing - Is ’Use DHCP’ option on Interface Parameters page of the *SPEEDLAN 9200* Configurator.
  A DHCP (Dynamic Host Configuration Protocol) server assigns the IP address to each computer as the computer connects to the network. If a computer moves to a new network (i.e., great for temporary employees or mobile users), it must be assigned a new IP address for that network. DHCP can be used to manage these assignments automatically. DHCP is described in further detail below.

What is DHCP?

Dynamic Host Configuration Protocol (DHCP) allows network administrators to assign dynamic IP addresses for the period of time needed to connect to the Internet. Think of DHCP as leasing an apartment. A prospective tenant may not need to live in an apartment for two years, maybe just a year. Therefore, the tenant will only sign a one-year lease

agreement. For example, each time a computer is set up to connect to the Internet, the network administrator uses DHCP to automatically assign the computer a unique IP address. That computer will give up its IP address when it is no longer needed (when the lease has ended) allowing new a computer (or a new tenant) on the same network to use it. This benefits educational and corporate settings where users often log on to different computers. In this case more IP addresses outnumber computers because you can quickly reconfigure the network if needed from a centralized location.

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

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

Figure of DHCP Addressing

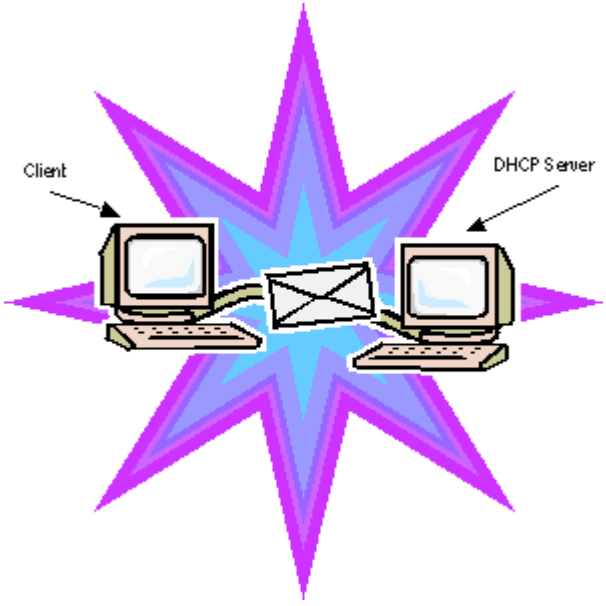


Figure 9-2: DHCP client and server

1. *The client asks DHCP server for IP address and configuration if needed.*
2. *The DHCP server assigns an available IP address to client.*

3 *The client takes IP address from DHCP server and requests any additional configuration needed.*

4 *DHCP server confirms IP address and configuration.*

What is NAT?

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

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

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

NAPT

What differentiates NAPT from NAT? NAPT (or Network Address Port Translation) not only translates the IP address but also the transport layer port. Thus, if an inbound packet was addressed to a web server port on 80, the NAPT device would translate and pass to the packet to the private network's web server. Without port translation, the NAT device has no means of knowing which host in the private network can pass packets to other devices. For an example see, *Diagram of Incoming NAT, page 9-12.*

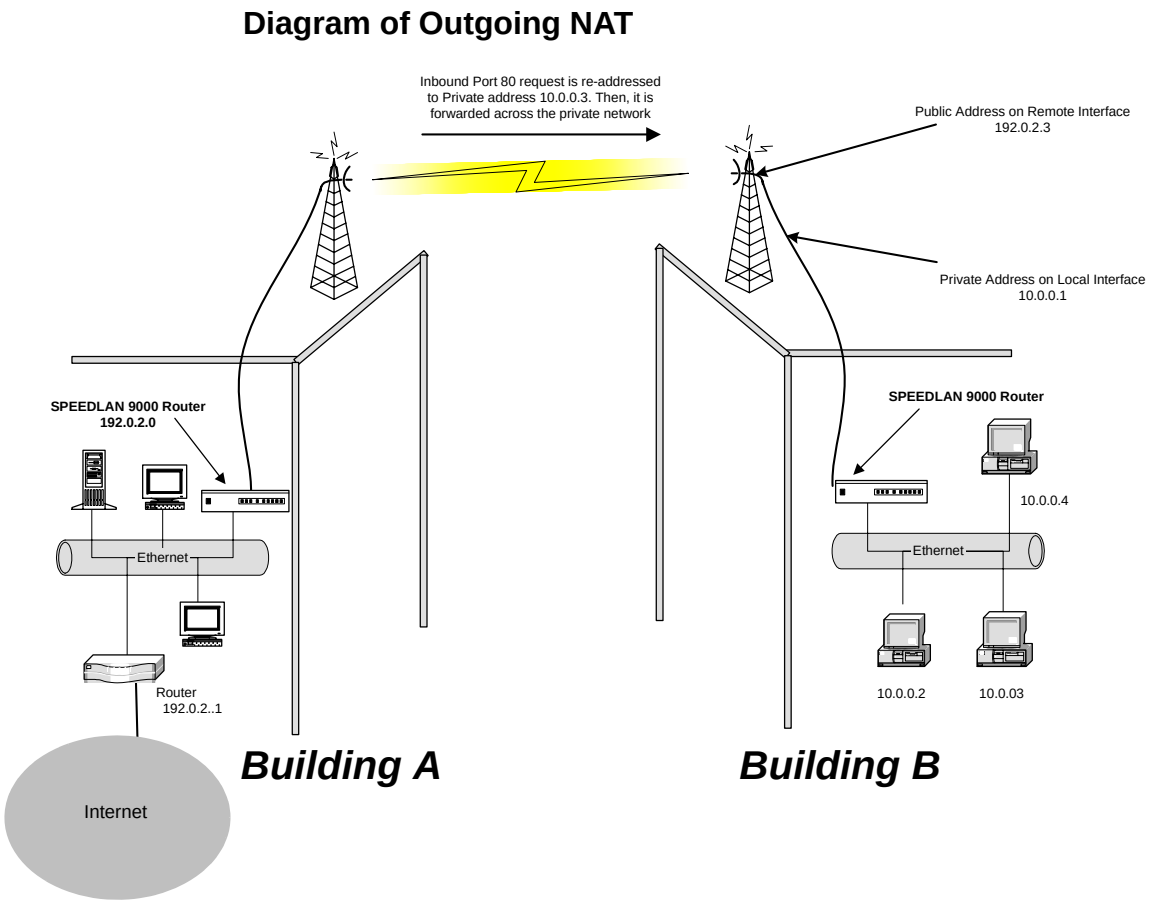


Figure 9-3: Outgoing NAT

As the packet is transmitted from the private network (in Building B) across the public network (public address in Building A and the Internet), the packet will be re-addressed as 192.0.2.3 (public address). When the packet returns to Building B, the packet will be re-addressed to the IP address of the private network by using the MAC address contained in the header to identify the destination.

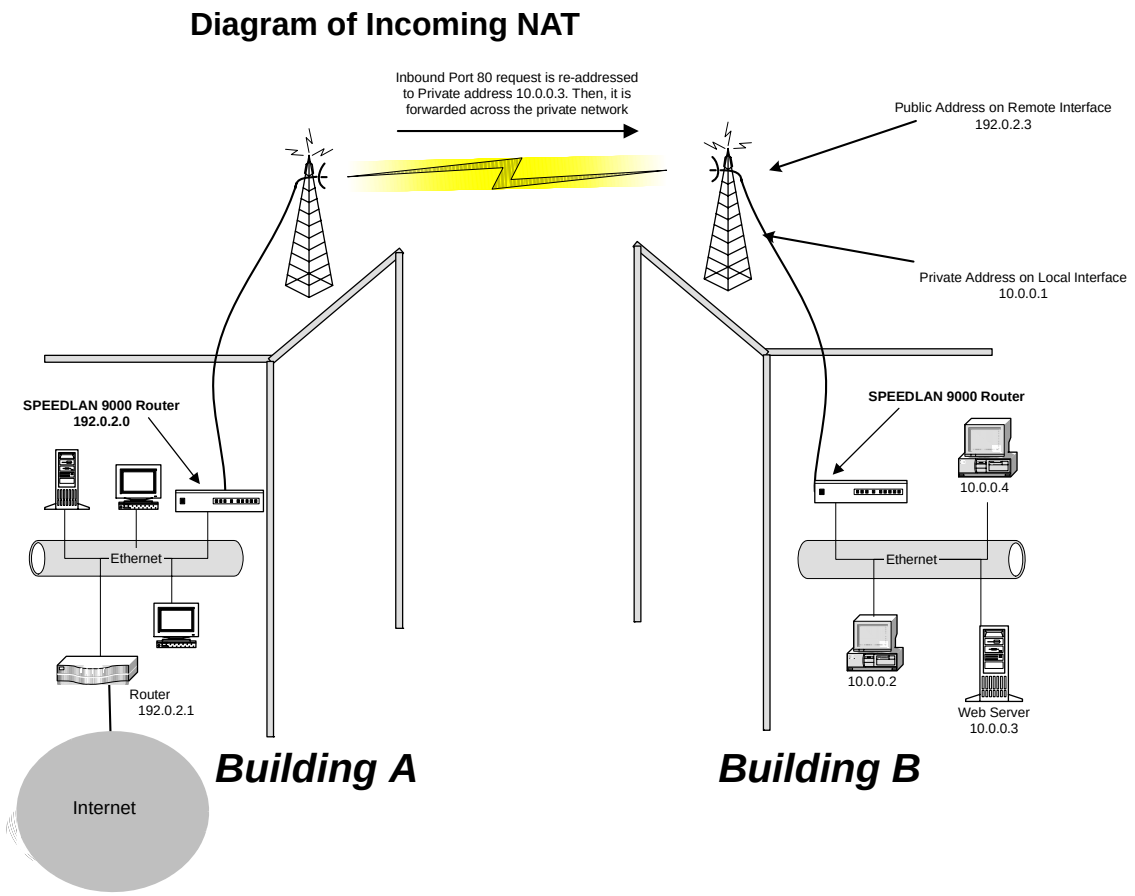


Figure 9-4: Incoming NAT

Incoming NAT allows you to specify ports on the private network (Building B) that you would like to be available on the public network (Building A and the Internet). For example, if a web server (IP Address 10.0.0.3) is being hosted on a private network in Building B, you can create a pair that will specify that all requests on the public IP address, Port 80, be forwarded to IP Address 10.0.0.3 on the private IP address, Port 80.

Basics of Routing

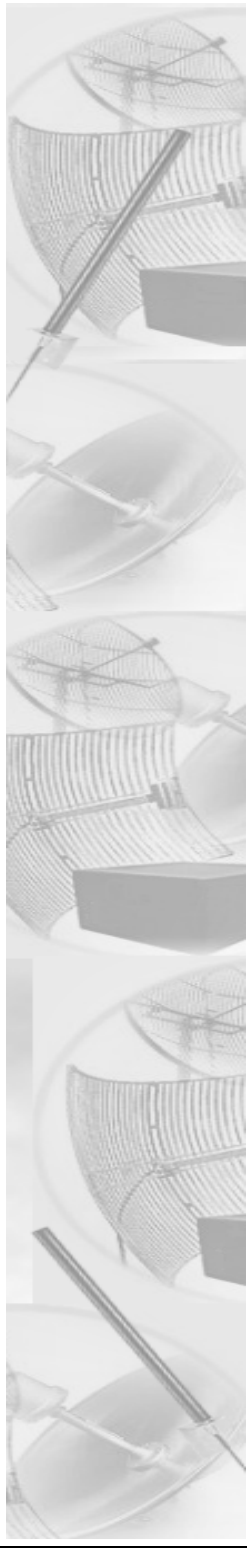
A router connects two or more networks or subnetworks together and decides which direction it should send each packet. A router is typically a gateway (where one network meets another). A router operates at the Network Layer of the OSI model. This means a router sends information based on the packet's IP address instead of the Ethernet (MAC) address (as in bridging).

Routing protocols use special metric algorithms when determining the best path for a packet to travel. All of this information is stored in a routing table. Some of this information includes hop count and destination information. The routing table also stores when the receiver gets the packet and lets the sender know that is was received.

Note: *For more information about routing, see www.whatis.com, http://www.techweb.com/encyclopedia/, http://www.computeruser.com/resources/dictionary/dictionary.html, or search for "basics of routing" on the World Wide Web.*

Notes:

Chapter 10
Public Safety Band



Background Information on the 4.9 GHz Public Safety Band (PSB)

The Federal Communication Commission (FCC) has allocated 50 megahertz (MHz) of spectrum in the 4940-4990 MHz band (4.9 GHz band) for fixed and mobile wireless data communications, designating the band for use in support of public safety (Public Safety Band, PSB). Specifically, the Commission adopted two emission masks limiting interference potential for the band, one for low power and one for high-power operations. These changes will allow public safety licensees to leverage commercial off-the-shelf (COTS) technologies available for the U-NII and ITS frequency bands. The FCC action allows for a nationwide focus on homeland security, and will ensure that all state and federal agencies possess the required communications resources to adequately protect the public.

This allocation will provide public safety users the additional spectrum required to support broadband applications such as high-speed data transitions and video over wireless, which in turn enhances local area networks for incident monitoring and supervision. The spectrum can also be used to support the dispatch operations communications as well as safety vehicle communications. Public safety agencies will be able to implement on-scene wireless networks for streaming video, rapid Internet and database access, and transfers of large files such as maps, building layouts, medical files, and missing person images. It also allows these agencies to establish temporary or permanent links to support surveillance operations. This allocation gives every jurisdiction in the country access to spectrum for deployable, interoperable, broadband communications.

The spirit behind the creation of the band was to allow the public safety organizations access to inexpensive hardware already available for the ISM bands, but in a section of the spectrum that is not available to the general public.

Key Facts of the 4.9 GHz PSB band

- *The FCC allocates the 4.9 GHz band for fixed and mobile communication.*
- *The FCC designates the 4.9 GHz band for use solely in the support of public safety encompassing the protection of life, health and property*
- *Users must be a state or local government entity or non-government entity authorized by a local or state public safety entity.*
- *Provide services that are not commercially available to the public.*
- *The FCC rules allow a maximum total power output of 33 dBm (2 W) per channel and a maximum antenna gain of 9 dBi for a maximum EIRP of 42 dBm.*
- *Public safety agencies can apply for licenses to use the spectrum within their areas of jurisdiction.*
- *The FCC rules permit broadband mobile operations, fixed hotspot use and temporary fixed links.*
- *Fixed point-to-point operations are also permitted but this use requires a separate license from the FCC for each station.*
- *The FCC rules prohibit use for services that are made commercially available to the public*
- *The new looser emissions mask is designed to allow users to utilize off the shelf technology to significantly reduce cost and time*

Eligibility for 4.9 GHz PSB Use

All state and local government entities that provide public safety services, this is defined as their primary focus being the protection for the safety of life, health, or property; are eligible to apply for a 4.9-GHz license. The control of the licensing is being managed at the state and local level to facilitate priority and availability of the 4.9 GHz band. Entities that do not meet these eligibility requirements, but that provide services in support of public safety, such as private infrastructure companies, can negotiate sharing agreements with license holders.

4.9 GHz PSB Frequency Band Plan

The 4.9 GHz band ranges from 4940.5-4989.5 MHz and can be segregated out using 1, 5, 10, 15, and 20 MHz of bandwidth.

4.9 GHz PSB Licensing Requirements

A 4.9 GHz band license gives the licensee authority to operate on any authorized channel in this band within the applicant's legal jurisdiction such as city, county, or state. The 4.9 GHz band is shared by all licensees, who must coordinate their usage of the band with other licensees within their areas of authority. The 4.9 GHz licenses are granted for a 10-year term.

The license gives authority to construct and operate:

- *Any number of base stations anywhere within the area authorized by the license*
- *Base and mobile units, including portable and handheld units*

A 4940-4990 MHz band license does not give the licensee authority to operate permanent fixed point-to-point stations. Licensees choosing to operate such fixed stations must license them individually on a site-by-site basis. Such fixed operation will be authorized only on a secondary, non-interference basis to base, mobile and temporary fixed operations.

4.9 GHz PSB Peak Power Limits

The transmitting power of radios operating in the 4940-4990 MHz band must not exceed the following maximum limits:

Channel Bandwidth in MHz	Class A peak output power in dBm	Class B peak output power in dBm
1	20	7
5	27	14
10	30	17
15	31.8	18.8
20	33	20

4.9 GHz PSB Emission Mask

The FCC has adopted two emission masks for use in the 4.9 GHz band. The first being DSRC-A, is a mask strictly for low-power applications. The second being the DSRC-C mask is strictly for high-power applications. The DSRC-A mask is identical to the mask defined in the widely used 802.11Wi-Fi standard, which is most commonly used in-home wireless LANs and consumer hotspots. These 802.11 devices are readily available for purchase and significantly reduce cost and time to market for wireless deployments.
Higher power units that are above 20 dBm of output power are required for deploying mobile networks and need to employ the DSRC-C mask.

SPEEDLAN 4.9 GHz PSB Introduction

The SPEEDLAN 9200 wireless router is now certified to operate under Part 90, Subpart Y of the FCC Rules to operate as a high power device in the 4.9 GHz PSB band with 5, 10 and 20MHz channel bandwidths.

All of the features available in SPEEDLAN including Point to Multipoint, Point to Point and Mesh topologies and all security features as presented in the User guide are available for use in the 4.9PSB.

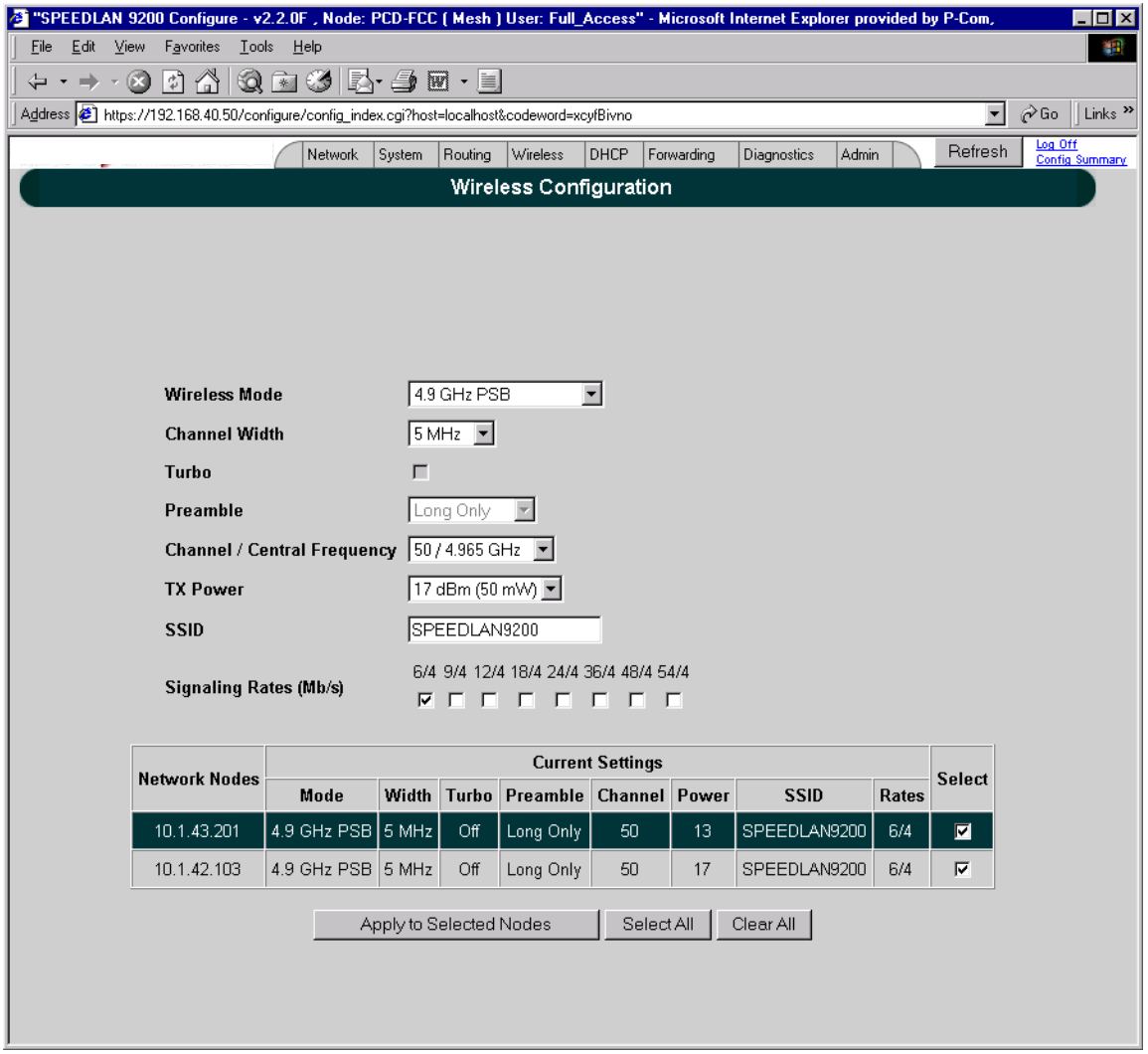
The wireless configuration screen was added to the router functionality to allow configuring the RF to operate in this band.

In fact the SPEEDLAN 9200 hardware is the same for 2.4GHz, 5.8GHz and 4.9GHz and only the software has been changed to enable 4.9GHz PSB operation.

- *20 MHz bandwidth settings may operate at signaling rates up to 54 Mbps,*
- *10 MHz bandwidth settings may operate at signaling rates up to 54/2 (27) Mbps and*
- *5 MHz bandwidth settings may operate at signaling rates up to 54/4 (13.5) Mbps.*

SPEEDLAN 4.9 GHz PSB Wireless Configuration using the https:// Configurator

Follow the guidelines in the user guide to establish communications with the SPEEDLAN router. Bring up the web based SPEEDLAN Configurator.
Select Wireless | Configuration from the menus in the Configurator.
The following screen will appear to allow configuration of the 4.9PSB in the SPEEDLAN 9200

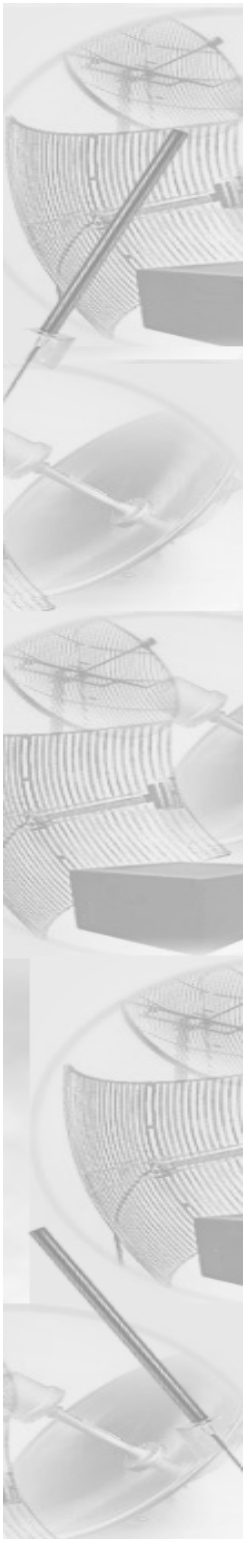


SPEEDLAN 4.9 GHz PSB Channel Plan

Table of Channel Center Frequencies vs. Channel Bandwidth:

WW Chan Number	5 MHz BW Frequency	FCC Channel Number	10 MHz BW Available? X=yes	20 MHZ BW Available? X=yes	Band Edge Delta, 4940 Plus (MHz):
5	4942.5	3	N/A	N/A	2.5
10	4945.0		X	N/A	5.0
15	4947.5	6	X	N/A	7.5
20	4950.0		X	X	10.0
25	4952.5	7	X	X	12.5
30	4955.0		X	X	15.0
35	4957.5	8	X	X	17.5
40	4960.0		X	X	20.0
45	4962.5	9	X	X	22.5
50	4965.0		X	X	25.0
55	4967.5	10	X	X	27.5
60	4970.0		X	X	30.0
65	4972.5	11	X	X	32.5
70	4975.0		X	X	35.0
75	4977.5	12	X	X	37.5
80	4980.5		X	X	40.0
85	4982.5	13	X	N/A	42.5
90	4985.0		X	N/A	45.0
95	4987.5	16	N/A	N/A	47.5

Chapter 11
Professional Installation Guidelines



Background Information on the Installation of Speedlan 9200

Wave Wireless requires a Professional Installer to install the Speedlan 9200 product

The Speedlan 9200 was tested for compliance to the Federal Communication Commission (FCC) rules part 15.247 and the testing results indicated the need for some special guidelines for the Professional Installer to follow when installing the Speedlan 9200.

2.4 GHz SPEEDLAN 9200 Installation Requirements

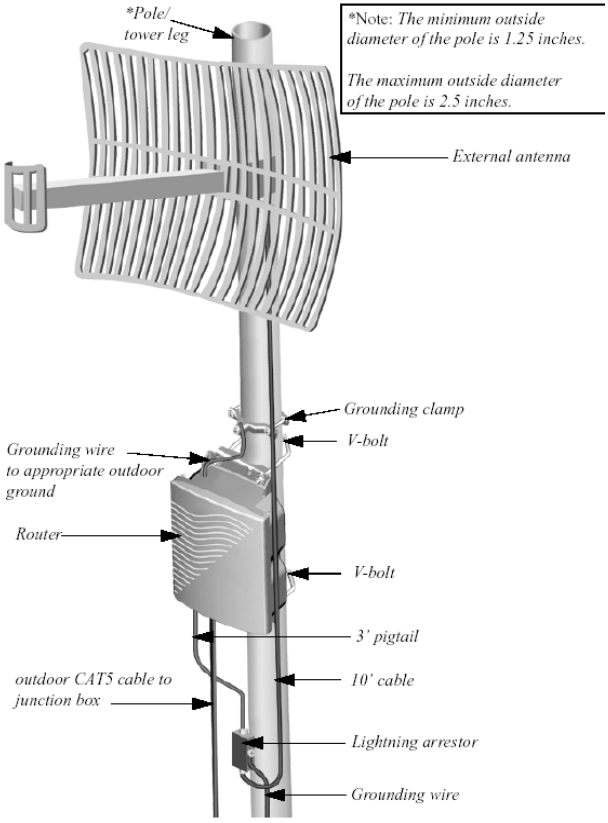


Figure 2-5: SPEEDLAN 9200 installation

The installer is to follow the diagram in Figure 2-5 of the Speedlan 9200 User guide, Wave Wireless part number 34357-MNL.

2.4 GHz SPEEDLAN 9200 Installation Requirements

The professional installer must follow the following guidelines in table 1 when installing the SPEEDLAN 9200 at 2.4 GHz.

Antenna Type	(802.11g), MAX TXPO Setting:
24 dBi, Parabolic Grid	**+17 dBm, except +15 dBm on Channel 11**
16 dBi, 90° Sector	**+17 dBm, except +14 dBm on Channel 1 & 11**
15 dBi, Yagi	**+17 dBm, except +13 dBm on Channel 1 & 11**
12 dBi OMNI	**+17 dBm, except +15 dBm on Channel 1 & 11**
8 dBi Patch	**+17 dBm, except +15 dBm on Channel 1 and +17 dBm, except +14 dBm on Channel 11**

For 802.11b, +17 dBm no TXPO restrictions

5.8 GHz SPEEDLAN 9200 Installation Requirements

The professional installer must follow the following guidelines in table 1 when installing the SPEEDLAN 9200 at 5.8 GHz.

Antenna Type	(802.11a), MAX TXPO Setting:
29 dBi, Parabolic Grid	**+17 dBm, Band-Stop or Band Pass filter required before Antenna**
23 dBi, Panel	**+17 dBm, Band-Stop or Band Pass filter required before Antenna**
17 dBi, Backfire Parabolic	**+17 dBm, no restrictions**
16 dBi, 120° Sector	**+17 dBm, no restrictions**
8 dBi OMNI	**+17 dBm, no restrictions**

The installer is to follow the diagram in Figure 2-5 of the Speedlan 9200 User guide, Wave Wireless part number 34357-MNL. The filter is to installed directly on the antenna or in line with the lightning arrestor.

4.9 GHz SPEEDLAN 9200 Requirements

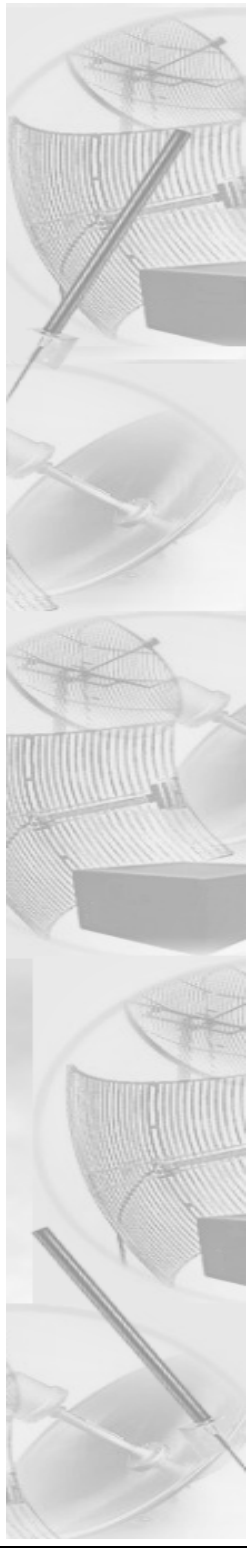
The professional installer must follow the following guidelines in table 1 when installing the SPEEDLAN 9200 at 4.9 GHz:

4.9 GHz complies with Part 90, Subpart Y,

As per 90.1215, the maximum antenna gain 9dBi for OMNI antennas. The maximum antenna gain is 26 dBi for directional antennas used in Point-to-Point or Point-to-Multipoint.

For each dB increase in antenna gain over the above stated values, the transmit power must be reduced correspondingly.

Glossary for Standard Data Communications



Glossary for Standard Data Communications

Advanced Encryption Standard (AES)
Advanced Encryption Standard was adopted by the National Institute of Standards and Technology in October of 2000. AES presents a new level in computer networking security, especially important in wireless communications because wireless circuits are easier to tap than their hard-wired counterparts. AES is more difficult to crack than its predecessor Data Encryption Standard. SPEEDLAN 9200 products use an AES 128-bit encryption key.

Address Resolution Protocol (ARP)
ARP is the abbreviation for Address Resolution Protocol, which maps an IP address to a machine's hardware address. Network administrators use ARP to locate systems on the LAN that are configured with incorrect IP addresses.

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

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

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

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

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

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

Attenuator
A device used to reduce the RF signal level.
Azimuth
This is the direction of antenna pointing relative to true north.

Band
A portion of the electromagnetic frequency spectrum.

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

Bit
An abbreviation for binary digits.

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

Bridge
The function of a bridge is to connect separate networks together. This device operates at the DataLink Layer of the OSI model. Bridges connect different network types (such as Ethernet and Token Ring) or networks of the same type.

Byte
A data unit consisting of eight bits.

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

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

Classless Inter-Domain Routing (CIDR)
This is an abbreviated method of entering the netmask. For more information, see CIDR Table (For Netmask Information Purposes) in Chapter 3.

Channel Service Unit/Data Service Unit (CSU/DSU)
A CSU/DSU is a pair of devices that adapts a dead pair (i.e., an unbiased line) to transmit high-speed data signals. Of course, the pair is manageable and provides a status, but their main function is be a dead-line modem. Latest versions use digital signals over the dead line, but older models did not.

Channel Spacing

Channel spacing is the spectral space between RF channels; it may be in KHz or MHz, depending on the band.

Class (IP Network)

There are three main classes are: Class A, Class B, and Class C.

- *Class A: Net, Node, Node, Node 35.***0.0.0** *(last three octets are available for equipment)*
- *Class B: Net, Net, Node, Node 128.5.***0.0** *(last two octets are available for equipment)*
- *Class C: Net, Net, Net, Node 192.168.1.***0** *(last octet is available for equipment)*

Coaxial Cable

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

Code Division Multiple Access (CDMA)

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

Common Management Information Protocol (CMIP)

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

Company name

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

Console

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

Crimp

Crimp the connector to secure the conductors.

Customer Premise Equipment (CPE)

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

Data Communication Equipment (DCE)

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

Data Terminal Equipment (DTE)

Hardware that provides for data communications. See also DCE above.

dBm
Decibels (dB) relative to 1 milliwatt.

dBw
Decibels (dB) relative to 1 watt.

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

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

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

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

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

Dynamic Host Configuration Protocol (DHCP)
DHCP servers provide efficient use of IP addresses by assigning them dynamically or statically. DHCP is used on the wired interface of the 9000.

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

E1
An E1 is a full-duplex synchronous digital stream with a signaling rate of 2.048 Mb/s. The electrical characteristics of the digital interface are defined in the recommendation UIT-T G.703 (which by the way also defines it for a T1). Framing structure is defined in ITU recommendations G.704 and G.732. Finally, the only countries in the world where E1 streams are not regularly used are in U A and Japan.

Elevation

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

Encryption

The method of converting data into a form that cannot be understood by unauthorized people. Encryption is very important when using wireless communication because wireless circuits are easier to tap into than wired circuits. There is also strong encryption, which means ciphers are used to make uncoding the signal almost impossible, unless you have the decryption keys.

ESD

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

Ethernet

This is the most popular physical layer LAN technology in use today. Other LAN types include Token Ring, Fast Ethernet, Fiber Distributed Data Interface (FDDI), Asynchronous Transfer Mode (ATM) and Local Talk. Ethernet is popular because it strikes a good balance between speed, cost and ease of installation.

Ethernet Switch

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

Fade Margin

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

Fading

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

Federal Communications Commission (FCC)

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

Firewall

A firewall protects resources in a private network from the users on outside networks. It can also restrict unwanted traffic from the private network to the outside. The firewall determines based on a set of rules whether packets should be forwarded to their destination.

Firmware

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

Forward Error Correction (FEC)

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

Framing

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

Frequency

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

Frequency Hopping (FH)

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

Fresnel Zone

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

File Transfer Protocol (FTP)

A protocol used to transfer files over a TCP/IP network.

Full Duplex

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

Gain

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

GHz

GigaHertz. Billions of Hertz.

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

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

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

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

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

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

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

Hub
This device on a network receives and repeats data to connected destinations on the network.

HyperText Transport Protocol (HTTP)
The communication protocol used to connect servers on the Web.

HyperText Transport Protocol Secure (HTTPS)
The protocol for accessing a secure Web server. Using HTTPS in the URL instead of HTTP directs the message to a secure port number rather than the default Web port number of 80. The session is managed by a security protocol.

Institute of Electrical and Electronics Engineers (IEEE)
A membership organization that includes engineers, scientists and students in electronics and allied fields. It was founded in 1963.

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

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

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

IP Address
This address tells the network how to locate the computers or network equipment connected to it. IP addresses are given so each computer or equipment on the network contains a unique address. There are two methods used when assigning an IP address:

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

ISM (Industrial, Scientific, and Medical Bands)
Ranges are 900 to 928 MHz; 2.4 to 2.4835 GHz; and 5.725 to 5.85 GHz. The FCC for unlicensed use allocated these bands with a restriction on the output power.

Isotropic
Uniform in all directions.

K^2
This is a polling protocol used in star networks (line of sight). A base station polls the remote stations (Customer Premise Equipment) and tells when and where CPEs can transmit.

Kb/s
Thousands of bits per second.

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

LAN (Local Area Network)
This is a local area network that enables computers, network equipment, or other peripherals to communicate on a small network.

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

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

LED
This is a light-emitting diode, which is a semiconductor, that sends out visible light when an electrical current moves through it. An electronic device that emits light with little generation of heat.

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

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

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

MAC address (MAC)

A MAC Address requires 12 hex-digits in groups of two that are separated by dashes or semicolons (i.e., 00:05:D5:12:AF:01).

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

Management Information Base (MIB)
The MIB is the definition of all standard objects that may be addressed inside a device. The most common protocol to retrieve the information associated to a specific object is SNMP.

MDS (RIP2 MD5 Authentication)
When RIP2 is used with an authentication algorithm, such as MD5, network security is increased since the destination receiving the RIP packet knows that it was generated by a reliable source (i.e., the actual sender of the packet). RIP2-MD5 authentication transmits the output of the authentication algorithm rather than the RIP2 authentication key. Therefore, the RIP2 authentication key is never transmitted over the network and cannot be heard by other routers. This means a router can determine exactly who sent the message and not assume which router sent it.

Mean Time Between Failure (MTBF)
This is defined by a specific set of calculations. The formula of the system longevity is based on the thermal, electrical and environmental stresses on each component.

MHz (MegaHertz)
Millions of Hertz.

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

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

Mb/s
Million of samples per second.

Multi-path fading
The condition in which the "true" signal from an antenna reflects off an object (usually the ground) and, as a

result, the reflected signal causes destructive interference at the receiving antenna. Multi-path fading affects linearly polarized signals more than circularly polarized signals.

Network Address Translation (NAT)
NAT helps to ensure network security and allows an entire company to share a single global IP address for communication on the Internet. This enables companies to communicate with other devices on the Internet.

Network
A set of connections that allow them to exchange data with each other, which enables multiple users to share to communicate data through the accepted path(s). Two or more locations tied together with equipment and communications channels.

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

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

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

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

Outside Diameter (OD)
Outside diameter of pipe for mounting an antenna.

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

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

Passive Repeater
It is easier to explain this using an analogy of an RF reflecting device, like a mirror.

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

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

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

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

Personal Computer (PC)
Any laptop or desktop (e.g., Windows or a Macintosh).

PC Memory Card International Association (PCMCIA)
This is a standard card for connecting peripherals to portable computers.

Polarization
It's the orientation of the electrical vector on an electromagnetic signal. The vector can be polarized as needed either linear or mixed (i.e., circular).

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

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

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

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

Protocol
A network protocol is the standard that allows computers to communicate with each other. A protocol defines how computers identify one another on the network, the form that the data should take in transit, and how this information is processed once it reaches its final destination. Protocols also define procedures for handling lost or damaged transmissions or "packets." IPX (for Novell Netware), TCP/IP (for UNIX, Windows NT, Windows 95 and 98 and other platforms), DECnet (for networking Digital Equipment Corp. computers),

AppleTalk (for main Macintosh computers), and NetBIOS/NetBEUI (for LAN and Windows NT networks) are some of today's most popular networks.

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

Public Switched Telephone Network (PSTN)
This refers to a worldwide voice telephone network accessible to all those with telephones and access privileges.

Public Safety Band (PSB)
The FCC allocates the 4.9 GHz band for fixed and mobile communication, and is restricted to use solely in the support of public safety encompassing the protection of life, health, and property.

Quadrature Amplitude Modulation (QAM)
It's a high-density modulation that uses phase and amplitude modulation at the same time. It's used in OFDM, and modulators require a high SNR to provide a stable signal recovery rate.

Quadrature Phase Shift Keying (QPSK)
Phase-shift keying in which there are four phase states or positions in the time or frequency domains within a single period.

Radiation
The emission of energy from a generator to a transmitter.

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

Radio Frequency (RF)
The frequency at which microwave systems transmit.

Received Signal Strength Indicator (RSSI)
The RSSI Voltage provided at the output of the RF Unit that is used to indicate the RF Input Level.

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

Refraction

The change on the energy's propagation direction as it travels through different density medium.

Reliability

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

Responsible personnel

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

RFC (Request for Comments)

RFCs are documents that explain specifications for types of technology. They primarily contain published tutorials that help people learn about the specific aspects of the Internet. For more information, see Internet Engineering Task Force (IETF) - http://www.rfc-editor.org/rfc.html.

RF Signal Level

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

Routing Information Protocol (RIP)

RIP determines a route based on the fewest hop count between the source and destination. RIP, a distance vector protocol, routinely sends broadcasting to its neighboring nodes. There are different classes of RIP:

Summary Table of Differences Between RIP 1 and RIP2

	RIP Version 1	RIP Version 2
Status	Obsolete	Current
Acronyms	RIP, RIP1, RIP-1, RIPv1	RIP2, RIP-2, RIPv2
Internet Standards	STD 34 (deprecated)	STDs 56 and 57
Defining RFCs	1058	2453 and 1722
Routing	Classfull	Classless
Subnet Mask	Implicit, fixed length	Explicit, variable length
Route Summarizing	No	Yes
Authentication	None	Optional
Updates Distribution	Broadcast	Multicast

Router

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

networks, overall efficiency is improved by using routers.

Rx (Receiver)
This is where the packet is going.

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

Sidelobe
Sidelobes are the spurious emissions caused by the antenna's geometrical irregularities. They are significantly lower than the main lobe (i.e., common when around 20dB under the main lobe).

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

Simple Network Management Protocol (SNMP)
The standard protocol for TCP/IP network management that has the most common worldwide use.

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

SMTP (Simple Mail Transfer Protocol)
SMTP is the standard e-mail protocol used in the Internet. SMTP is a TCP/IP protocol, and it defines the message format and message transfer agent, which is used to store and forward the mail.

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

Star
A topology (in the K2 polling protocol category) that includes point-to-point or point-to-multipoint activity, as long as those routers are within line-of-sight of each other.

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

Subnet

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

Symbol Threshold

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

System Gain

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

TCP (Transmission Control Protocol)

TCP is a user datagram type of protocol that ensure that the message was sent accurately.

TCP/IP (Transmission Control Protocol/Internet Protocol)

This is an Internet protocol, and it ensure that the data was sent accurately from one host to another.

Tx (Transceiver)

This is where the packet is coming from.

UDP (User Datagram Protocol)

A protocol within the TCP/IP protocol suite that is used in place of TCP when a reliable delivery is not required.

WAN

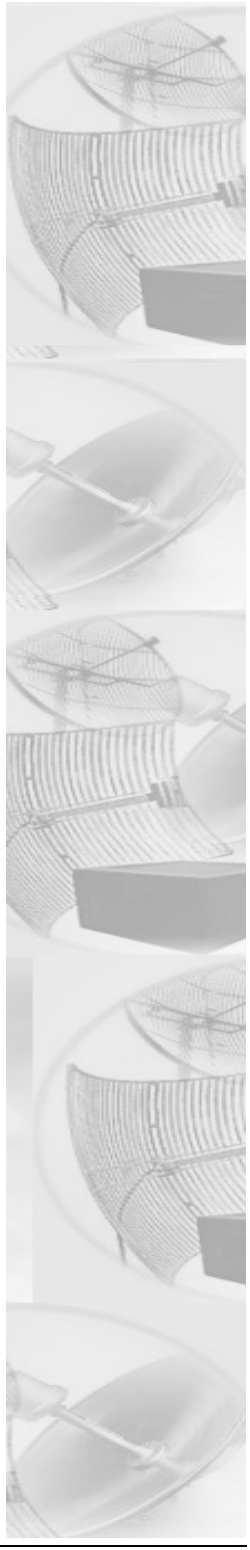
A wide-area metropolitan network is a connection between LANs, which may be privately owned or rented.

Wired

A network interface connected by wire to other nodes in the network.

Wireless

A network interface that uses radio to communicate to other nodes in the network.



Appendices (A-F)

The Appendices include:

- *Appendix A: Changing the Router's Topology Mode*
- *Appendix B: Passwords for the SPEEDLAN 9200 Configurator*
- *Appendix C: Declarations of Conformity and Regulatory Information*
- *Appendix D: Acronyms*
- *Appendix E: Firmware History*
- *Appendix F: Channels for IEEE 802.11x.*

Appendix A - Changing the Router's Topology Mode

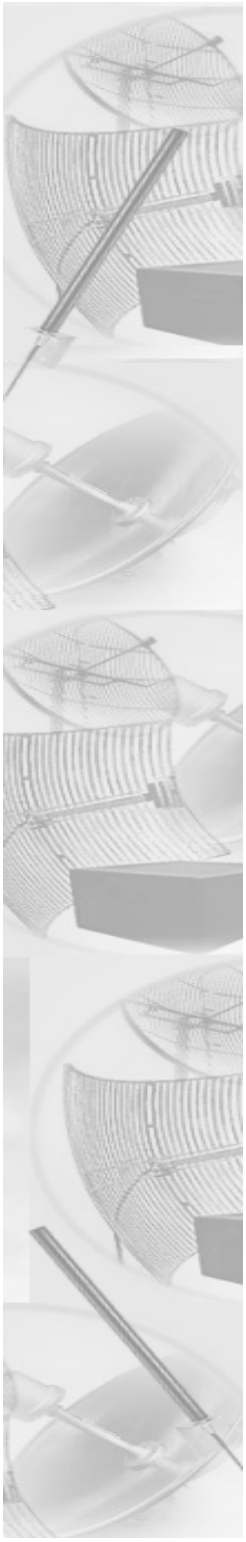
Changing the Router's Topology Mode

This tutorial tells you how to change the router's topology mode (base station, CPE, point-to-point or mesh) from or to another topology mode (base station, CPE, point-to-point or mesh).

1. Enter the correct URL or IP address for the router in your web browser.
2. Enter the correct password and click Login.
3. After logging in, the Network Interfaces page will appear. Select the new mode (e.g., Mesh) from the Interface Type drop-down menu. Then, click Apply.
4. The system will reboot the router.

Appendix B - Passwords for the SPEEDLAN 9200 Configurator

This appendix provides the passwords needed for the SPEEDLAN 9200 Configurator.



SPEEDLAN 9200 Configurator Passwords

There are five classes of users. The classes are as follows with their default passwords:

- *Full Access (also known as a superuser): "wave_full"*
  Note: *"Full Access" does not show up in "Admin/Users" because the user will not be able to change its permissions and it has write permission on everything.*
- *Wired Admin: "wave_wired_admin" (account for the private Ethernet network)*
- *Wired Read: "wave_wired" (account for the private Ethernet network)*
- *Wireless Admin: "wave_wireless_ad" (account for the wireless SPEEDLAN 9200 network)*
- *Wireless Read: "wave_wireless" (account for the wireless SPEEDLAN 9200 network)*

Admin accounts have administration rights to their appropriate network (wired or wireless), and Read Only accounts have only read only access.

Note: *If you are a network administrator and want to modify the default passwords and settings for any of the users, choose the* Admin *menu. For more information, see Admin Menu, Chapter 3.*

Appendix C - Declarations of Conformity and Regulatory Information

This appendix provides declarations of conformity and regulatory information for P-Com's SPEEDLAN 9200 products.

This appendix contains the following sections:

- *Safety Instructions*
- *European Telecommunications Standards Institute Statement of Compliance Information to User*
- *Manufacturers Canadian Declaration of Conformity Statement*
- *Radio Approval Table*

Safety Instructions

Rooftop and Tower Installations Warning

Rooftop, tower, and other mounted location equipment installations are extremely dangerous and incorrect installation can result in death, injury, or property damage.

General Safety Requirements for Installation of SPEEDLAN 9200 Models

1. *The AC power socket outlet should be installed near the switching power supply and junction box.*
2. *It is recommended that replacement of the battery which is soldered to the PC board should be done by manufacturer or professional installer.*
   CAUTION: THERE IS RISK OF EXPLOSION IF BATTERY IS REPLACED BY INCORRECT TYPE. DISPOSE USED BATTERIES ACCORDING TO INSTRUCTIONS.
3. *During installation of SPEEDLAN 9200 on the tower or on the wall, the necessary clearance from the power and lightning conductors should be maintained and proper grounding provided. The installation should be done in accordance with National Electrical Code:*
   - *NEC Article 725 – CEC Rule 16*
   - *NEC Article 800 – CEC Section 60, and*
   - *NEC Article 810 – CEC Section 54.*

Manufacturer Information

Manufacturer/Importer Name: P-COM, Inc.
7020 Professional Parkway East
Sarasota, FL 34240
Phone: 941-907-2300
Fax: 941-355-0219

European Telecommunications Standards Institute Statement of Compliance

Information to User

This equipment has been tested and found to comply with the requirements of ETSI standards. The product is in conformity with COUNCIL DIRECTIVE 89/336/EEC (EMC Directive) and COUNCIL DIRECTIVE 73/23/EC&93/68/EEC (SAFETY).
The Standards to which conformity is declared:

EN 300 328-2 (Radio Transmission)
EN 301 489-1/17 (EMC/EMI)
EN 55022 class B (EMC)
EN 60950 (Safety)

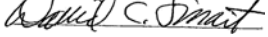
These Standards cover Wideband Data Transmission Systems referred to in the CEPT recommendation T/R 10.01. This type of accepted equipment is designed to provide reasonable protections against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructional manual, may cause harmful interference to radio communications.

Warning! *Please note that SL9204 models comply with ETSI standards and can carry the CE mark ONLY if the correct external antenna is installed. It is the customer's responsibility to use an external antenna that does not cause exceeding EIRP greater than 100mW or 20dBm.*

DECLARATION OF CONFORMITY is herby issued to the named Manufacturer/ Importer and is VALID ONLY for the equipment identified below:

Date of Approval: 10/22/2004

Declares That This Product (Product Description):
2.4 GHz BAND DSSS & OFDM WIRELESS LAN
Dave C. Smart



Director of Engineering - P-Com, Inc. *Date Signed: 10/22/2004*

Manufacturers Canadian (IC) Declaration of Conformity Statement

This Class B Digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations. Cet appareil numerique de la classe B respecte les exigences du Reglement sur le material broilleur du Canada. This device complies with Class B Limits of Industry Canada. Operation is subject to the following two conditions: 1. This device may not cause harmful interference, and 2. This device must accept any interference received, including interference that may cause undesired operation. The device is certified to the requirements of RSS-139-1 and RSS-210 for 2.4 / 5 GHz spread spectrum devices. The use of this device in a system operating either partially or completely outdoors may require the user to obtain a license for the system according to the Canadian regulations. For further information, contact your local Industry Canada office.

Radio Approvals

To determine the correct device you are allowed to use in your country, refer to the tables below:

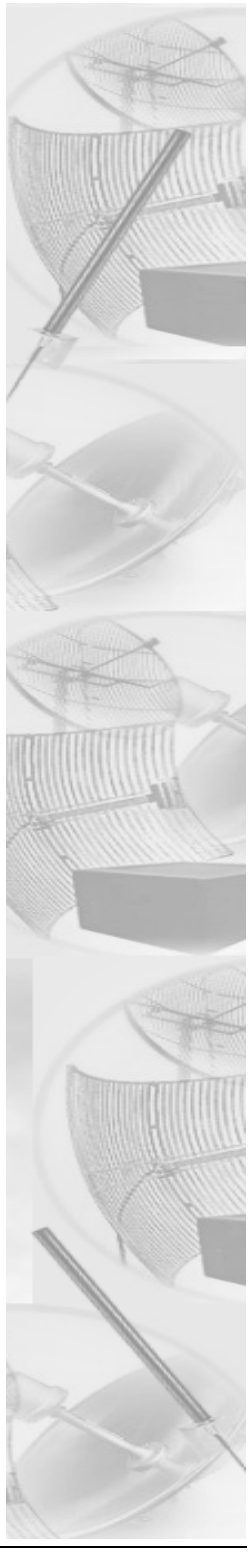
Radio Approval Table for Models SL920x

Country	*Commission*	*Model SL920x & Certification Number*
United States	*FCC*	*SL9201, SL9202, SL9203, SL9204, SL9200*
Europe	*ETSI*	*SL9204*
Canada	*IC*	*4309A-SL9201, 4309A-SL9202*

Minimum Receive Sensitivity (in dBm) for SL920x

Frequency	*dBm & Mb/s*
5.8GHz OFDM	*-65dBm @ 54Mb/s, -82dBm @ 6Mb/s*
2.4GHz OFDM	*-65dBm @ 54Mb/s, -82dBm @ 6Mb/s*
2.4GHz DSSS	*-80dBm @ 11Mb/s, -87dBm @ 1Mb/s*
4.9GHz OFDM	*-65dBm @ 54Mb/s, -89dBm @ 6/4Mb/s*

Appendix D - Acronyms



List of Acronyms

A

ANSI (American National Standards Institute)
ARP (Address Resolution Protocol)
ARPA (Advanced Research Projects Agency)

C

CDMA (Code Division Multiple Access)
CIDR (Classless Inter-Domain Routing)
CMIP (Common Management Information Protocol)
CPE (Customer Premise Equipment)
CSU/DSU (Channel Service Unit/Data Service Unit)

D

dB (Decibel)
dBm (DeciBels below 1 Milliwatt)
DCE (Data Communication Equipment)
Decibels (dB) relative to 1 milliwatt.
DHCP (Dynamic Host Configuration Protocol)
DOS (Disk Operating System)
DS (Direct Sequence)
DSP (Digital Signal Processor)
DSSS (Direct Sequence Spread Spectrum)
DTE (Data Terminal Equipment)

E

E1
ESD (Electro-Static Discharge)
FAQ (Frequently Asked Questions)

F

FCC (Federal Communications Commission)
FEC (Forward Error Correction)
FH (Frequency Hopping)
FTP (File Transfer Protocol)

G

GHz (GigaHertz)
GUI (Graphical User Interface)

H

Hex or H (Hexadecimal)
HTTP (HyperText Transport Protocol)
HTTPS (HyperText Transport Protocol Secure)
Hz (Hertz)

I

ICMP (Internet Control Message Protocol)
IEEE (Institute of Electrical and Electronics Engineers)
IMAP (Interactive Mail Access Protocol)
IP (Internet Protocol Address)
IP (Internet Protocol)
ISM (Industrial, Scientific, and Medical Bands)

K

K2 (Star Protocol)
Kb/s (Kbits/sec)
KHz (KiloHertz)

L

LAN (Local Area Network)
LED (Light-Emitting Diode)
LIU (Line Interface Unit)
LOS (Line of Sight)

M

MAC (Medium Access Protocol) address
MAN (Metropolitan Area Network)
Mb/s (MegaBytes per SECond)
MD5 (RIP2 MD5 Authentication)
MIB (Management Information Base)
MODEM (MOdulator-DEModulator)
MTBF (Mean Time Between Failure)

N

NAT (Network Address and Port Translation)
NAT (Network Address Translation)

O

OD (Outside Diameter)

P

PC (Personal Computer)
PCMCIA (PC Memory Card International Association)
PCS (Personal Communication Services)
PD (Public Domain)
PDA (Personal Digital Assistant)
PDF (Adobe's Portable Document Format)
PN (Pseudo-random Noise code)
POP (Post Office Protocol)
PPP (Point-to-Point)
PSB (Public Safety Band)
PSTN (Public Switched Telephone Network)

Q

QAM (Quadrature Amplitude Modulation)

QPSK (Quadrature Phase Shift Keying)

R

RAM (Random Access Memory)

RF (Radio Frequency)

RF (Radio Frequency)

RFC (Request for Comments)

RIP (Routing Information Protocol)

ROM (Read Only Memory)

RSSI (Received Signal Strength Indicator)

Rx (Receiver)

S

SMTP (Simple Mail Transfer Protocol)

SNMP (Simple Network Management Protocol)

SST (Spread Spectrum Technology)

STD (Standard)

T

TCP (Transmission Control Protocol)

TCP/IP (Transmission Control Protocol/Internet Protocol)

Tx (Transceiver)

U

UDP (User Datagram Protocol)

USB (Universal Series Bus)

W

WAN (Wide Area Network)

WWW (World Wide Web)

Appendix E - Firmware History

This appendix lists history of any prior firmware notes.

Version 2.2.0

New Features:

4.9 GHz PSB: Adds the capability to transmit Radio Frequency signals in the Public Safety Band of 4.9 GHz as per FCC Rules part 90, Subpart Y.

Field Upgradeable: Adds the ability to upgrade the router, via software, to a different model configuration, without physically removing the router from the network.

Bug Fixes: None.

Known Problems: None.

Version 2.1.0

New Features:

The following new features are added to this release:

Stronger Security: adds the support of WPA with TKIP & MIC and WPA2 with AES-CCMP which include a dynamic key management system. The new design also allows "Per Group" encoding of unicast and multicast packets as well as simultaneous and independent "Per Link" encoding of unicast packets in each link in the network.

Star or PMP Network Topology: adds the support of new SpeedLAN 9203 model, which can be configured as a STAR Base or as a CPE [Customer Premise Equipment]. It creates a bona fide PMP product in which the parameters of the network are easily controllable from the Base Station.

Bandwidth Limiting: adds the support to allow the user to control the bandwidth use of each SpeedLAN unit in a mesh or a star network. This feature allows controlling the amount of traffic from the Wireless Port to the Ethernet Port and also from the Ethernet Port to the Wireless Port with independent parameters.

ToS [Type of Service]: adds the support of ToS which provides a comprehensive traffic classification scheme and the choice of 8 levels of priority selection for each classification. Tagged traffic is classified by its DiffServ Code Point, and untagged traffic by other set of properties like for example the protocol and IP port.

Configuration File Upload/Download: adds the support of configuration file upload/ download to simplify the process of unit configuration that generally requires a good degree of expertise and can lead to errors.

System Log: adds the configurable Sys Log capability to improve troubleshooting and general network management.

Ethernet Port DHCP Client: replaces DHCP Client "PUMP" with ISC dhclient. The ISC dhclient corrects: 1) Non-zero Source IP address and, 2) "Do Not Fragment" bit problems in the IP header of DHCP Request packet generated by "PUMP". The ISC dhclient also allows SpeedLAN unit to specify: 1) Subnet Mask, 2) Broadcast address, 3) Time-offset, 3) Routers, 4) Domain-name, 5) Domain-name-server, and 6) Host-name options in the DHCP Request packet.

Wireless Port DCHP Server: adds the Server support to the Wireless Port to assign IP addresses to mobile mesh clients.

License Control: adds the license control to allow a SpeedLAN unit to control the communication with a certain number of mobile clients that associate to it. The license is provided by uploading to a given unit a license file specific for that unit.

Bug Fixes:

1) The problem in controlling the XMT power settings is fixed; the functions to handle the Calibration Table stored on Radio card is incorporated in V2.1.0.

Known Problems:

None

Version 1.0.8

Bug Fixes:

1. *This release fixes the problem that when DHCP Client is unable to obtain an IP address from the DHCP Server, or if a DHCP Server is just not available, then the Ethernet interface goes into "not functioning" mode. IPRecover then does not see the unit.*
2. *Also fixes the problem that the ACK timeout interval cannot support the link distance, which is longer than 2.4 miles in 11a mode, 4.6 miles in 11b mode, and 4.1 miles in 11g mode.*

Known Problems:

Same status as previous release minus the bug fixes indicated above.

Version 1.0.6

Bug Fixes:

Enlarges ACK and CTS timeout interval to support link with longer distance.

Known Problems:

Cannot fully control the settings of the XMT power; the functions to handle the Calibration Table stored on Radio card are not supported in the HAL

Version 1.0.5

Bug Fixes:

The transmitted/received counters were reported incorrectly under the Wireless Statistics section on the Statistics page. (This page is located under the Diagnostics menu of the SPEEDLAN 9200 Configurator.) For more information, see Interface Statistics, page 3-81.

Known Problems:

The transmit power exceeds FCC certified power ranges.

Version 1.0.4

New Features:

A new Transmit Rate Adaptation Algorithm allows the radio to transmit unicast packets at the optimum signaling rate. If there are changes, caused by either obstacles or interference in the wireless channel, the rate adaptation algorithm will automatically increase or decrease to an optimum rate, which is selected for each packet by the algorithm based on statistics of recent transmissions. This process creates reliable data transmission at the fastest possible rate.

Bug Fixes:

- *There were collisions between broadcast packets (Mesh Neighbor Discovery Packet) when the network had hidden nodes, which caused some links to be unstable.*
- *When the link had errors, the Signaling Rate dropped to the lowest enabled rate, and was slow to increase.*
- *In few instances, the unit hung up when the link experienced heavy interference. This problem occurred when the unit was in 2.4 GHz DSSS mode.*

Known Issues:

The transmit power exceeds FCC certified power ranges.

Beta Version 1.0.3

Bug Fixes:

- *Unit loses connectivity via the Ethernet port (Version 1.0.1): Unit can be accessed via the RF port but cannot be seen via its Ethernet interface. A link light is seen on the computer. The Configurator command shows that the Ethernet interface is receiving no traffic.*
- *Host route deleted by unit (Version 1.0.1): Under certain rare circumstances, a static host route was deleted from the routing table.*
- *Auto-fallback kicks in with fixed rates: (Version 1.0.1): Unit does not report the Signaling Rate change to SPEEDView.*

Known Issues:

- *There are collisions between broadcast packets (Mesh Neighbor Discovery Packet) when the network has hidden nodes, which causes some links to be unstable.*
- *When the link has errors, the Signaling Rate drops to the lowest enabled rate, and is slow to increase.*
- *In few instances, the unit hangs up when the link is heavily interferenced. This problem occurs when the unit is in 2.4 GHz DSSS mode.*

Documentation Fixes

- *Removed SPEEDLAN 9205 references. Refer to Chapter 2, beginning on SPEEDLAN 9200 Hardware, page 2-1 for more information.*
- *In Revision 02 of this User Guide, we stated that the 2.4GHz operates on a non-interference basis with other devices operating at the 2.4GHz frequency when using the 17dBi directional grid antenna. The correction is that it should read, "...when using the 18dBi directional antenna." Also, the Declaration of Conformity for RF Exposure Statement has been revised. Please see Declaration of Conformity for RF Exposure, page 2-3 for more information.*
- *2.4GHz OFDM and DSSS references have been added to this User Guide. This means that the preamble setting is now functional.*
- *The List of MIBs supported by SPEEDLAN 9200 table has been corrected to display the right version. For more informaton, see List of MIBs supported by SPEEDLAN 9200, page 3-28.*
- *RTS/CTS allows you to fine-tune the operation of your wireless LAN. RTS/CTS will help minimize collisions between transmissions from hidden nodes on the*

wireless network.. For more information, see Request to Send (RTS) / Clear to Send (CTS), page 4-8.

- *The Glossary has been improved. The following terms were revised: attenuator, CSU/DSU, channel spacing, dB, DHCP, E1, MAC, MIB, MTBF, passive repeater, polarization, QAM, raditaion, refraction, reliability, sidelobe and system gain. For more information, see the Glossary.*
- *Added ETSI Statement of Compliance. Added KINSL9201 & SL9204 in Radio Approval Table. 2.4GHz OFDM and 2.4GHz DSSS values have been added to the Minimum Receive Sensitivity table. See Appendix C, pages 3 and 4.*

Beta Version 1.0.2

This was an internal version.

Beta Version 1.0.1

- *TX power level drop-down list has been added on the Wireless Configuration page. See Configuration, page 3-44. Also, the default value for the SSID on the Wireless Configuration page is "SPEEDLAN9200" instead of "SP9200".*
- *Default values for Maximum Throughput were added for 2.4GHz OFDM and 2.4GHz DSSS values. For more information, see Max Throughput (Regulating Bandwidth), page 3-49.*
- *New Wireless Mode parameters (e.g., 5GHz OFDM, 2.4GHz DSSS or 2.4GHz OFDM), Preamble, Tx power and SSID). For more information, see Configuring the Radio Parameters, page 3-44.*
- *Double the transmission rate with turbo mode, up to 108Mb/s for 5GHz OFDM. For more information, see Configuring the Radio Parameters, page 3-44.*
- *You can allow a mesh node in a 9200 network to communicate with a SPEEDMesh-enabled client in adhoc mode. For more information, see Enabling/ Disabling the SPEEDMesh-Enabled Client, page 4-6.*

- *Provide network security between SPEEDMesh-enabled clients (PDAs and laptops) and SPEEDLAN 9200 routers via WEP. In a SPEEDLAN 9200 network, you can authenticate a SPEEDMesh-enabled client with a standard security mechanism called Wired Equivalent Privacy (WEP). WEP encrypts data that is transmitted over the wireless LAN. WEP protects the wireless link between clients and access points. Network administrators can control access via standard 802.11 client using WEP. For more information, see B. Enabling WEP*

Security Between a SPEEDMesh-Enabled Client and SPEEDLAN 9200, page 4-5.

NOTES:

Appendix F - Channels for IEEE 802.11x

Channels for IEEE 5GHz OFDM (UNII upper band)

Channel Information		Regulatory Domains	
Channel Number	Frequency	FCC	IC
149	5.745 GHz	✓	✓
153	5.765 GHz	✓	✓
157	5.785 GHz	✓	✓
161	5.805 GHz	✓	✓
165	5.825 GHz	✓	✓

2.4GHz DSSS Channels

Channel Information		Regulatory Domains		
Channel	Frequency	FCC	IC	ETSI
1	2412	✓	✓	✓
2	2417	✓	✓	✓
3	2422	✓	✓	✓
4	2427	✓	✓	✓
5	2432	✓	✓	✓
6	2437	✓	✓	✓
7	2442	✓	✓	✓
8	2447	✓	✓	✓
9	2452	✓	✓	✓
10	2457	✓	✓	✓
11	2462	✓	✓	✓

2.4GHz OFDM Channels

Channel Information		Regulatory Domains		
Channel	Frequency	FCC	IC	ETSI
1	2412	✓	✓	✓
2	2417	✓	✓	✓
3	2422	✓	✓	✓
4	2427	✓	✓	✓
5	2432	✓	✓	✓
6	2437	✓	✓	✓
7	2442	✓	✓	✓
8	2447	✓	✓	✓
9	2452	✓	✓	✓
10	2457	✓	✓	✓
11	2462	✓	✓	✓

4.9 GHz Channel Center Frequencies vs. Channel Bandwidth

WW Chan Number	5 MHz BW Frequency	FCC Channel Number	10 MHz BW Available	20 MHZ BW Available	Regulatory Domain
5	4942.5	3	N/A	N/A	FCC
10	4945		✓	N/A	FCC
15	4947.5	6	✓	N/A	FCC
20	4950		✓	✓	FCC
25	4952.5	7	✓	✓	FCC
30	4955		✓	✓	FCC
35	4957.5	8	✓	✓	FCC
40	4960		✓	✓	FCC
45	4962.5	9	✓	✓	FCC
50	4965		✓	✓	FCC
55	4967.5	10	✓	✓	FCC
60	4970		✓	✓	FCC
65	4972.5	11	✓	✓	FCC
70	4975		✓	✓	FCC
75	4977.5	12	✓	✓	FCC
80	4980.5		✓	✓	FCC
85	4982.5	13	✓	N/A	FCC
90	4985		✓	N/A	FCC
95	4987.5	16	N/A	N/A	FCC

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