Chapter

4

4 PMP Operation

4.1 Introduction

This section describes only the additional parameters required for configuring PMP support, and an overview about defining and using VLAN and pass-through groups.

The AN-80i PMP software provides the following main features:

- IEEE 802.1Q standard compliance
- VLAN Groups span subscribers
- Multiple VLAN Connections per subscriber
- Multiple TLS transport based on VLAN ID classification
- QoS provisioning with individual CIR setting per connection
- VLAN trunking with tag insert/delete/re-map
- VLAN tagged management traffic

Notices: **1. DFS is _not_ supported for PMP operation.**

2. PMP operation is supported for the 5.8 GHz radio, and the 5.4 GHz radio where DFS is _not_ required by regional regulations.

4.2 PMP Menu

The following menu items are available for configuring and monitoring the PMP functions. See Table 5**:** Web - Default System Users on page 30 for the factory default usernames and passwords.

Figure 19: PMP - Main Menu

4.3   Functional Description

4.3.1   Overview

The AN-80i can operate as a VLAN-aware wireless switch, as a standard wireless bridge (pass-through mode), or a combination of both. The following figure illustrates a simple pass-though configuration. This configuration does not use VLAN tagging or filter the Ethernet traffic.
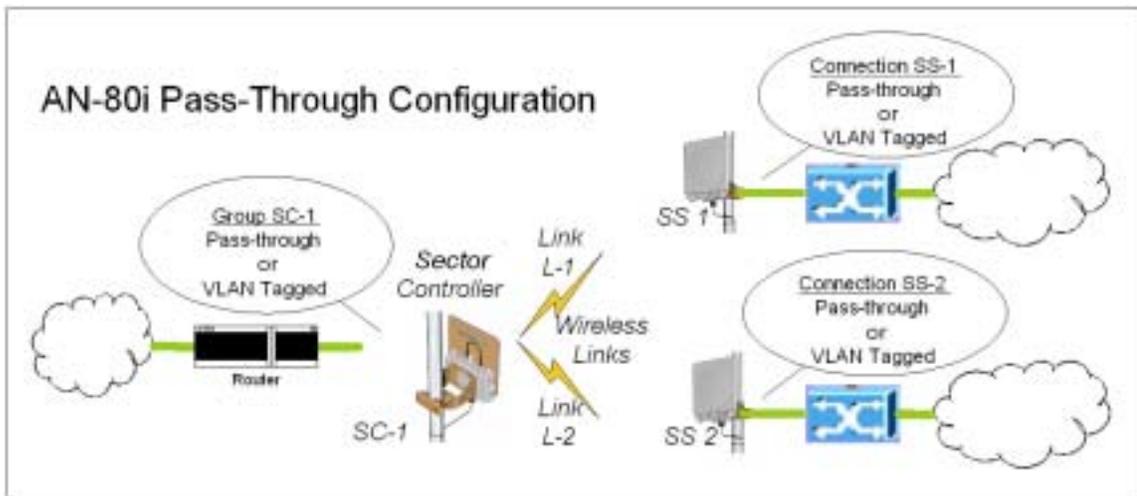

Figure 20: PMP - Basic Pass-through Group Configuration

The following diagram illustrates a network implementation using two VLAN groups. The packets tagged with VID=107 are classified as data traffic, while the packets tagged with VID=108 are classified as voice traffic.
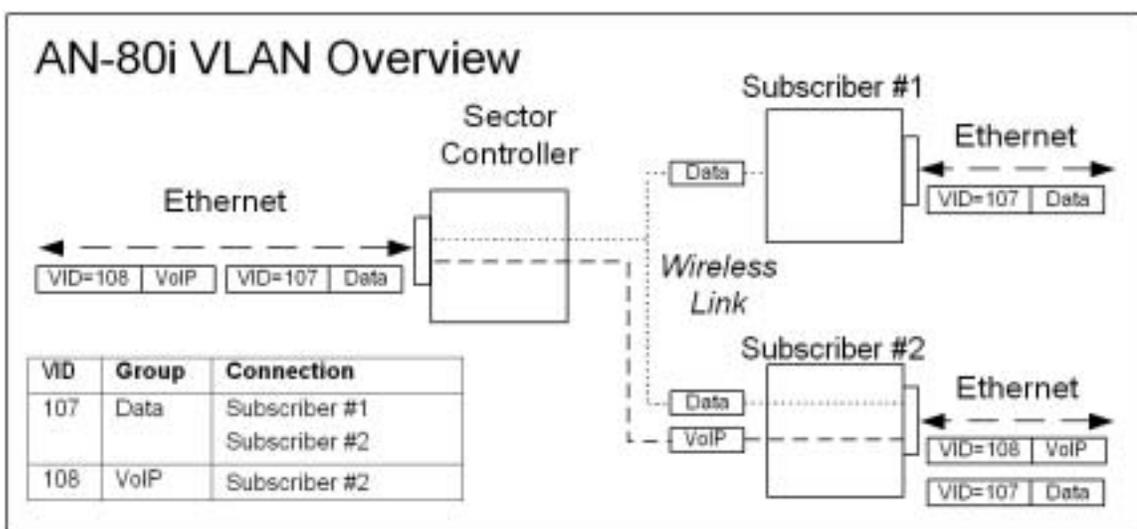

Figure 21: PMP - VLAN Tagged Traffic Example

4.3.2 Minimum Setup Requirements

A minimum set of parameters must be configured to enable data and management traffic on any PMP deployment:

1. Create one or more Links to identify each subscriber in the sector, and set the wireless link operating characteristics, including the maximum uplink and downlink modulation.

2. Create one or more Groups (VLAN or pass-through) and set the operating characteristics of this group.

3. Create one or more Connections (to Groups) for each subscriber, to assign membership to at least one Group.

The following table provides a summary of the configuration shown in the pass-through configuration diagram above. The actual Group ID and Link ID values are not available until these items have been created during configuration of the system. This configuration passes all data traffic as a standard PMP configuration.

Table 7: PMP - Basic Pass-Through Group Settings							
Group Configuration (Sector Controller)			Connection Configuration (Subscriber)				
Group Name	Port Tagging	Group VID	Connection Name	Port Tagging	Link ID	Group ID	Connection VID
SC-1	Pass Through	NA	SS-1	Pass Through	[L-1]	[SC-1]	NA
			SS-2	Pass Through	[L-2]	[SC-1]	NA

Notes: 1. The Group ID, Conn ID, and Link ID values are assigned automatically and must be read from the screen after items are created.
2. The QoS settings must be determined using the PMP Configuration Tool.

4.3.3 Packet Classification

The AN-80i PMP deployment can be configured for use with VLAN tagged traffic, untagged traffic, or a combination these two types. Ingress packets received on the Ethernet port are classified into tagged or pass-through groups according to the criteria in the following table. The Group settings apply to packets processed at the sector controller, while Connection settings apply to packets processed at the subscriber.

Table 8: PMP - Packet Classification	
Type	**Description**
Tagged Traffic	Packet has a VLAN tag <u>and</u> there is a Group/Connection configured for this VID. Sector Controller: Packets are forwarded over the wireless link to all subscribers with Connections to this VLAN Group. Subscribers: Packets are forwarded to the sector controller. The sector controller forwards the packets to the local Ethernet port and subscribers with Connections to this VLAN Group.
Pass-Through Traffic	The packet does <u>not</u> have a VLAN tag, or no Group/Connection exists for this VID. If a pass-through Group has <u>not</u> been defined, unclassified packets are discarded. If a pass-through Group has been defined, classified packets are forwarded based on the rules for tagged traffic. The packet VLAN information is <u>not</u> modified.

4.4 PMP Screens

This section describes the configuration screens used to setup a PMP deployment.

4.4.1 Configuration Screen

Click Configure System in the menu to view and adjust configuration settings for general system identification, Ethernet, and the wireless interface (partial screen shown below). The highlighted fields are specific to PMP deployments.

Ethernet Settings

Figure 22: **PMP - Ethernet Settings**

Polling Interval: Enter the SNTP polling interval (hours).

Mgmt. Tag Enable: Check ☑ this box to enable VLAN tagged traffic.

The Mgmt Tag Enable setting is disabled (factory default) when shipped from the factory or following a long-reset operation. In this mode the sector controller and subscriber stations can be managed through the local Ethernet port using untagged traffic. Over-the-air management is possible only after creating a pass-through group and pass-through connections for each subscriber station.

When Mgmt Tag Enable is enabled, this sector controller or subscriber station can be managed only using VLAN traffic tagged with the value specified in the Mgmt. VID field. Over-the-air management is possible only after creating a VLAN tagged group and VLAN tagged connections for each subscriber station.

It is recommended to create and test a VLAN group for tagged management traffic before activating the Mgmt Tag Enable function. Set the associated QoS and priority values to ensure management traffic has adequate priority and bandwidth during system operation.

Mgmt. VID: Enter the VLAN ID. When Mgmt. Tag Enable is selected, the system recognizes only management commands with this VLAN ID.

Important: The VLAN network support should be verified before enabling this feature to ensure the AN-80i system will be reachable using the VLAN tagged traffic.

Wireless Settings

The highlighted wireless settings are specific to PMP deployments.

Figure 23: **PMP - Wireless Settings**

System Mode: The system designated as sector controller establishes and manages the bi-directional data link with a remote end AN-80i. Only one system in a wireless link must be set for Sector Controller mode.

> **PTP Sector Controller**: AN-80i begins transmitting automatically, sends poll messages to locate remote AN-80i subscribers, and negotiates operating settings for the link.

> **PTP Subscriber**: AN-80i waits passively, monitoring the selected channel(s) until polled by the PTP Sector Controller.

Registration Period: The polling period for detecting new subscribers. Period is based on the number of wireless frames transmitted. Permitted values are 1 to 400. The recommended default registration period is 4.

Max. Distance [km]: Enter the distance to the subscriber located farthest away from the sector controller (outer boundary of sector). This parameter is used to optimize communications with the subscribers.

4.4.2 Link Screen

Click New Link in the menu to add a new subscriber and choose the wireless parameters.
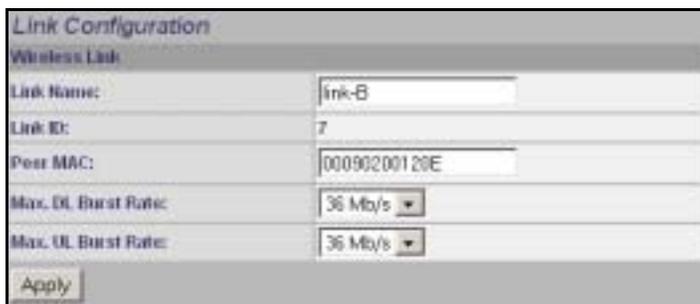
Figure 24: **PMP - Link Configuration Screen**

Link Name: Enter a name for this link. This name is displayed with the Link ID on information and statistics screens.

Link ID: (Read only) A unique Link ID is generated automatically when a new link is added.

Peer MAC: Enter the MAC address of the subscriber station. The sector controller only registers a subscriber station if the MAC address has been entered using the link configuration screen.

Max. DL Burst Rate: Select the downlink burst rate for unicast traffic from the sector controller to the subscriber (based on link budget calculations).

Max UL Burst Rate: Select the uplink burst rate for unicast traffic from the subscriber to the sector controller (based on link budget calculations).

Table 9: PMP Maximum Achievable UBR	
Uncoded Burst Rate (Mbps)	**SINADR (dB)**
54	25
48	23
36	18
24	15
18	11
12	9
9	9
6	7

4.4.3 Group Screen

Click New Group in the left-hand menu to display a blank Group configuration screen. The Group configuration defines how Ethernet packets are handled on the sector controller. A Group must be created for each VLAN to be transported across the wireless interface.
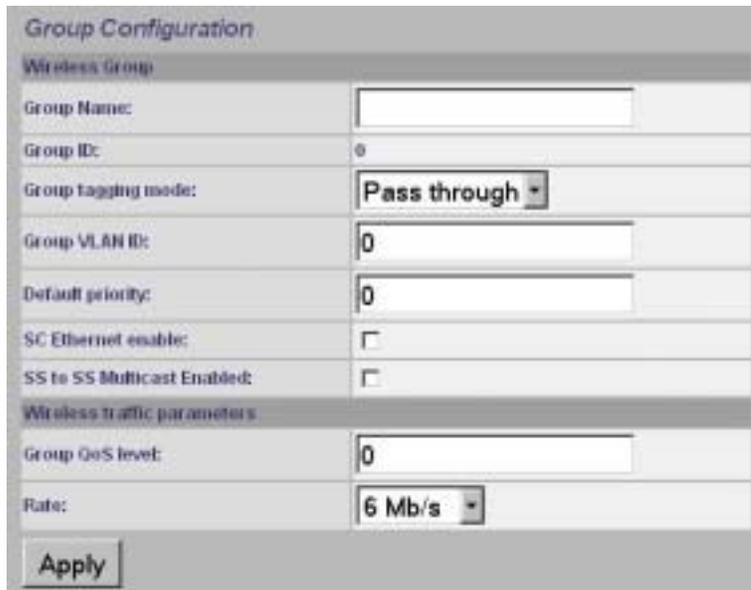

Figure 25: PMP - Group Configuration Screen

Group

Group Name: Enter a name for this Group. This name is displayed on configuration and statistics screens.

Group ID: (Read only) A unique Group ID is generated automatically when a new Group is created. The Group ID number is required when associating Connections to this Group.

Group Tagging Mode: Select the packet processing performed at the sector controller. Packets are forwarded unicast (known address) or multicast (unknown address). Further processing is performed at the subscriber based on the Connection configuration.

   Tagged: Select tagged to associate a unique VID with this Group.

   Packet received at sector controller Ethernet interface:

   A packet with this VID has the matching (outermost only) VLAN tag removed. The packet is forwarded over the wireless to all subscribers in this Group.

   Packet received at sector controller wireless interface (from subscriber):

   The packet belonging to this Group is forwarded unmodified over the wireless to all subscribers belonging to this Group.

   If the sector controller Ethernet port is enabled, a VLAN tag is added (outermost) and set to the VID (Group VLAN ID field) for this Group and the packet is forwarded to the sector controller Ethernet Port.

   Pass-through: Select pass-through to create a Group to process all packets that do <u>not</u> have a VLAN ID, or the outermost VLAN ID tag does <u>not</u> match the VLAN ID for any Group. Only one pass-through Group can be defined for each sector controller. If a

pass-through Group is not configured, all untagged packets received at the sector controller Ethernet ingress port are discarded.

Packet received at sector controller Ethernet interface:

The packet is forwarded unmodified over the wireless to all subscribers in this Group.

Packet received at sector controller wireless interface (from subscriber):

The packet is forwarded unmodified over the wireless to all subscribers in this Group.

If the sector controller Ethernet port is enabled, the packet is also forwarded to the sector controller Ethernet port.

Group VLAN ID: Enter the VID associated with this Group definition.

This field is used only when 'Tagged' is selected in the Group Tagging Mode field.

Default Priority: Enter the default 802.1p priority setting.

The default priority setting is used only when the Group Tagging Mode is set to 'pass-through' mode and the associated Connection Tagging Mode is set to 'Tagged'. The Group Default Priority value is used when adding the 802.1Q tag (Connection VLAN ID) to the packet being forwarded.

SC Ethernet Enable: Controls the sector controller Ethernet port.

Check this box ☑ to allow ingress and egress data traffic on the sector controller Ethernet interface.

Uncheck this box (☐) to block all data traffic on the sector controller Ethernet interface. The sector controller Ethernet port remains available for management traffic.

SC To SS Multicast Enable:

Check this box ☑ to enable group multicast traffic between subscribers.

Uncheck this box (☐) to block all multicast traffic between subscribers.

Wireless traffic parameters

Group QoS Level: Enter the Group bandwidth index. This index is used to set the desired bandwidth for downlink multicast and broadcast traffic to Group members. It is recommended to set this value at *less* than the UBR of the subscriber having the lowest UBR. Setting this value too high will result in unreliable transmission (no ARQ for broadcast/multicast traffic) to subscribers operating at low modulations.

The default value is five. A value of zero disables all DL broadcast/multicast traffic for the group.

Rate: Enter the maximum downlink UBR allowed for this Group.

Use the following steps to obtain the recommended setting:

1. Determine the member Link having the lowest UBR for this Group.

2. Set the Rate to UBR-1.

4.4.4 Connection Screen

Click New Connection in the left-hand menu to display a blank Connection configuration screen. To view an existing Connection, click Groups or Links, and then click Expand to display the Connections for that Group/link, and then click Config for the desired Connection.

At least one Connection must be created for each VLAN to be transported across the wireless switch. The Connection configuration defines how Ethernet packets are handled on the subscribers. Each subscriber can participate in multiple VLANs.

Figure 26: PMP - Connection Configuration Screen

Connection Configuration

Connection Name: Enter a name for this Connection. This name is displayed on configuration and statistics screens.

Connection ID: (Read only) A unique Connection ID is generated automatically when a new link is created. The Connection ID number is required when assigning this Connection to a Group.

Connection Tagging Mode: Select the packet processing at the subscriber.

Tagged: Select tagged to associate a unique VID with this Connection. Further processing is performed at the sector controller based on the Group configuration associated with this Connection.

Packet received at subscriber Ethernet interface:

Each packet with this VID (Connection VLAN ID field) has the matching VLAN tag (outermost only) removed and is forwarded over the wireless interface to the sector controller.

Packet received at subscriber wireless interface (from sector controller):

A VLAN tag is added (outermost) and set to the VID (Connection VLAN ID field) for this Connection. The packet is forwarded to the subscriber Ethernet port.

Pass-through: Select pass-through to create a Connection to process all untagged packets and packets where the outermost VLAN ID tag does not match the VID (Connection VLAN ID field) for with this Connection. Only one pass-through

Connection can be defined for each subscriber. If a pass-through Group is <u>not</u> configured, all untagged packets received at the subscriber Ethernet ingress port are discarded.

<u>Packet received at subscriber Ethernet interface</u>:

The packet is forwarded unmodified over the wireless to the sector controller.

<u>Packet received at subscriber wireless interface (from sector controller)</u>:

The packet is forwarded unmodified to the subscriber Ethernet port.

Connection VLAN ID: Enter the VLAN ID tag associated with this Connection definition. This field is used only when 'Tagged' is selected in the Connection Tagging Mode field.

Default priority: Enter the default 802.1p priority setting.

The default priority setting is used only when the Connection Tagging is set to 'pass-through' mode <u>and</u> the associated Group Tagging Mode is set to 'Tagged'. The Connection Default Priority value is used when adding the 802.1Q tag (Group VLAN ID) to the packet being forwarded.

Parent Link ID: Enter the Link ID for this Connection. This is the unique identification value created automatically when the subscriber Link was added. See Links List below.

Links List: Click this text (right side of screen) to display a list of existing Link IDs.

Parent Group ID: Enter the Group ID for this Connection. This is the unique identification value created automatically when the subscriber Link was added. See Groups List below.

Groups List: Click this text (right side of screen) to display a list of existing Group IDs.

Wireless Traffic Parameters

DL QoS Level: Enter the desired CIR value for downlink unicast traffic using this connection.

UL QoS Level: Enter the desired CIR value for uplink unicast traffic using this connection.

Important: It is recommended to calculate these settings using the Redline AN-80i PMP Configuration Tool. The sector controller allocates bandwidth for all subscribers using the Weighted Round Robin algorithm, with the combined total of all user-configured QoS levels acting as weights. The aggregate QoS settings affect packet delay and jitter values for the entire sector.

4.5 Browse Screens

4.5.1 Links Screen

Click Links in the menu to display the links browse screen. This is a list of all configured wireless links.

<div align="center">

Figure 27: PMP - Links Browse Screen

</div>

ID: Unique number identifying each link.

Name: User-assigned name for each link.

Config: Click Config on any line to display the Link Configuration screen associated with that Link.

Status: Click Status on any line to display the Link Statistics screen associated with that Link. This includes uplink and downlink statistics for the link.

Expand: Click Expand on any line to display the Connections browse screen showing all Connections associated with that Link.

Delete: Click Delete on any line to delete that Link. A link can <u>not</u> be deleted until all Connections referencing this link are deleted.

4.5.2 Groups Screen

Click Groups in the menu to display the Groups browse screen. This is a list of all configured Groups.

Figure 28: PMP - Groups Browse Screen

ID: Unique number identifying each Group.

Name: User-assigned name for each Group.

Config: Click Config on any line to display the Group Configuration screen associated with that Group.

Status: Click Status on any line to display the Group Statistics screen associated with that Group. This includes uplink and downlink statistics for the Group.

Expand: Click Expand on any line to display the Connections browse screen showing all Connections associated with that Group.

Delete: Click Delete on any line to delete that Group. A Group can <u>not</u> be deleted until all Connections referencing this Group are deleted.

4.5.3 Connections Screen

The Connections browse screen is accessible only from the Groups or Links browse screens. Click Groups or Links in the menu and then click Expand for any Group or Link.
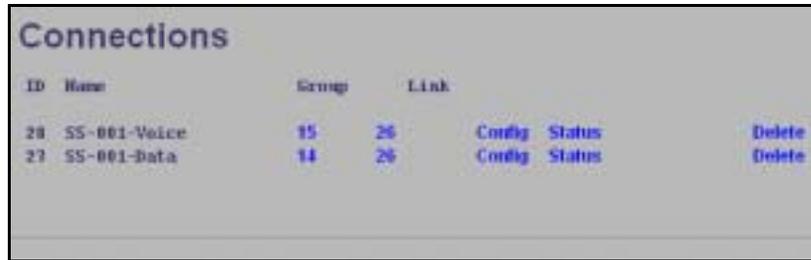
Figure 29: PMP - Connections Browse Screen

ID: Unique number identifying each Connection.

Name: User-assigned name for each Connection.

Group: Click the Group number (i.e., 4) on any line to display the Group associated with this Connection.

Link: Click the link number (i.e., 5) on any line to display all Connections configuration for that link.

Config (Configure): Click Config on any line to display the Link configuration screen for that item.

Status (Statistics): Click Status on any line to display uplink and downlink statistics for that Connection.

Expand: Click Expand on any line to display the Connections browse screen.

Delete (Delete): Click Delete on any line to delete that Connection.

4.6 Statistics Screens

4.6.1 Link Statistics

The Link Statistics screen is accessible only from the Links browse screen. Click Links in the menu and then click Status to display the statistics screen.

Figure 30: PMP - Link Statistics Screen

General

Link Name: User-assigned name for this link.

Link ID: Unique number identifying this link.

Peer MAC: MAC Address of the subscriber.

Active: Indicates if wireless link is operational (Active=YES).

Link Up Time: Total time the wireless link has been operational.

Link lost Count: Number of times link has been out of service.

Status Code: Code indicating the condition of the AN-80i system. Status indications are specific for PMP and PTP operation.

Configured Connections: The number of Connections configured on this link.

Wireless

The following statistics are displayed for both uplink and downlink.

Burst Rate: The current uncoded burst rate for the link.

RSSI: RSSI measured since the last screen refresh.

SINADR: Average signal to interference, noise, and distortion ratio measured since the last screen refresh.

Lost Frames: Number of frames lost.

Blocks

Blocks Total: Total number of blocks retransmitted over the wireless interface.

Blocks Retransmitted: Number of blocks retransmitted over the wireless interface.

Blocks Discarded: Number of blocks discarded (could not be sent over the wireless).

Controls

Refresh: Click Refresh to update the statistics display.

4.6.2   Group Statistics

Use the Group statistics screen to view statistics for all downlink traffic on Connections to this Group. Click Groups in the menu to display the Groups browse screen. Click Status to display downlink statistics for the selected Group.

Figure 31: PMP - Group Statistics Screen

General

Group Name: Name assigned to this Group.

Group ID: Unique numeric identifier for this Group.

Packet (Downlink)

Packets Discarded: Number of Ethernet packets discarded (could not be sent over the wireless interface).

Packets Transmitted: Number of Ethernet packets transmitted over the wireless interface.

Packets Received: Number of Ethernet packets received over the wireless interface.

Controls

Refresh: Click Refresh to update the statistics display.

4.6.3   Connection Statistics

Use the Connection statistics screen to view statistics for all uplink and downlink traffic on the selected Connection. Click Groups in the menu to display the Groups browse screen. Click Expand to display a list of Connections. Click Status to display statistics for the selected Group.

Figure 32: PMP - Connection Statistics Screen

General

Name: Name assigned to this Connection.

ID: Unique numeric identifier for this Connection.

Packet

Packets Discarded: Number of Ethernet packets discarded (could not be sent over the wireless interface).

Packets Transmitted: Number of Ethernet packets transmitted over the wireless interface.

Packets Received: Number of Ethernet packets received over the wireless interface.

Controls

Refresh: Click Refresh to update the statistics display.

4.6.4 System Status - PMP Wireless Statistics

Click System Status in the menu to view system, Ethernet statistics, and wireless interface statistics. The sector controller status screen includes information about the PMP deployment.

Figure 33: PMP - System Status Screen

Configured Stations: This is the number of Links defined (to subscribers).

Configured Connections: The number of Connections defined for all subscribers.

Active Wireless Links: The number of registered subscribers.

Active Wireless Connections: The number of connections to registered subscribers.

For all other statistics, refer to section 3.4.3: Wireless Statistics on page 21.

4.7   Quick Configuration Guide

This procedure is to aid configuring point-to-multipoint (PMP) operation on AN-80i systems. For complete installation and operational procedures. refer to the *AN-80i System User Manual*, the *AN-80i Quick Install Guide,* and the *Installation Guidelines* provided on CD-ROM.

The VLAN tagging feature allows the user to configure and operate an AN-80i deployment as a VLAN-aware wireless switch. A 'group' is created at the sector controller for each VLAN to be transported, and 'connections' are added to enable data flow with any subscriber station participating in that VLAN. If VLAN is not required, a default group and set of connections must be setup to define the traffic characteristics. Prior to completing this setup, no Ethernet data traffic can be transmitted over the wireless interface.
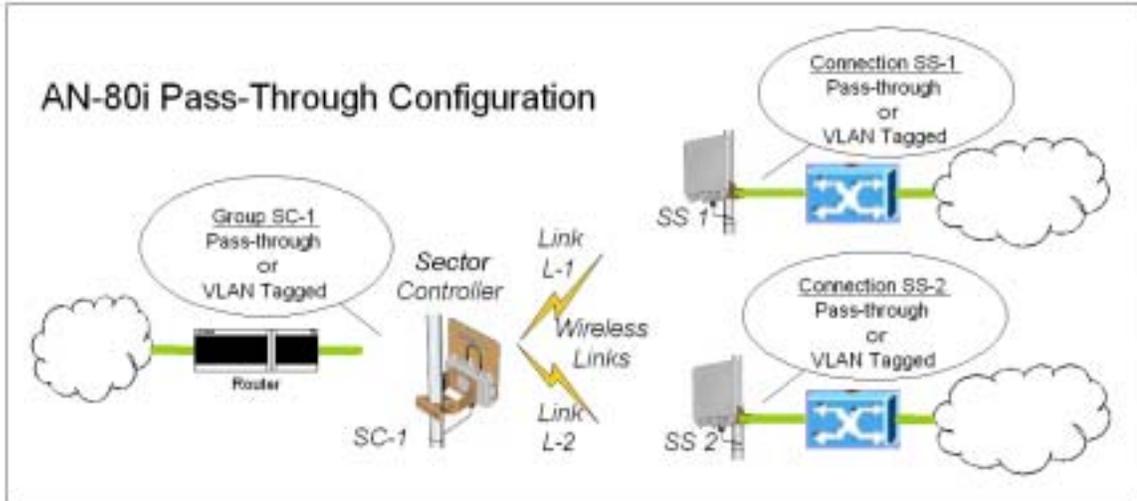
Figure 34: **PMP - Pass-through Only Deployment**

The procedures provided below include steps to setup a basic working configuration for initial testing, and then to introduce VLAN traffic controls.

4.7.1 Configure Pass-Through Operation

For initial installation and testing, it is recommended to setup a PMP configuration without VLAN support. Use the following steps to configure a PMP pass-through link.

Step 1: Create New Link for Each Subscriber

1. Click New Link to display the Link Configuration screen.
2. Enter a unique name for this link in the Link Name field.
3. Enter the MAC address of the subscriber station in the Peer MAC field.
4. Enter the UBR for this link (based on link budget calculations).
5. Use the default values for all other fields.
6. Click the Apply button to save and activate these settings.
7. Repeat steps 1 - 6 for each subscriber station.

Step 2: Create Single Pass-through Group

1. Click New Group to display the Group Configuration screen.
2. Enter a unique name for this group in the Group Name field.
3. Set the Group Tagging Mode to Pass-through.
4. Check the SC Ethernet Enable box ☑.
5. Set the Group QoS value for sending multicasts (i.e., 5). A value of zero (0) disables all traffic.
6. Use the default values for all other fields.
7. Click the Apply button to save and activate these settings.

Step 3: Create Connections

1. Click New Connection to display the Connection Configuration screen.
2. Enter a unique name for this connection in the Connection Name field.
3. Set the Connection Tagging Mode to Pass-through.
4. Enter the Link ID of a subscriber station in the Link ID field.
5. Enter the Group ID in the Group ID field.
6. Set the DL QoS Level and UL QoS Levels. Default values are MAX Burst Rate Value - 1. A value of zero (0) disables all traffic.
7. Click the Apply button to save and activate these connection settings.
8. Repeat steps 1 - 7 to add a connection for each subscriber station.

Step 4: Save Configuration

Click Save in the left-hand menu to permanently save all settings. The system will pass all tagged and untagged data and management traffic.

The following table provides sample settings for a pass-though group at the sector controller and connections to two subscriber stations.

Table 10: PMP - Basic Pass-Through Group Configuration Settings							
Group Configuration (SC)			Connection Configuration (SS)				
Group Name	Group Tagging Mode	Group VLAN ID	Connection Name	Connection Tagging Mode	Link ID	Group ID	Connection VLAN ID
SC-1	Pass Through	NA	SS-1	Pass Through	[L-1]*	[SC-1]*	NA
			SS-2	Pass Through	[L-2]*	[SC-1]*	NA

The group ID and link ID are numbers generated automatically by the AN-80i.

4.7.2 VLAN Configuration

Use these steps to convert the system from pass-through operation to VLAN tagged connections.

Step 1: Change Group to VLAN Tagged

1. Click Groups to display the Groups Configuration screen.
2. Click Config to edit the Group configuration.
3. Set the mode to Tagged in the Group Tagging Mode field.
4. Enter the VID for this group in the Group VLAN ID field.
5. Click the Apply button to save and activate these settings.

Step 2: Change Connections to VLAN Tagged

1. Click Groups in the menu to display the Groups Configuration screen.
2. Click Expand to view all connections for that Group.
3. Choose a connection and click Config to edit the Connection Configuration.
4. Set the mode to Tagged in the Connection Tagging Mode field.
5. Enter the VLAN ID for this connection in the Connection VLAN ID field.
6. Click the Apply button to save and activate these settings.
7. Repeat steps 1 through 6 for each Connection in the Group.

Step 3: Save Configuration

Click Save in the left-hand menu to permanently save and activate all settings. The system will now pass only VLAN tagged traffic.

5   CLI Interface

This section describes the procedures for configuring and operating the AN-80i using CLI over a Telnet Connection.

5.1   CLI Command Summary

All commands are case-sensitive. Use the following general format:

command <Enter>

Online help is available for all commands, and the Tab key can be used for auto-complete functions. The following table lists all AN-80i commands available from root mode (default mode when you login).

Table 11: CLI - Command Summary			
PTP	**PMP**	**Command**	**Description**
√	√	**chgver**	Change the default version of software and reboot the AN-80i.
	√	**clear**	Clear commands.
	√	**del**	Delete an ID
	√	**enable**	Enable an ID
√	√	**get**	Display the value of a statistic or read-only parameter (i.e., MAC).
	√	**load**	Load commands.
	√	**new**	Create a new ID
√	√	**reset**	Reset the AN-80i statistics values.
√	√	**save**	Save the selected configuration settings (i.e., SNMP settings)
	√	**script**	Generate a configuration script.
√	√	**set**	View/modify a system parameter value.
√	√	**show**	View system compound objects (i.e., configuration settings).
√	√	**snmpcommunity**	View/modify the SNMP community settings.
√	√	**snmptrap**	View/modify the SNMP trap settings.
√	√	**test**	Activate edited changes to the system configuration for a test period of five minutes.
√	√	**upgrade**	Upload a software binary image to the AN-80i.
√	√	**user**	View/modify the user/password configuration.

			Table 12: CLI - Root Mode Commands
PTP	**PMP**	**Command**	**Description**
√	√	**?**	Use the '?' character to display help for any command or mode. Example: From the root directory, enter the following command to list all parameters that can be changed using the 'set' command: set ?
√	√	**CTRL-Z**	Return to root mode. Cancel command entry (alternative to backspace delete).
√	√	**exit**	Return to parent node / mode. all (exit all) Return to root mode.
√	√	**logout**	Terminate this telnet session. May be entered from any mode.

5.2   Connecting with Telnet

To connect to the AN-80i, open a Telnet session to the IP address of the AN-80i. On a Windows™ PC, open the Run command and type 'telnet' followed by the IP address of the AN-80i. When the command prompt screen appears, login to the AN-80i. The AN-80i may now be controlled using a set of CLI commands.
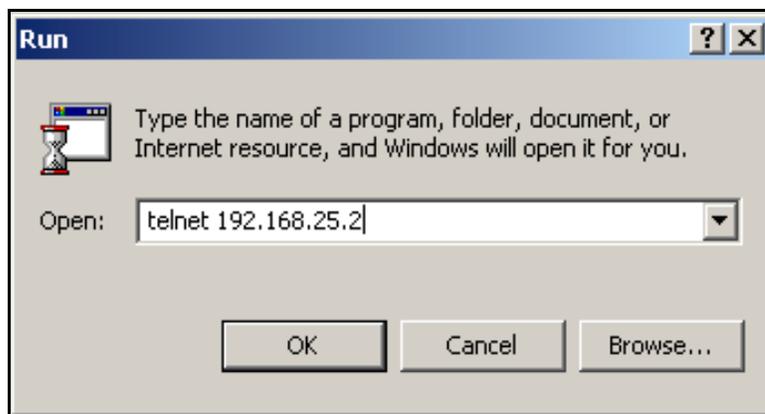
Figure 35: **CLI - Connecting via Telnet**

The system will logout users automatically if no commands are received (idle) for five minutes. To exit immediately from the CLI, type the following command:

    logout [ENTER]

5.3 CLI Command Set

5.3.1 Chgver

Use the *chgver* command to change the software version to loaded when you reboot the AN-80i. Also see the Get command 'swver'.

PTP	PMP	Parameter/Description
		Table 13: CLI - chgver
√	√	Enter this command to toggle between software versions. The setting will alternate between the two banks of memory (no parameters). chgver <Enter>

5.3.2 Clear

Use the *clear* command to delete all IDs from an ID table.

PTP	PMP	Parameter/Description
		Table 14: CLI - clear
	√	**clear** idtable - Clear all the IDs

5.3.3 Del

Use the *del* command to delete a specific ID.

PTP	PMP	Parameter/Description
		Table 15: CLI - del
	√	**del** <id> - [id number]

5.3.4 Enable

Use the *enable* command to re-enable a specific ID (that was disabled).

PTP	PMP	Parameter/Description
		Table 16: CLI - enable
	√	**enable** <id> - [id number]

5.3.5 Get

Use the *get* command to view system parameters. Use the following general format to view a parameter:

get [field] <Enter>

		Table 17: CLI - get
PTP	**PMP**	**Parameter/Description**
√		**calcdst**: Calculated link distance between units.
√	√	**erxpkt**: Number of Ethernet packets received.
√	√	**erxpktd**: Number of Ethernet packets received that were discarded.
√	√	**etxpkt**: Number of Ethernet packets transmitted.
√	√	**mac**: AN-80i MAC address.
√	√	**radiotype**: Radio type.
√	√	**rffreq**: Current RF frequency setting.
√		**rflink**: Status of the RF link.
√	√	**rfstatus**: Status RF transmitter.
√		**rssimax**: Maximum RSSI.
√		**rssimean**: Mean RSSI.
√		**rssimin**: Minimum RSSI.
√		**sinadr**: Ration of signal to interference + noise.
√	√	**swver**: List the downloaded software versions.
√	√	**sysuptime**: Display the time since the last reboot.
√	√	**txpower**: Current Tx power setting.
√		**ubrate**: Current UBR value.
√		**wrxpkt**: Number of wireless packets received.
√		**wrxpktd**: Number of wireless packets received that were discarded.
√		**wrxpktr**: Number of wireless packets that were retransmitted.
√		**wtxpkt**: Number of wireless packets transmitted.
√		**wtxpktd**: Number of wireless packets transmitted that were discarded.
√		**wtxpktr**: Number of wireless packets that were retransmitted.
	√	**activeids**: Number of active IDs.
	√	**activelinks**: Number of the active links.
	√	**boardtype**: Board type.
	√	**dldpkt**: Downlink discarded packets counter.
	√	**dlrpkt**: Downlink Rx packets counter.
	√	**dltpkt**: downlink Tx packets counter.
	√	**idenable**: ID status.
	√	**lactive**: Link active status.
	√	**ldlblk**: Downlink total blocks counter.

		Table 17: CLI - get
	√	**ldlbr**: Downlink burst rate.
	√	**ldldblk**: Downlink discarded blocks counter.
	√	**ldllfr**: Downlink lost frames counter.
	√	**ldlrblk**: Downlink retransmitted blocks counter.
	√	**ldlrssi**: Downlink RSSI.
	√	**ldlsnr**: Downlink SINADR.
	√	**llostc**: Link lost Connection counter counter.
	√	**lrcon**: Number of link registered Connections.
	√	**lscode**: Link status code.
	√	**lulblk**: Uplink total blocks counter.
	√	**lulbr**: Uplink burst rate.
	√	**luldblk**: Uplink discarded blocks counter.
	√	**lullfr**: Uplink lost frames counter.
	√	**lulrblk**: Uplink retransmitted blocks counter.
	√	**lulrssi**: Uplink RSSI.
	√	**lulsnr**: Uplink SINADR.
	√	**luptime**: Link up-time.
	√	**regconn**: Number of configured Connections.
	√	**regstations**: Number of configured stations.
	√	**uldpkt**: Uplink discarded packets counter.
	√	**ulrpkt**: Uplink Rx packets counter.
	√	**ultpkt**: Uplink Tx packets counter.
	√	**werxpkt**: Wireless Eth Rx packets counter.
	√	**werxpktdis**: Wireless Eth Rx discarded packets counter.
	√	**werxpkterr**: Wireless Eth Rx packets with errors counter.
	√	**wetxpkt**: Wireless Eth Tx packets counter.
	√	**wetxpktdis**: Wireless Eth Tx discarded packets counter.
	√	**wetxpkterr**: Wireless Eth Tx packets with errors counter.

5.3.6   Load

Use the *load* command to load an ID table from non-volatile memory.

Table 18: CLI - load		
PTP	**PMP**	**Parameter/Description**
	√	**load** idtable - Load all IDs from saved (FLASH) memory.

5.3.7 New

Use the *new* command to create a new link, group, or connector ID.

		Table 19: CLI - new		
PTP	**PMP**	**Parameter/Description**		
	√	**new** <id_type> - [link | group | conn] <id> - <id number>		

5.3.8 Reset

Use the *reset* command to set all AN-80i statistics values to zero.

		Table 20: CLI - reset
PTP	**PMP**	**Parameter/Description**
√	√	stats: Reset the AN-80i statistics counters. reset stats <Enter>

5.3.9 Save

Use the *save* command to copy edited parameter settings into non-volatile memory.

        save [option] <Enter>

		Table 21: CLI - save
PTP	**PMP**	**Parameter/Description**
√	√	**config**: Save Ethernet, wireless, and user configuration settings.
		snmp: Save SNMP settings.
		defaultconfig: Overwrite current settings with the factory default Ethernet, wireless, and SNMP settings.

5.3.10 Script

Use the *script* command to save a file containing a string of CLI commands that can be used to restore the current (active) configuration of the AN-80i.

		Table 22: CLI - script		
PTP	**PMP**	**Parameter/Description**		
	√	**script** <server> - [server IP address] <name> - [script file name]		

5.3.11 Set

Use the *set* command to view and/or change a parameter.

View a parameter:

set [field] <Enter>

Change a parameter:

set [field] [value] <Enter>

PTP	PMP	Parameter/Description
Table 23: CLI - set
	√	**activekey**: Current active options key. <active_idx> - [0 | 1]
√		**adaptmod**: Enable or disable the adaptive modulation function. **off** - Disable **on** - Enable When enabled, the AN-80i will automatically change the modulation to the highest setting that can sustain a packet error rate lower than 1x10e-6. If the packet error rate exceeds 1x10e-6, the system automatically steps down modulation/code rate (i.e., from 16 QAM 3/4 to 16 QAM 1/2) to maintain the wireless link quality.
√		**antgain**: Enter value for antenna gain (dBi). When DFS is enabled, it is important that the Antenna Gain setting matches the true antenna gain. If the antenna gain is set higher incorrectly, the AN-80i is less sensitive to detecting interference, and is not operating in compliance with the UK/ETSI standard.
√		**atpc**: Enable or disable the ATPC function. Both AN-80i units monitor Rx signal and automatically adjust the Tx level of the transmitting system to optimize system performance. The ATPC feature must be enabled on both ends of the link. **off** - Disable **on** - Enable This mode can be changed only if allowed by the options key. If the options key does not allow changes: 1) value is specified by the options key, 2) executing a set command for this field will generate an error message.
√	√	**autoscan**: Enable or disable the Autoscan function. **off** - Disable **on** - Enable When enabled, the PTP Subscriber (system mode) AN-80i automatically scans available channels to locate the current operating frequency of the PTP Sector Controller system. Executing a set command this field on a PTP Sector Controller will generate an error message.
	√	**bsporten**: Sector controller Ethernet port enable. <id> - [id number] <mode> - <on/off>
√	√	**buzzer**: Enable or disable the audible alignment buzzer. **off** - Disable **on** - Enable When enabled, the rate of the tone is proportional to the receive signal strength (faster = stronger signal).
√	√	**chwidth**: Enter the channel bandwidth in MHz. Valid entries are 10, 20, and 40.

Table 23: CLI - set

	√	**congid**: Connection's group ID. <id> - [id number] <gid> - <gid>
	√	**conlid**: Connection's link ID. <id> - [id number] <lid> - <lid>
	√	**conpri**: Connection priority. <id> - [id number] <pri> - <VLAN priority>
	√	**convid**: Connection VLAN ID. <id> - [id number] <vid> - <VLAN ID>
	√	**conviden**: Connection VLAN enable. <id> - [id number] <mode> - <on/off>

√		**dfsaction**: Select the mode of operation for DFS. The system set to master-mode monitors for interference from radar devices and other equipment using the same channel frequency. When interference is detected, the system automatically takes the action selected using the drop-down menu:
		<action> - [none=0 | txoff=1 | chgfreq=2]
		   None: The DFS function is disabled.
		   Tx Off: Transmission is immediately disabled when radar signals are detected. This action is recorded in the message log and an SNMP trap message is sent (if SNMP enabled).
		   Chg Freq: Relocate transmission to an alternative frequency immediately when radar signals are detected. This action is recorded in the message log and a trap message is sent (if SNMP enabled).

	√	**dlqos**: Downlink QoS. <id> - [id number] <qos> - <QoS>
	√	**dlrate**: Downlink rate. <id> - [id number] <rate> - <rate>
√		**dst**: Enter the actual length of the path that the wave travels in order to establish the link. Units are defined by dstmu setting. This value is used to calculate the transmission-to-response interval and disregard reflections of the transmitted signal. Used only if dstmod is set to 'manual'.

√		**dstmode**: Select the mode for determining the distance of the wireless link.
		   auto: Distance is calculated automatically by the AN-80i.
		   manual: Operator enters link distance.

√		**dstmu**: Select the measurement unit for the link length (dstmode).
		   mile - dstmode units are miles
		   km - dstmode units are kilometers

Table 23: CLI - set			
√		**efw**: Enable or disable the Ethernet Follows Wireless function.	
		off - Disable	
		on - Enable	
		When Ethernet Follows Wireless is enabled the Ethernet port status is controlled to reflect the status of the wireless interface. When the AN-80i detects that the wireless interface has failed (or is manually disabled), the local Ethernet port is immediately disabled When the AN-80i re-establishes the wireless link, the Ethernet port is re-enabled..	
√		**encen**: Enable or disable the encryption function.	
		off - Disable	
		on - Enable	
		If encryption is enabled, the correct encryption keys must be entered on both communicating systems.	
√		**enckey**: Enter the encryption key. If encryption is enabled, the correct encryption keys must be entered on both communicating systems. Used only if encen is set to 'on'.	
√	√	**ethmode**: Enter the Ethernet speed and duplex setting.	
		auto - Auto-negotiate	
		10hd - 10Base-T Half Duplex	
		10fd - 10Base-T Full Duplex	
		10hd - 100Base-T Half Duplex	
		100fd - 100Base-T Full Duplex	
√	√	**flowctrl**: Enable or disable the flow control function. The Flow control feature enables the AN-80i to request other Ethernet devices to pause transmission during busy periods.	
		off - Disable	
		on - Enable	
√	√	**gateway**: Enter the IP address of the default gateway on this segment.	
√	√	**gmt**: Enter the time offset from GMT (i.e., -5 for EST).	
	√	**grppri**: Group priority.	
		<id> - [id number]	
		<pri> - <VLAN priority>	
	√	**grpqos**: Group QoS.	
		<id> - [id number]	
		<qos> - <QoS>	
	√	**grprate**: Group rate.	
		<id> - [id number]	
		<rate> - <group rate>	
	√	**grpvid**: Group VLAN ID.	
		<id> - [id number]	
		<vid> - <VLAN ID>	
	√	**grpviden**: Group VLAN enable.	
		<id> - [id number]	
		<mode> - <on/off>	
√	√	**http**: Enable or disable the HTTP function. When disabled, the Web interface will not be available.	
		off - Disable	
		on - Enable	

		Table 23: CLI - set
	√	**idname**: ID name. <id> - [id number] <name> - <id name> - maximum 15 characters
√	√	**ipaddr**: Enter the IP address of the AN-80i.
	√	**maxdst**: Maximum distance to a subscriber [Km]. <distance> - Maximum distance from SC to SS [Km].
√	√	**maxtxpower**: Enter the Tx power level (dBm). This setting is for the transceiver output only. The actual EIRP depends on the gain of the connected antenna. See ETSI Certified Antennas on page 84 for a list the maximum transmit power setting based on the antenna gain for a series of frequency settings. The maximum value for this field is determined by the options key.
	√	**mgmtag**: Management VLAN enable. <mode> - [on | off]
	√	**mgmvid**: Management VLAN ID. <vlan_id> - <VLAN ID>

√		**mrate**: Enter the maximum uncoded burst rate (Mbps). Entry values are dependant on the channel bandwidth (chwidth).
		         10 MHz: 3, 4.5, 6, 9, 12, 18, 24 or 27
		         20 MHz: 6, 12, 18, 24, 30, 36, 48, or 54
		         40 MHz: 12, 24, 36, 48, 60, 72, 96, or 108
		The maximum value for this field is determined by the options key.

√	√	**netmask**: Enter the IP netmask.
√	√	**optionskey**: Enter the options key string. <kIdx> - Index of the options key [0 | 1] <kStr> - [<options_key_string>]
	√	**peermac**: Peer MAC address. <id> - [id number] <mac> - <MAC address>

√	√	**radio**: Enable or disable the radio transmitter.
		     off - Disable
		     on - Enable

√		**ratedif**: Enter the number of modulation levels to step down during re-transmission of errored wireless packets. The level can be set from 0 to 7 (recommended value = 2).
	√	**regper**: Frames number between registrations. <frames> - The number of frames between registrations [4..100].
√	√	**rffreq**: Enter the center frequency for the RF channel. When operating multiple links in close proximity, channel frequencies should be separated by a minimum of the channel size to minimize interference. For example, when operating in with 20 MHz channels, the separation must be greater than 20 MHz.

√	√	**snmp**: SNMP enable setting.
		     off - Disable the SNMP agent.
		     on - Enable the SNMP agent.

		Table 23: CLI - set
√	√	**snmptraplink**: Enable or disable sending an SNMP trap message for each link-up and link-down event. 　<setting>　　- [on | off]
	√	**snmptraps**: Status of the SNMP traps flag. 　<mode>　　　　- [on | off]
√		**snmptraps**: Enable or disable sending all SNMP traps. 　<setting>　　- [on | off]
√	√	**sntp**: SNTP enable setting. 　　　**off** - Disable SNTP protocol support. 　　　**on** - Enable SNTP protocol support.
√	√	**sntpip**: Enter the SNTP server IP address. Valid only if sntp is enabled.
√	√	**sntppoll**: Enter the interval to synchronize with the sntp server. 　<polltime>　　　- SNTP polling interval [hours].
	√	**sstoss**: Status of packet routing between SSs. 　<id>　　　　- [id number] 　<mode>　　　　　- <on/off> - Route broadcast packets from SS to SS
√	√	**syscontact**: Enter additional descriptive details about this AN-80i. The description can be any combination of up to 20 letters and numbers.
√	√	**sysdescr**: Enter descriptive details about this AN-80i. The description can be any combination of up to 20 letters and numbers.
√	√	**sysloc**: Enter descriptive details about the location of this AN-80i. The description can be any combination of up to 20 letters and numbers.
√	√	**syslog**: Syslog enable setting. 　　　**off** - Disable syslog server protocol support. 　　　**on** - Enable syslog server protocol support.
√	√	**syslogip**: Enter the syslog server IP address. Valid only if syslog is enabled.
√	√	**sysmode**: PTP Operation: 　　　**ptpsector controller** - The sector controller (base station) begins transmitting automatically; sending poll messages to locate the remote subscribers (ptpsubscriber). 　　　**ptpsubscriber** - Subscriber waits passively, monitoring the selected channel(s) until polled by the ptpsector controller (base station). PMP Operation: 　　　**pmpsc** - The sector controller (base station) begins transmitting automatically; sending poll messages to locate the remote subscribers (pmpss). 　　　**pmpss** - Subscribers wait passively, monitoring the selected channel(s) until polled by the pmpsc (sector controller). 　　　<SysMode>　　- [pmpss | pmpsc]
√	√	**sysname**: Enter the name for this AN-80i. The name can be any combination of up to 20 letters and numbers.
√	√	**telnet**: Enable or disable the Telnet port. If the Telnet port is disabled, it will not be possible to use the CLI interface. 　　　**off** - Disable 　　　**on** - Enable Changes to this field are effective only following reboot.

Table 23: CLI - set		
√	√	**telnetport**: Enter Telnet port address (default is 23).
	√	**ulqos**: Uplink QoS. <id> - [id number] <qos> - <QoS>
	√	**ulrate**: Set the uplink rate. <id> - [id number] <rate> - <rate>

5.3.12 Show

Use the *show* command to display system statistics.

show <Enter>   Change to 'show' mode.

show [field] <Enter>   Display values for the selected parameter.

Table 24: CLI - show		
PTP	**PMP**	**Description**
	√	**config**: list all system configuration information.

		Example:
		192.168.25.2(show)# config
		    System Information:
		sysname = 1234567890
		sysdescr = b
		sysloc = c
		syscontact = d
		    Ethernet Configuration:
		ipaddr = 192.168.25.2
		netmask = 255.255.255.0
		gateway = 192.168.25.1
		flowctrl = Off
		sntp = On
		sntpip = 192.168.25.1
		sntppoll = 24
		gmt = +0:00
		syslog = Off
		syslogip = 192.168.25.1
		ethmode = auto
		http = On
		telnet = On
		
		telnetport = 23
		snmp = On
		snmptraps = On
		snmptraplink = On
		mgmtag = Off
		mgmvid = 0
		    Wireless Configuration:
		rffreq = 5610.0
		autoscan = Off
		maxtxpower = 15
		chwidth = 20 MHz
		sysmode = pmpsc
		swver = 10.00.027 (other: 2.00.004)
		buzzer = On
		regper = 18
		maxdst = 2
		radio = Off = 2
		radio = Off

	√	**conns**: list all Connections. <id> - [id number] *Example:* 192.168.25.2(show)# conns 14 27 SS-001-Data Conn

		Table 24: CLI - show

	√	**groups**: list all Groups.
		Example:
		192.168.25.2(show)# groups
		   14 Data Group
		   15 Voice Group

	√	**idtable**: list all system IDs.
		Example:
		192.168.25.2(show)# idtable
		
		        ID Name Type Status
		-- 	
		     4 Link Not Enabled
		     5 Link Not Enabled
		   14 Data Group Enabled
		   15 Voice Group Enabled
		   24 Conn Not Enabled
		   25 Conn Not Enabled
		   26 Subscriber-001 Link Enabled
		   27 SS-001-Data Conn Enabled
		   28 SS-001-Voice Conn Enabled

	√	**links**: list of links. *Example:* 192.168.25.2(show)# links 26 Subscriber-001 Link
√	√	**log**: list the system log. *Example:* 192.168.25.2(show)# log 000d, 00:00:00 1005 - User Configuration Load: OK 000d, 00:00:00 1016 - Options Key Properties Load: OK 000d, 00:00:00 1014 - Options Key Load: OK 000d, 00:00:00 1018 - Options Key Activated: OK 000d, 00:00:00 1001 - System Configuration Load: OK 000d, 00:00:00 1030 - SNMP Configuration Load: OK 000d, 00:00:00 1012 - System Description Load: OK 000d, 00:00:00 1007 - Network Configuration Load: OK 000d, 00:00:00 1010 - Version Ctrl Data Load: OK 000d, 00:00:02 1009 - Network Configuration: OK 000d, 00:00:11 1023 - Firmware configuration: OK 000d, 00:00:26 1033 - MAC Initialization: OK 000d, 00:13:29 2039 - SNTP: Time received: OK 000d, 02:15:00 1006 - User Configuration Save: OK
√	√	**snmp**: list the SNMP Configuration. *Example:* Trap Configuration: SNMP Enabled: On Traps Enabled: On Trap Link Up/Down Enabled: On 0: 192.168.23.254 : 162 : public

Table 24: CLI - show			

√	√	**stats**
		 <id> - <id>
		 Example:
		 (show)# stats 14
		     General Information:
		 sysname = abcdef
		 sysdescr = b
		 sysloc = c
		 syscontact = d
		 mac = 00:09:02:00:bb:77
		 boardtype = AN-80i Rev 1.0
		 radiotype = T54i
		 swver = 10.00.023 (other: 10.00.019)
		 sysuptime = 8 day(s), 20 hr, 19 min
		 sysstarttime = N/A
		 sysmode = pmpsc
		 rffreq = 5490.0
		 txpower = 10
		 chwidth = 20 MHz
		 rfstatus = 0
			Ethernet Statistics:
			 erxpkt = 3081
			 erxpktd = 0
			 etxpkt = 8089
			     Wireless Statistics:
			 regstations = 0
			 regconn = 0
			 activelinks = 0
			 activeids = 0
			     Wireless Ethernet Statistics:
			 werxpkt = 4592
			 werxpktdis = 0
			 werxpkterr = 0
			 wetxpkt = 0
			 wetxpktdis = 0
			 wetxpkterr = 0

5.3.13 Snmpcommunity

Use the *snmpcommunity* command to configure SNMP community permissions.

Table 25: CLI - snmpcommunity		
PTP	**PMP**	**Description**

√	√	**add**: add a new snmp community to the snmp community table. The index value is assigned automatically. Up to eight community entries can be entered in the table.
		
		     snmpcommunity add <name> <string> <Enter>
		
		     snmpcommunity add <rights> 0 | r | w | rw <Enter>
		 Where.
		 0 (zero):Deny read and write permission.
		 r: Grant read access permission only. Deny write permission.
		 w: Grant write access permission only. Deny read permission.
		 rw: Grant read and write access permission for this community.

		default: Set all snmp parameters to factory default settings. snmpcommunity default <idx> <Enter>
		del: Delete the specified community entry. snmpcommunity del <idx> <Enter>
		print: List all SNMP communities and associated permissions. snmpcommunity print <Enter>

5.3.14 Snmptrap

Use the *snmptrap* command to configure the SNMP trap message reporting.

		Table 26: CLI - snmptrap
PTP	**PMP**	**Description**
√	√	**add**: add a new snmp trap to the snmp trap table. The index value is assigned automatically. Up to eight settings can be entered.
		snmptrap add <ipaddr> <port> <community> <Enter>
		change: Modify the specified snmp setting.
		snmptrap change <idx> [-p <port>] [-i <ip_add>] [-c <community] <Ent>
		del: Delete the specified snmp setting.
		snmptrap del <idx> <Enter>
		print: List all SNMP trap settings.
		snmptrap print <Enter>

5.3.15 Test

Use the *test* command to load the current edited (but not permanently saved) configuration settings.

		Table 27: CLI - test
PTP	**PMP**	**Parameter/Description**
√	√	**config** - AN-80i configuration settings
		test config <Enter>

The system will operate using these setting for five minutes. During this five minute period, you may enter 'save' at any time to permanently save the running configuration. If you do not 'save' the configuration within five minutes, the AN-80i reboots -- discarding the unsaved settings and loading the last saved configuration.

5.3.16 Upgrade

Use the *upgrade* command to upload a new software binary file to the AN-80i.

		Table 28: CLI - upgrade
PTP	**PMP**	**Description**
√	√	**ipaddr**: Enter the IP address of the TFTP server.
		filename: Enter the name of the binary file to be uploaded to the AN-80i.
		upgrade <ipaddr> <filename> <Enter>
		You must specify the TFTP server address and the full name of the binary file (including .bin extension). The AN-80i software binary file <u>must</u> be located in the default directory of the TFTP server.

5.3.17 User

Use the *user* command to manage user accounts, passwords, and user Groups. When in user mode, only the <chgpasswd> field is available, since the user can change only his own password. The other commands are available only for members of the administrator Group.

Table 29: CLI - user		
PTP	**PMP**	**Description**
√	√	**add**: Administrators can use this command to add new user accounts. This option is available only for administrators. user add <username> <usertype> <Enter>

		chgpasswd: For the user accounts, the chgpasswd command must be executed without the <username> parameter -- user's can change only their own password.
		
		    user chgpasswd [<username>] <Enter>
		
		Administrators can change their own password, or specify a <username> to change the password of the specified user account.
		
		    user chgpasswd [<username>] <Enter>

		del: Administrators can use this command to delete user accounts. This option is available only for administrators. user del <username> <Enter>
		print: Administrators can use this command to display a list of user accounts. This option is available only for administrators. user print <Enter>

6 Diagnostics and Troubleshooting

This section provides basic diagnostic and troubleshooting procedures to help solve problems that may occur with the system. If the system is not operating correctly after applying the suggestions in this section, please contact your local Redline representative. Include the model name and serial number of the system in your communications.

6.1 Factory Default Settings

The following parameters are the factory default settings for the AN-80i.

Table 30: Diag. - Factory Default Settings		
Section	**Item**	**Factory Default Setting**
System	User Name	admin
	Password	admin
Ethernet	IP Address	192.168.25.2
	Subnet Mask	255.255.255.0
	Gateway	0.0.0.0
Wireless	RF Channel	Set by factory key.
	Tx power	14 dBm
	Encryption	Enabled / no key

Note: Factory defaults can only be restored using the CLI 'save' command.

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User Manual

6.2   Procedure to Reset AN-80i IP Address

The AN-80i features a method to gain access to the CLI command prompt for a unit where the IP address, username, and/or password is unknown. This method requires local access to the AN-80i PoE power adapter, the capability to power-cycle the AN-80i, a PC with a telnet client, and an Ethernet cable.

Power On

Power Off

① ② ③ ④

1. Power on AN-80i for more than 30 seconds.
2. Power-off AN-80i for about 7 seconds (10 s max.).
3. Power-on AN-80i.
4. Wait 15 seconds and start Telnet session to AN-80i (30 s max.)
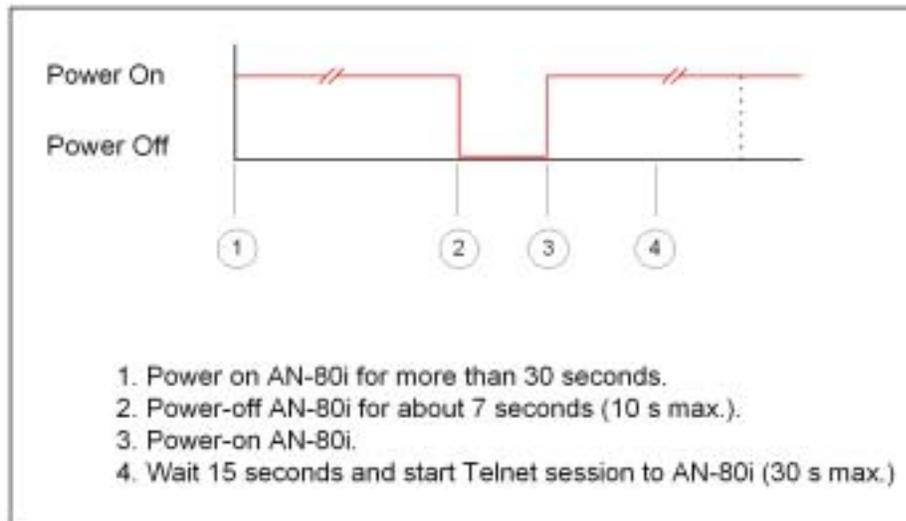
Figure 36: CLI - Recovering Lost IP Address

Use the following steps to gain access to the CLI command prompt:

1. Power-off the AN-80i PoE power adapter. Remove the local network Ethernet cable and connect your computer directly to the PoE power adapter 'INPUT' Ethernet port (requires Cat 5e cross-over cable).

2. Open a command prompt window on the PC and enter the command:

    telnet 192.168.25.2   <Do <u>not</u> press Enter key at this time>

3. Power-on the AN-80i PoE power adapter for over 30 seconds.

4. Power-off the AN-80i PoE power adapter for 7 seconds.

5. Power-on the AN-80i PoE power adapter, wait 15 seconds, and then press the Enter key on the PC (to start the Telnet session). The Telnet session <u>must</u> connect to the AN-80i within 10 to 30 seconds from when the AN-80i starts the second time.

6. When prompted, login using 'admin' as the user name and 'admin' as password.

7. Use the following commands to save a new IP address:

    ipaddr <IP Address> <Enter>

    save config <Enter>

    If required, use the 'user' command to enter new username and password information or the 'save' command to reset all parameters to factory default settings.

8. Power-off the AN-80i, restore the network Connections, and restore power.

6.3   Testing and Saving System Parameters

The AN-80i is a highly configurable communications device. All configurable options are saved in non-volatile RAM. The system configuration and snmp settings are saved separately.

6.3.1   CLI Interface

Use the 'test' command to have the AN-80i load the edited settings. The AN-80i will operate with these settings for a period of five minutes. During the test period, you may click the Save button at any time to save this configuration permanently. Otherwise, after five minutes, the AN-80i will reboot and load the previously saved settings.

Note: Factory defaults can only be restored using the CLI commands.
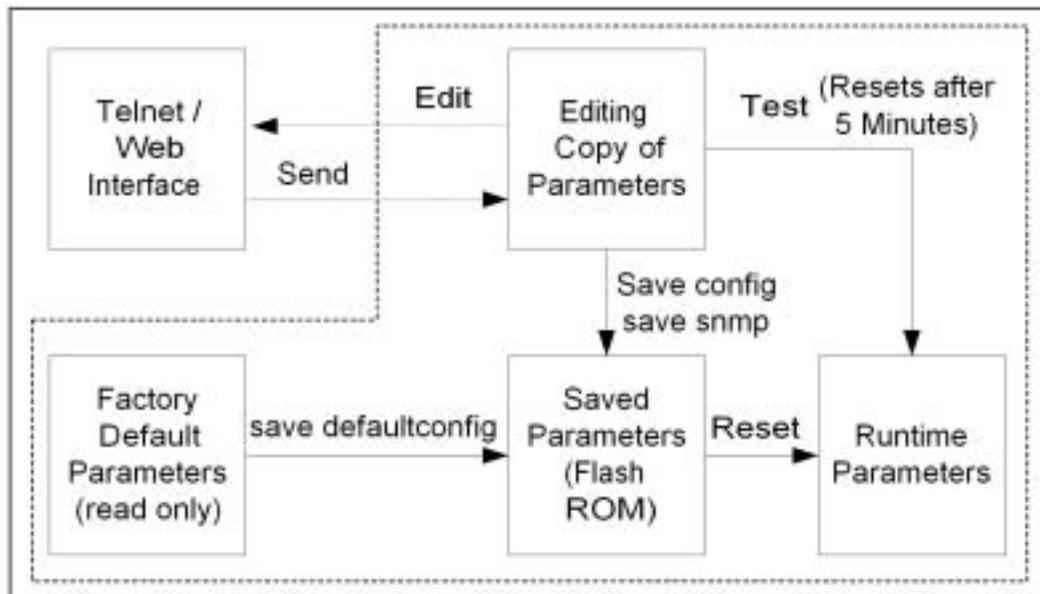
Figure 37: Diag - Saving Parameters in NVRAM

6.3.2   Web Interface

The Test button is located on the System Configuration page. Click this button to have the AN-80i load the current settings displayed in the configuration screen. The AN-80i will operate with these settings for a period of five minutes. During the test period you may click the Save button at any time to save this configuration permanently (also terminating the five minute timer). After five minutes, if the Save function button has not been applied, the AN-80i will reboot and load the previously saved settings.

The following table lists some common troubleshooting tips for the web interface.

Table 31: Diag. - Web Interface Diagnostics		
Symptom	**Possible Problem**	**Solution**
General Information screen is not displayed	Incorrect IP address and/or Subnet Mask.	Perform a ping test from the host computer command line. If the ping test is unsuccessful, then the problem is with the IP address. Perform a long reset to apply the default address (192.168.25.2) and Subnet Mask (255.255.255.0)
	Problems with host computer, or AN-80i.	If the ping is successful, reset the AN-80i, and/or reset the host computer.
	Host PC ARP table is incorrectly configured	Run 'arp -d' whenever the AN-80i is swapped. Check that the subnet mask for the host PC matches the subnet mask of the AN-80i. Check that the host PC's address is 192.168.25.n, where 'n' is not equal to 0,2, or 255.

Attempt to login to the AN-80i using a Web browser. Microsoft Internet Explorer is recommended. If the AN-80i does not respond by displaying the login dialog box, check that the correct IP address is being used. The value 192.168.25.2 is the factory default value and may have been changed during installation.

Test is to verify the IP address is reachable from the computer. Use the ping command to test the Connection between the AN-80i and host computer.

>*ping 192.168.25.2*

If the ping test is successful, the host computer was able to send and receive packets to/from the AN-80i. The problem may be with the Internet browser or related settings on the host computer. Reboot the host computer to try to resolve the problem.

If the ping is unsuccessful, there may be problems using that IP address; the IP address may be incorrect, or there may be a duplicate address. For correct operation the host computer and the AN-80i must be on the same subnet. For example, if the AN-80i is using the factory default settings, the host computer could be set for an IP of *192.168.25.3 and a subnet mask of 255.255.255.0.*

If the correct IP address of the AN-80i cannot be determined, it is recommended to perform the IP recovery procedure. See 6.2: Procedure to Reset AN-80i IP Address on page 75.

6.4 Log Messages

The following table provides a brief description of the key messages recorded in the logs by the system.

Table 32: Diag. - System Log Messages	
Log Message	**Description**
1001	System Configuration Load: OK
1002	System Configuration Save: OK
1003	EEPROM Directory Load: OK
1004	EEPROM Directory Save: OK
1005	User Configuration Load: OK
1006	User Configuration Save: OK
1007	Network Configuration Load: OK
1008	Network Configuration Save: OK
1009	Network Configuration: OK
1010	Version Ctrl Data Load: OK
1011	Version Ctrl Data Save: OK
1012	System Description Load: OK
1013	System Description Save: OK
1014	Options Key Load: OK
1015	Options Key Save: OK
1016	Options Key Properties Load: OK
1017	Options Key Properties Save: OK
1018	Options Key Activated: OK
1019	Data server started: OK
1021	Upgrade: OK
1023	Firmware configuration: OK
1026	Factory Data Save: OK
1029	HTTP(User Mgm): Chg User Attributes: OK
1030	SNMP Configuration Load: OK
1031	SNMP Configuration Save: OK
1032	SNTP: Time received: OK
1033	DFS: Event Detected
1033	MAC Initialization: OK
1034	DFS: Event Detected
1035	ID deleted: OK
1036	Restart freq scan (RSSI)
1037	Restart freq scan (TimeOut)
1038	Reg Req (step 1)
1039	Reg Req (step 2
1040	Reg Req (step 2)

Table 32: Diag. - System Log Messages	
Log Message	**Description**
1041	Restart freq scan (!act links)
1042	ID tables saved: OK
1043	ID defined: OK
1044	ID tables not changed: OK
1045	ID modified: OK
1046	RF frequency validation: OK
2001	System Configuration Load: ERROR
2002	System Configuration Save: ERROR
2003	EEPROM Directory Load: ERROR
2004	EEPROM Directory Save: ERROR
2005	User Configuration Load: ERROR
2006	User Configuration Save: ERROR
2007	Network Configuration Load: ERROR
2008	Network Configuration Save: ERROR
2009	Network Configuration: ERROR
2010	Version Ctrl Data Load: ERROR
2011	Version Ctrl Data Save: ERROR
2012	System Description Load: ERROR
2013	System Description Save: ERROR
2014	Options Key Load: ERROR
2015	Options Key Save: ERROR
2016	Options Key Properties Load: ERROR
2017	Options Key Properties Save: ERROR
2018	Options Key Activated: ERROR
2019	No Options Key
2020	Fail to start the data server
2021	Data server
2022	Data server
2023	Upgrade client start: ERROR
2024	Upgrade in progress
2025	Upgrade: FAIL
2026	Upgrade: ERROR
2028	Factory Data Corrupted (use fallback values)
2028	TFTP: ERROR
2029	Firmware configuration: ERROR
2031	Factory Data Save: ERROR
2034	HTTP(User Mgm): Invalid password
2035	HTTP(User Mgm): Invalid User
2036	HTTP(User Mgm): Chg User Attributes: ERROR

| Table 32: Diag. - System Log Messages ||
Log Message	Description
2037	SNMP Configuration Load: ERROR
2038	SNMP Configuration Save: ERROR
2039	Invalid Options Key
2039	SNTP: Time received: ERROR
2040	MAC Initialization: ERROR
2041	MAC Busy
2042	ID database corrupted
2043	Invalid ID
2044	Max. ID number reached
2045	Int Procs programming: ERROR
2046	Int Procs starrt: ERROR
2047	ID action not possible
2048	ID validation: ERROR
2049	HW validation: ERROR
2050	FTP: ERROR
2051	RF frequency validation: ERROR
2099	UNKNOWN MESSAGE

6.5 Status Codes

6.5.1 PTP Status Codes

There are no PTP status codes defined.

6.5.2 PMP Status Codes

The status code is a series of eight hexadecimal characters, each representing thirty-two individual status bits. Each hexadecimal value represents a group of four status bits (high/low nibble). The value '1' indicates the associated condition is active. Use the following tables to interpret the status code. All unused bits are set to zero.

For example, if the only reported error was ' No Ethernet packets received by the wireless MAC' (bit 16) the status code value would be '10000' (leading zeros are not displayed).

Table 33: Diag. - PMP Status Code Bits																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	9	8	7	6	5	4	3	2	1	0	
Byte 3								Byte 2								Byte 1							Byte 0								
High Nibble				Low Nibble				High Nibble				Low Nibble				High Nibble			Low Nibble				High Nibble				Low Nibble			

Table 34: Diag. - PMP Status Codes									
Hex	**Nibble**				**Hex**	**Nibble**			
0	0	0	0	0	8	1	0	0	0
1	0	0	0	1	9	1	0	0	1
2	0	0	1	0	A	1	0	1	0
3	0	0	1	1	B	1	0	1	1
4	0	1	0	0	C	1	1	0	0
5	0	1	0	1	D	1	1	0	1
6	0	1	1	0	E	1	1	1	0
7	0	1	1	1	F	1	1	1	1

Table 35: Diag. - PMP Status Codes	
Bit	**Description**
17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28	MAC Internal Errors
16	No Ethernet packets received by the wireless MAC
8	Firmware Error
4, 5, 6	PLL Errors
1	Radio over-temperature
0	Low Power

7 Appendices

7.1 AN-80i Technical Specifications

Table 36: Spec. - AN-80i Technical Specifications	
System Capability:	LOS, Optical-LOS, and Non-LOS
RF Band:	5.4 GHz Radio Installed: 5.470 - 5.725 GHz (TDD) [1]
	5.8 GHz Radio Installed: 5.725 - 5.850 GHz (TDD) [1]
Center Frequency Steps:	2.5 / 20 MHz [2]
Channel Size:	PTP: 10, 20, 40 MHz (software selectable)
	PMP: 20 MHz
RF:	> 50 dB Rx Dynamic Range
	20 dBm Ave. Max. Tx Power [3]
	Automatic Transmit Power Control (ATPC)
	Dynamic Frequency Selection (DFS)
	Up to 80 km (50 mi) line-of-sight @ 48 dBm EIRP [3]
Data Rate:	Up to 90 Mbps average Ethernet rate (40 MHz channel) [4]
Rx Sensitivity:	-85 dBm @ 3 Mbps max. (based on BER of 1x10e-9)
PoE Cable:	Up to 91 m (300 ft) [5]
Network Attributes:	802.3x Ethernet flow control
	Automatic link distance ranging
	DHCP pass-through, transparent bridge
	802.1p network traffic prioritization [6]
	802.1Q classification [7]
Modulation/Coding Rates:	1/2 BPSK, 3/4 BPSK, 1/2 QPSK, 3/4 QPSK, 1/2 16 QAM, 3/4 16 QAM, 2/3 64 QAM and 3/4 64 QAM
Over The Air Encryption:	Private key encryption
MAC:	Concatenation
	Time Division Multiple Access (TDMA)
	Automatic Repeat Request (ARQ) error correction
	Dynamic adaptive modulation (bi-dir. burst to burst auto select) [6]
	Packet fragmentation [7]
Network Services:	Transparent to 802.3 services and applications
Duplex Technique:	Dynamic TDD (time division duplex)
Wireless Transmission:	OFDM (orthogonal frequency division multiplexing)
Network Connection:	10/100 Ethernet (RJ-45)
System Configuration:	HTTP (Web) interface, SNMP, Telnet (CLI)
Network Management:	SNMP V2: standard and proprietary MIBs
Power Requirements:	Standard IEEE 802.3af (15.4 W Max.)
Operating Temperature:	-40 C to 60 C
Dimensions/Weight:	289 mm x 190 mm x 515 mm (11.38 in x 7.50 in x 2.03 in)
Humidity:	0% to 90% Non-condensing

Table 36: Spec. - AN-80i Technical Specifications	
Weight:	2 Kg (4.4 lb) without bracket or antenna
Storage Temperature:	-50 C to 70 C
Compliance:	Safety: IEC, EN, and UL/CSA 60950
	EMC: 301 489-1, 301 489-17
	5.8 GHz Radio: Industry Canada RSS 210, FCC part 15, ETSI EN 302 502
	5.4 GHz Radio (with DFS): Industry Canada RSS 210, FCC part 15, ETSI EN 301 893
	Ingress Protection: IP65

[1] Actual RF Band limited by regional regulations. Refer to Table 43: Spec. - Regional Identification Codes on page 87 for available channels.

[2] Center frequency is dependent on region.

[3] Maximum operational power per channel with a given antenna is limited in accordance to maximum allowable EIRP levels for the region.

[4] Actual Ethernet data throughput is dependent on: protocols, packet size, burst rate, transmission latency, and link distance.

[5] With lightning arrestor installed.

[6] PTP Only

[7] PMP Only

Specifications are subject to change without notice.

7.2   AN-80i PoE Specifications

Table 37: Spec. - AN-80i PoE Specifications	
PoE Power Block:	CINCON Model TR60A-POE-L
Input:	Auto-sensing 110/220/240 VAC 50/60 Hz
Output:	48 VDC 1.2A Max. Load
Environmental:	Operating temperature: 0 to 60 C
	Storage Temperature: -50 to 70 C
	Operating Humidity: 5% to 95%
Dimensions:	35 x 70 x 150 mm (1.38 x 2.76 x 5.91 in)
Specifications are subject to change without notice.	

7.3 ETSI Certified Antennas

7.3.1 5.4 GHz Radio: ETSI Certified Antennas

The following table lists ETSI certified 5.4 GHz antennas.

Table 38: Spec. - ETSI Certified Antennas: 5.4 GHz Operation				
Redline PN	**Ant. Gain (dBi)**	**Antenna Type**	**App.**	**Tx Power Setting**
48-00021-02	22	9 Degree 5.15-5.875 GHz Directional Flat Panel	PTP	+8
48-00030-00	22	12 Degree 5.250-5.850 GHz Directional Parabolic	PTP	+8
48-00024-00	28	4.5 Degree 5.15-5.875 GHz Directional Flat Panel	PTP	+1
48-00031-00	28	6.2 Degree 5.250-5.850 GHz Directional Parabolic	PTP	+1
48-00032-00	31.2	4.2 Degree 5.250-5.850 GHz Directional Parabolic	PTP	-1

Note: The RF output power and selection must be professionally programmed and installed by the manufacturer or a trained professional installer.

7.3.2 5.8 GHz Radio: ETSI Certified Antennas

The following table lists ETSI certified 5.8 GHz antennas. Operation is restricted to 10 MHz and 20 MHz channel operation only.

Table 39: Spec. - ETSI Certified Antennas: 5.8 GHz Operation				
Redline PN	**Ant. Gain (dBi)**	**Antenna Type**	**App.**	**Tx Power Setting**
48-00021-02	22	9 Degree 5.15-5.875 GHz Directional Flat Panel	PTP	-3
48-00030-00	22	12 Degree 5.250-5.850 GHz Directional Parabolic	PTP	-3

Note: The RF output power and selection must be professionally programmed and installed by the manufacturer or a trained professional installer.

7.4   FCC & IC Certified Antennas

7.4.1   5.4 GHz Radio: FCC & IC Certified Antennas

This device has been designed to operate with the antennas listed below, and having a maximum gain of 22 dB. Antennas not included in this list or having a gain greater than 22 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Table 40: Spec. - FCC & IC Certified Antennas: 5.4 GHz Operation				
Redline PN	**Ant. Gain (dBi)**	**Antenna Type**	**App.**	**Tx Power Setting**
48-00021-02	22	9 Degree 5.15-5.875 GHz Directional Flat Panel	PTP	-3

Note: The RF output power and selection must be professionally programmed and installed by the manufacturer or a trained professional installer.

7.4.2   5.8 GHz Radio: FCC & IC Certified Antennas

This device has been designed to operate with the antennas listed below, and having a maximum gain of 34.6 dB. Antennas having a gain greater than 34.6 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. The following table lists FCC and IC certified antennas:

Table 41: Spec. - FCC & IC Certified Antennas: 5.8 GHz Operation						
Redline PN	**Ant. Gain (dBi)**	**Antenna Type**	**App.**	**Minimum Conducted Power (dBm)**	**Max Conducted Power Ratings (dBm)**	**Average GUI Power Display (dBm)**
48-00021-02	22	9 Degree 5.15-5.875 GHz Directional Flat Panel	PTP	-12.7	26.2	20
48-00030-00	22	12 Degree 5.250-5.850 GHz Directional Parabolic	PTP	-12.7	26.2	20
48-00024-00	28	4.5 Degree 5.15-5.875 GHz Directional Flat Panel	PTP	-12.7	26.2	20
48-00031-00	28	6.2 Degree 5.250-5.850 GHz Directional Parabolic	PTP	-12.7	26.2	20
48-00032-00	31.2	4.2 Degree 5.250-5.850 GHz Directional Parabolic	PTP	-12.7	26.2	20
48-00033-00	34.6	3.4 Degree 5.250-5.850 GHz Directional Parabolic	PTP	-12.7	26.2	20

Note: The RF output power and selection must be professionally programmed and installed by the manufacturer or a trained professional installer.

Table 42: Spec. - FCC & IC Certified Antennas: 5.8 GHz PMP Operation					
Redline Part Number	**Description**	**Application**	**Gain (dBi)**	**GUI Settings**	**Tx Peak Conducted Power (dBm)**
48-00014-00	ANTENNA, 60 DEG, 16 dBi, 5.150-5.875 GHz, BS, 1.43x0.82 FT (436x250 mm) SECTOR FP	PMP	16	9	18.6 18.3 18.5
48-00017-00	ANTENNA, 90 DEG, 14 dBi, 5.150-5.875 GHz, BS, 1.43x0.82 FT (436x250 mm) SECTOR FP	PMP	14	11	20.3 20.5 19.8
48-00028-00	ANTENNA, 60 DEG, 17 dBi, 5.250-5.850 GHz, BS, 2.13x0.7 FT (650x216 mm), SECTOR FP	PMP	17	8	17.2 17.3 16.8
48-00029-00	ANTENNA, 90 DEG, 16 dBi, 5.250-5.850 GHz, BS, 2.13x0.7 FT (650x216 mm), SECTOR FP	PMP	16	9	18.6 18.3 18.5
48-00047-00	ANTENNA, 120 DEG, 15 dBi, 5.15-5.875 GHz, BS, FP (550x250 mm)	PMP	15	10	19.4 20.1 18.7
48-00065-00	ANTENNA, 120 DEG, 15 dBi, 4.9-5.9 GHz, SECTOR FP	PMP	15	10	19.4 20.1 18.7
48-00067-00	ANTENNA, 62 DEG, 17.5 dBi, 4.9-5.9 GHz, SECTOR FP	PMP	17.5	5	15.1 14.9 14.2
48-00066-00	ANTENNA, 90 DEG, 16.6 dBi, 4.9-5.9 GHz, SECTOR FP	PMP	16.6	8	17.2 17.3 16.8
48-00048-01	ANTENNA, 360 DEG, 9 dBi, 5 - 6 GHz, OMNI	PMP	9	13	19.4 20.8 20.3

Note: The RF output power and selection must be professionally programmed and installed by the manufacturer or a trained professional installer.

7.5   Regional Codes

The regional code is incorporated into the options key. This feature enforces compliance to regional regulatory statutes.

Table 43: Spec. - Regional Identification Codes					
Regions	**Band**	**DFS Required** [1]	**Channel Size (MHz)**	**Channel Step (MHz)**	**Start - End** [2] **(MHz)**
Region 01					
CALA, Canada, China, middle-east, US	US 5.8 ISM	No	10	2.5	5730 - 5845
			20	2.5	5735 - 5840
			40	2.5	5745 - 5830
Region 02					
UK, Jersey, Norway	UK 5.8G	Yes [3]	10	2.5	5730 - 5790 5820 - 5845
			20	2.5	5735 - 5785 5825 - 5840
Region 03					
EU	CE 5.4G	Yes [4]	10	20	5500 - 5700
			20	20	5500 - 5700
			40	20	5500 - 5700
Region 04					
US	US 5.4 ICM	Yes [5]	10	2.5	5475 - 5720
			20	2.5	5480 - 5715
			40	2.5	5490 - 5705
Region 05					
Australia, Canada	IC 5.4G	Yes [6]	10	2.5	5475 - 5595 5655 - 5720
			20	2.5	5480 - 5590 5660 - 5715
			40	2.5	5490 - 5580 5670 - 5705
Region 06					
India	IN 5.8 G	No	10	2.5	5830 - 5870
			20	2.5	5735 - 5865
			40	2.5	5845 - 5855

Notes:

1. Where DFS is required by regional regulations, this function is permanently enabled at the factory and can <u>not</u> be disabled by the installer or end-user.
2. Center frequencies.
3. UK VNS 2107/ EN302 502
4. ETSI EN301893 v1.3.1
5. FCC Part 15
6. IC RSS-210

7.6 Glossary Of Terms

Term	Definition
Table 44: Spec. - Glossary	
Antenna Gain	The measure of antenna performance relative to a theoretical antenna called an isotropic antenna.
ARQ	Automatic Repeat Request. This is the protocol used over the air for error correction.
ATPC	Automatic Transmission Power Control. The sector controller-end system automatically adjusts the RF transmit level of both systems to optimize performance of the link (match a target RSSI value).
Beamwidth	The angle of signal coverage provided by an antenna.
BFW	Broadband Fixed Wireless
Bps	Bits Per Second A unit of measurement for the rate at which data is transmitted.
BPSK	Binary Phase Shift Keying.
Channel	A communications path wide enough to permit a single RF transmission.
dB	A ratio expressed in decibels.
dBi	A ratio, measured in decibels, of the effective gain of an antenna compared to an isotropic antenna.
dBm	Decibels above a milliwatt
DFS	Dynamic Frequency Selection (DFS) can detect interference from other devices using the same frequency (especially radar) and automatically take a pre-selected action such as disable transmission or relocate transmission to alternative frequency.
DHCP	Dynamic Host Configuration Protocol. A DHCP server automatically issues IP addresses within a specified range to devices on a network.
Directional Antenna	An antenna that concentrates transmission power into one direction.
Encryption	For the purposes of privacy, the transformation of data into an unreadable format until reformatted with a decryption key.
Ethernet	A LAN architecture using a bus or star topology
FD	Full Duplex. Refers to the transmission of data in two directions simultaneously (i.e. a telephone)
FWA	Fixed Wireless Access
Gain	The ratio of the output amplitude of a signal to the input amplitude of a signal. Typically expressed in decibels (dB).
Gateway	A network point that acts as an entrance to another network.
GHz	Gigahertz. 1,000,000,000 Hz, or 1,000 MHz
GUI	Graphical User Interface
IP	Internet Protocol. See TCP/IP.
Isotropic	A theoretic construct of an antenna that radiates its signal 360 degrees both vertically and horizontally—a perfect sphere. Generally used as a reference.
IXC	Inter-exchange Carrier. A long-distance phone company.
LEC	Local Exchange Carriers. The traditional local wired phone company.
LED	Light Emitting Diode

Table 44: Spec. - Glossary	
Term	**Definition**
LOS	Line Of Sight. A clear direct path between two antennas, with no obstructions within the first Fresnel zone.
MAC	Media Access Control. A unique number assigned to a network device. Corresponds to ISO Network Model Layer 2 data link layer.
MHz	Megahertz. 1,000,000 Hz
Modem	MOdulator/DEModulator. A hardware device that converts digital data into analog and vice versa.
Modulation	Any of several techniques for combining user information with a transmitter carrier signal.
Multipath	The radio echoes created as a radio signal bounces off objects.
NVRAM	Non-volatile RAM. System parameters are stored in NVRAM. This data is not affected by powering off the system.
NLOS	Non Line Of Sight. Completely obstructed path between two antennas.
OFDM	Orthogonal Frequency Division Multiplexing. OFDM spreads data to be transmitted over a large number of orthogonal carriers.
OLOS	Optical Line Of Sight. A clear direct path between two antennas, with obstructions within the first Fresnel zone.
Packet	A bundle of data organized in a specific way for transmission. The three principal elements of a packet include the header, the text, and the trailer (error detection and correction bits).
PHY	Physical Layer. Provides for the transmission of data through a communications channel by defining the electrical, mechanical, and procedural specifications.
PMP	Point to Multipoint
PTP	Point to Point
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
Receiver Sensitivity	A measurement of the weakest signal a receiver can receive and still correctly translate it into data.
RF	Radio Frequency
Rx	Receiver
S/N	Signal to Noise Ratio
SINADR	Signal to noise and distortion ratio.
TCP/IP	Transmission Control Protocol/Internet Protocol The standard set of protocols used by the Internet for transferring information between computers, handsets, and other devices.
TFTP	Trivial File Transfer Protocol
Tx	Transmitter
UBR	Uncoded Burst Rate

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