BelAirOS

User Guide

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Contents

About This Document

This document provides the information you need to install and configure BelAir Networks Wi-FI Access Points (APs) using the BelAirOS Operating System, and the procedures for using the AP Command Line Interface (CLI).

This document may contain alternate references to APs. Table 1 shows possible synonyms to the product name.

Table 1: Product Name Synonyms

Product Name	Synonym
BelAir100N™	BA100N
BelAir2100™	BA100P
BelAir100SN™, BelAir100SNE™	BA100S
BelAir20™, BelAir100i WCS, BelAir20E™, BelAir20EO™	BA20

Typographical Conventions

This document uses the following typographical conventions:

- Text in < > indicates a parameter required as input for a CLI command; for example, < IP address >
- Text in [ ] indicates optional parameters for a CLI command.
- Text in { } refers to a list of possible entries with | as the separator.
- Parameters in ( ) indicate that at least one of the parameters must entered.

Related Documentation

The following titles are BelAir Networks reference documents:

- *BelAir20 Quick Install Guide*
- *BelAir100i WCS Quick Install Guide*
- *BelAir20E Quick Install Guide*
- *BelAir20EO Quick Install Guide*
- *WCSv1 Deployment and Installation Technical Bulletin*
- *BelAir100SN Installation Guide*
- *BelAir100SNE Installation Guide*
- *BelAir100N Installation Guide*
- *BelAir2100 Metrocell Installation Guide*
- *BelAir2100 Metrocell Cellular Reference Guide*

System Overview of BelAir Networks APs

This chapter provides a brief systems description of each available BelAir Networks AP, including an overview of its hardware modules. This chapter defines terms of reference used through the rest of the document. The APS are described in the following sections:

- "BelAir20" on page 5
- "BelAir100i WCS" on page 7
- "BelAir20E" on page 9
- "BelAir20EO" on page 11
- "BelAir100N" on page 12
- "BelAir100SN" on page 14
- "BelAir100SNE" on page 16
- "BelAir2100" on page 18

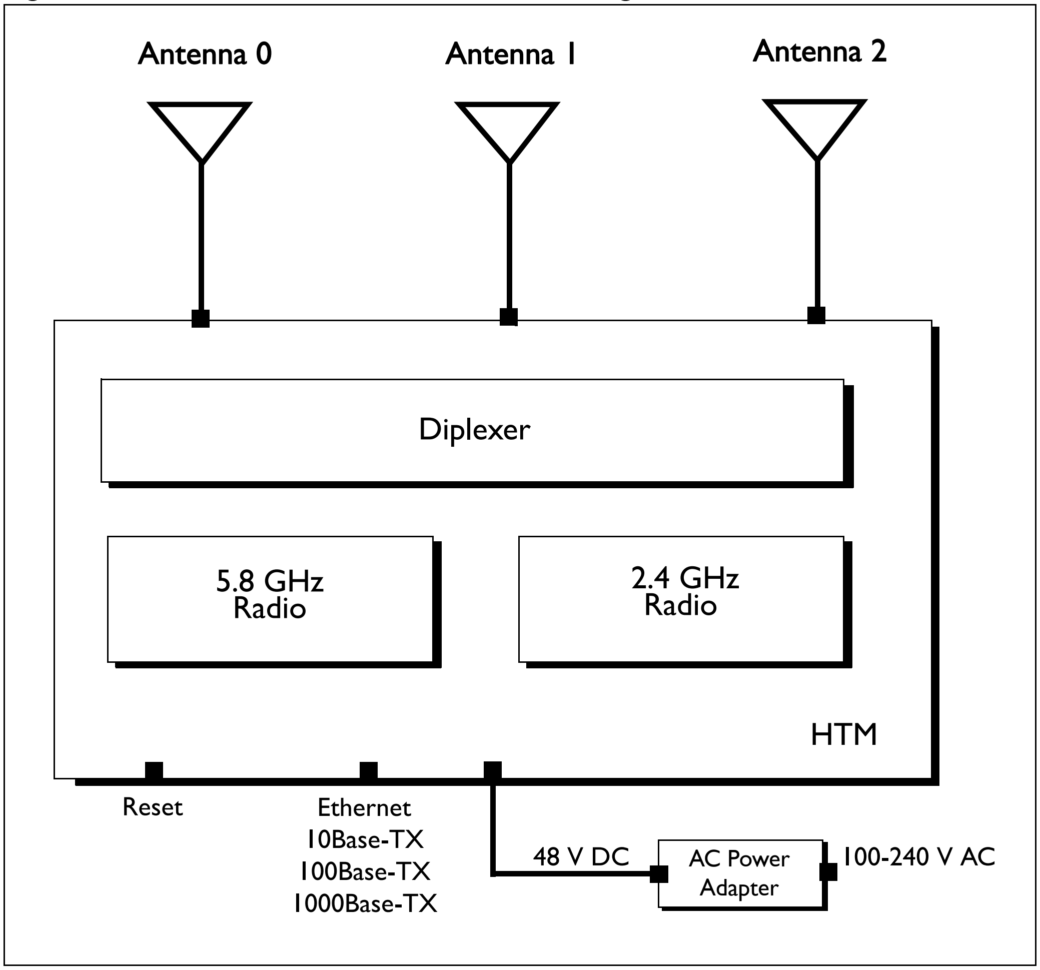
BelAir20

The BelAir20 is a Wi-Fi access point that meets IEEE 802.11n standards. It is fully interoperable with existing 802.11a/b/g standards, providing a transparent, wireless high speed data communication between the wired LAN and fixed or mobile devices. The unit includes three detachable dual-band 2.4/5.8 GHz antennas with the option to attach higher specification external antennas that boost network coverage. A power adapter and all required mounting hardware is also included.

BelAir20 Hardware Description

Figure 1 shows the relationship between the main BelAir20 hardware modules.

Figure 1: BelAir20 Hardware Module Block Diagram



The BelAir20 consists of the following modules:

- one High Throughput Module (HTM) providing:
  - —a wireline 10/100/1000 Base-TX Ethernet interface to the Internet
  - —a 2.4 GHz Wi-Fi radio and a 5.8 GHz Wi-Fi radio using enhanced performance links. Each radio can act as an Access Point (AP) or provide backhaul links. An AP provides user traffic wireless access to the BelAir20. Backhaul links connect to other BelAir Networks radios to create a radio mesh.
- three detachable dual-band antennas
- an external connector field

BelAir20 Antenna Connectivity

Table 2 shows which antennas to connect for 802.11a/b/g/n operation.

Table 2: BelAir20 Antenna Connectivity

Radio Operation	BelAir20 Ports to Connect to Antennas	
	2.4 GHz Radio	5.0 GHz Radio
802.11a	n/a	all[1]
802.11b/g	all[1]	n/a
802.11n, 1x1 MIMO	0	1
802.11n, 2x2 MIMO	0, 2	1, 2
802.11n, 3x3 MIMO	all[1]	all[1]
Note 1: For 802.11a/b/g operation, all antennas carry the same data. For 802.11n operation, different antennas carry different data.		

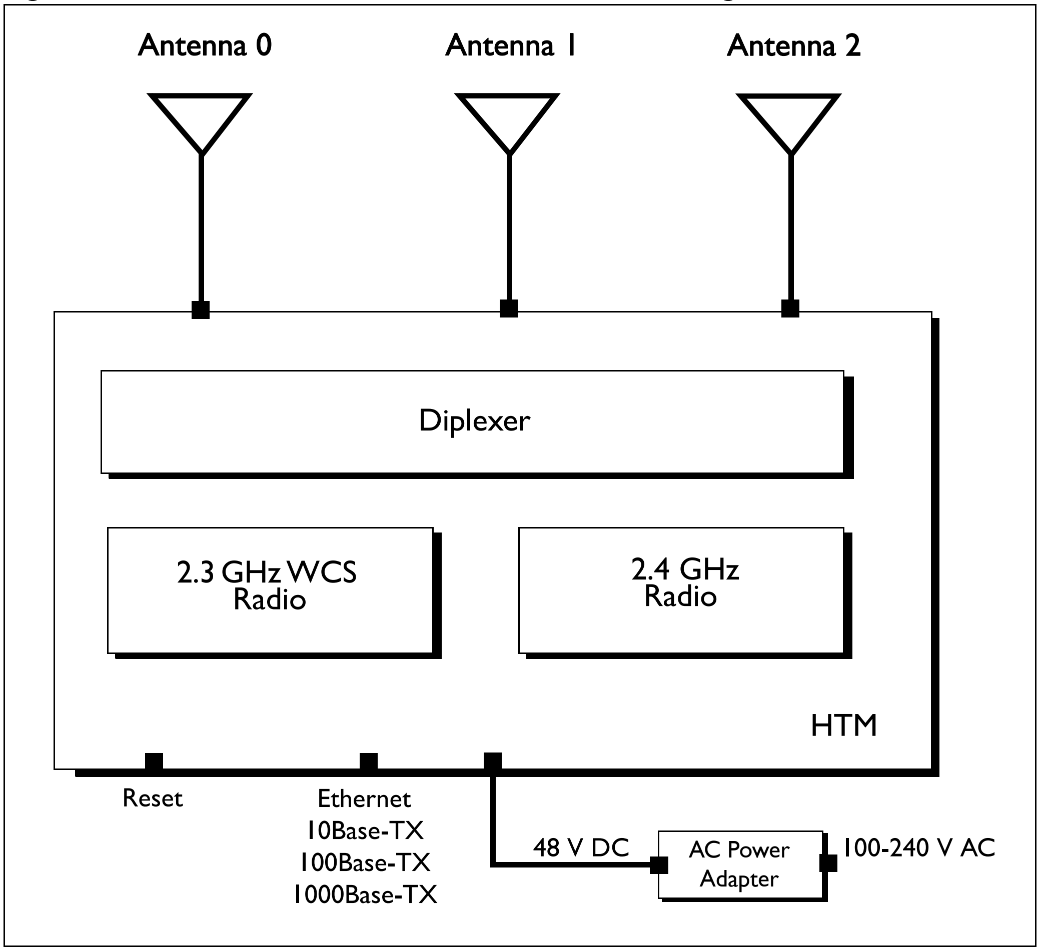
BelAir100i WCS

The BelAir100i WCS is a Wi-Fi access point that meets IEEE 802.11n standards. It is fully interoperable with existing 802.11b/g standards, providing a transparent, wireless high speed data communication between the wired LAN and fixed or mobile devices. The unit includes three detachable dual-band 2.4 GHz antennas with the option to attach higher specification external antennas that boost network coverage. A power adapter and all required mounting hardware is also included.

BelAir100i WCS Hardware Description

Figure 2 shows the relationship between the main BelAir100i WCS hardware modules.

Figure 2: BelAir100i WCS Hardware Module Block Diagram



The BelAir100i WCS consists of the following modules:

- one High Throughput Module (HTM) providing:

  —a wireline 10/100/1000 Base-TX Ethernet interface to the Internet

  —a 2.4 GHz Wi-Fi radio and a 2.3 GHz WCS Wi-Fi radio using enhanced performance links. The 2.4 GHz radio can act as an Access Point (AP) or provide backhaul links. The 2.3 GHz WCS radio can provide backhaul links. An AP provides user traffic wireless access to the BelAir100i WCS. Backhaul links connect to other BelAir Networks radios to create a radio mesh.

- three detachable dual-band antennas
- an external connector field

BelAir100i WCS Antenna Connectivity

Refer to the *WCSv1 Deployment and Installation Technical Bulletin*.

BelAir20E

The BelAir20E Access Point (AP) is an evolution of BelAir Networks indoor solution and part of BelAir Networks industry leading product portfolio. The BelAir20E adds standards-based beamforming, five Gigabit Ethernet ports (one WAN port with PoE and four LAN ports), integrated antennas, and full 802.11n compliance (802.11n-2009) to BelAir Networks leading low cost, high capacity indoor access.

The next generation BelAir20E continues to lead with the industry's highest performance and most flexible indoor Wi-Fi AP. Offering all the same features and management as the other BelAir Networks products, the BelAir20E has been optimized for managed hot spot applications, with Edge Policy Enforcement using centralized control and a true Plug-and-Play architecture. And, with the latest fully compliant 802.11n, it is ideal for even the most demanding applications, including voice and video. The BelAir20E also provides connectivity between indoor and outdoor networks, enabling true standards-based seamless mobility as users move from outside to inside.

The operating temperature of the BelAir20E is -20 °C to +45 °C.

The BelAir20E is available in following models:

- The BelAir20E-11 contains both a 2.4 GHz radio and a 5.8 GHz radio.
- The BelAir20E-10 contains only a 2.4 GHz radio.

This document may describe 5.8 GHz radio functionality. In such case, the descriptions apply to the BelAir20E-11 model only. They do not apply to the BelAir20E-10 model.

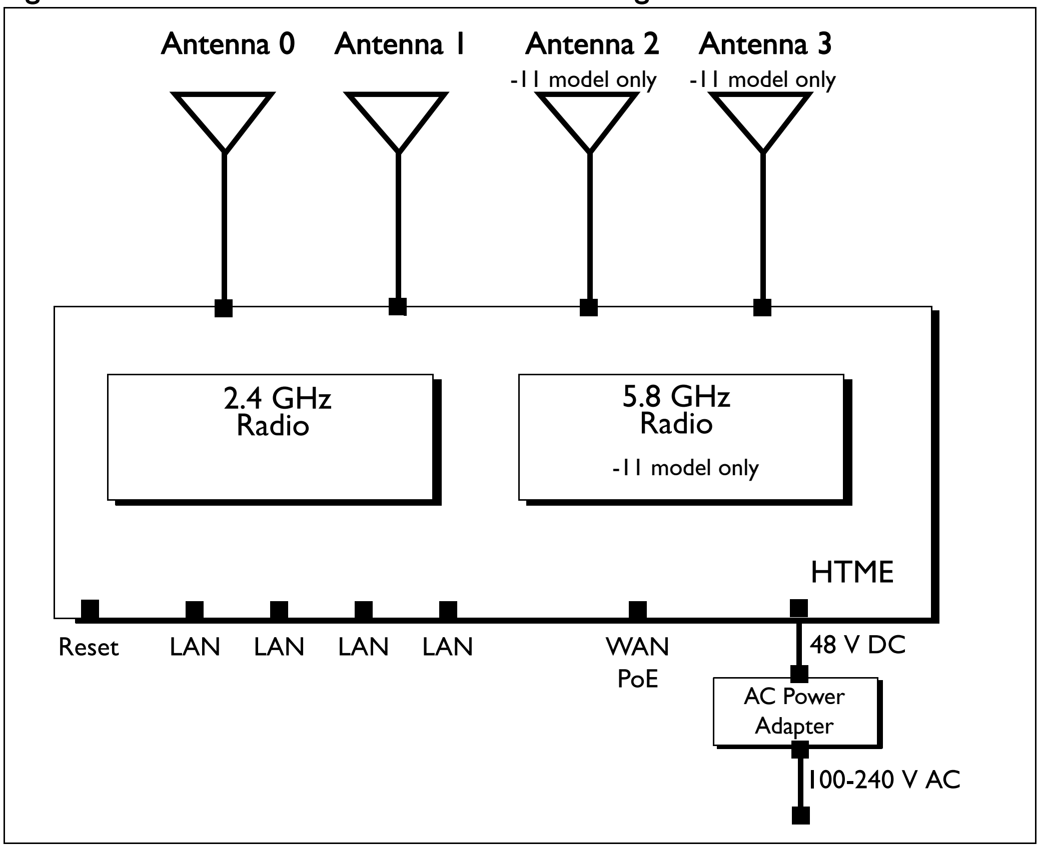
The BelAir20E is available in following variants:

- The BelAir20E-11 and the BelAir20E-10 are available for the USA only. Operators of the BelAir20E-11 and the BelAir20E-10 can set the country of operation only to *US*. Similarly, the operating channels, antenna gain, and the transmit power levels can be set only to values that are valid for the USA.
- The BelAir20E-11R and the BelAir20E-10R are available for countries other than the USA. Operators of the BelAir20E-11R and the BelAir20E-10R can set the country of operation to any BelAir Networks approved country. Similarly, the operating channels, antenna gain, and the transmit power levels can be set to values that are valid for the specified country of operation.

BelAir20E Hardware Description

Figure 3 shows the relationship between the main BelAir20E hardware modules.

Figure 3: BelAir20E Hardware Module Block Diagram



The BelAir20E consists of the following modules:

- one High Throughput Module Evolved (HTME) providing:

  —a wireline 10/100/1000 Base-TX WAN Ethernet interface to the Internet

  —four wireline 10/100/1000 Base-TX LAN Ethernet interfaces

  —a 2.4 GHz Wi-Fi radio and a 5.8 GHz Wi-Fi radio (-11 model only) using fully compliant 802.11n links. E Each radio can act as an Access Point (AP) or provide backhaul links. An AP provides user traffic wireless access to the BelAir20E. Backhaul links connect to other BelAir Networks radios to create a radio mesh.

- four integrated dual-band antennas (-11 model only)
- an external connector field

BelAir20EO

The BelAir20EO Outdoor Access Point (AP) is an extension of BelAir Networks outdoor solutions and part of BelAir Networks industry leading product portfolio. The BelAir20EO addresses new deployment models and regional requirements and is part of BelAir Networks portfolio of outdoor hardened products. The BelAir20EO also adds standards-based beamforming, Gigabit Ethernet ports (one WAN port with PoE in and one LAN port), integrated or external antennas, and full 802.11n compliance (802.11n-2009) in a compact, streamlined package.

The next generation BelAir20EO continues to lead with the industry's highest performance and most flexible outdoor Wi-Fi AP. Offering all the same features and management as the other BelAir Networks products, the BelAir20EO has been optimized for managed Hot Zone and 3G Offload applications, with Edge Policy Enforcement using centralized control and a true Plug-and- Play architecture. And, with the latest fully compliant 802.11n, it is ideal for even the most demanding applications, including voice and video. The BelAir20EO also provides connectivity between indoor and outdoor networks, enabling true standards-based seamless mobility as users move from outside to inside.

The operating temperature of the BelAir20EO is -20 °C to +45 °C.

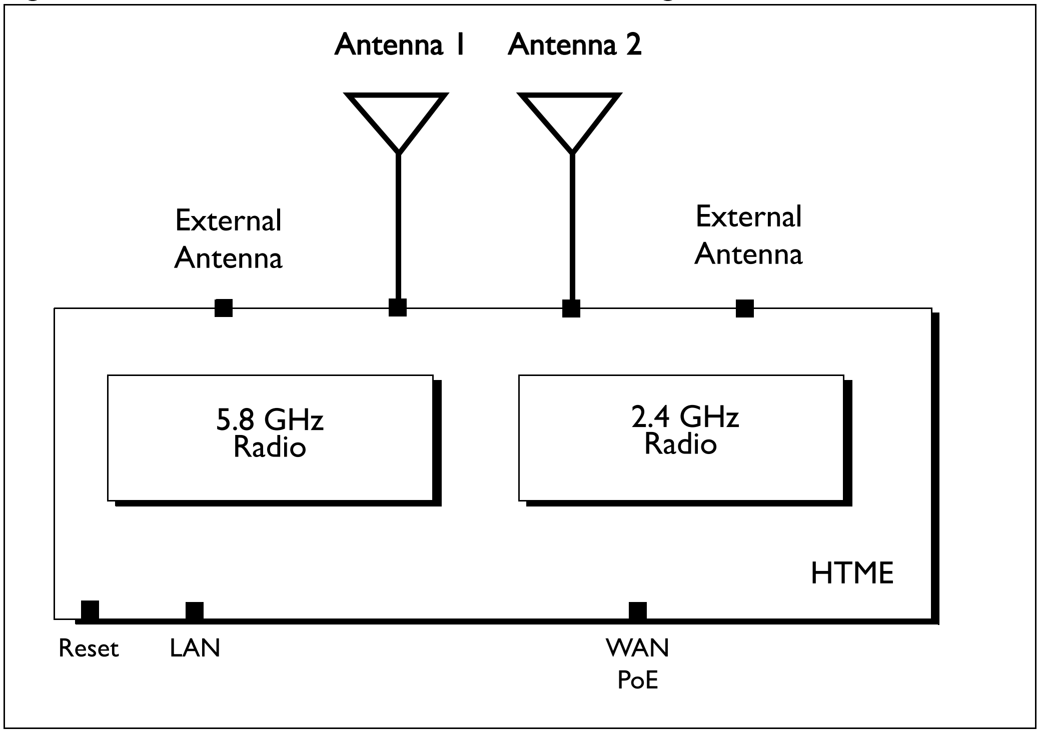
The BelAir20EO is available in following variants:

- The BelAir20EO-11 is available for the USA only. Operators of the BelAir20EO-11 can set the country of operation only to *US*. Similarly, the operating channels, antenna gain, and the transmit power levels can be set only to values that are valid for the USA.
- The BelAir20EO-11R is available for countries other than the USA. Operators of the BelAir20EO-11R can set the country of operation to any BelAir Networks approved country. Similarly, the operating channels, antenna gain, and the transmit power levels can be set to values that are valid for the specified country of operation.

BelAir20EO Hardware Description

Figure 4 on page 12 shows the relationship between the main BelAir20EO hardware modules.

Figure 4: BelAir20EO Hardware Module Block Diagram



The BelAir20EO consists of the following modules:

- one High Throughput Module Evolved (HTME) providing:

  —a wireline 10/100/1000 Base-TX WAN Ethernet interface to the Internet

  —a wireline 10/100/1000 Base-TX LAN Ethernet interface

  —a 2.4 GHz Wi-Fi radio and a 5.8 GHz Wi-Fi radio using fully compliant 802.11n links. Each radio can act as an Access Point (AP) or provide backhaul links. An AP provides user traffic wireless access to the BelAir20EO. Backhaul links connect to other BelAir Networks radios to create a radio mesh.

- two integrated dual-band antennas
- an external connector field

BelAir100N

The BelAir100N is a Wi-Fi access point that meets IEEE 802.11n standards. It is fully interoperable with existing 802.11a/b/g standards, providing a transparent, wireless high speed data communication between the wired LAN and fixed or mobile devices.

The BelAir100N can operate as a standalone device, or participate in a BelAir Networks mesh as an edge node or to terminate the mesh.

The 802.11n Wi-Fi radios provide user traffic wireless access to the BelAir100N and can form point-to-point, point-to-multipoint, or multipoint-to-multipoint mesh backhaul links.

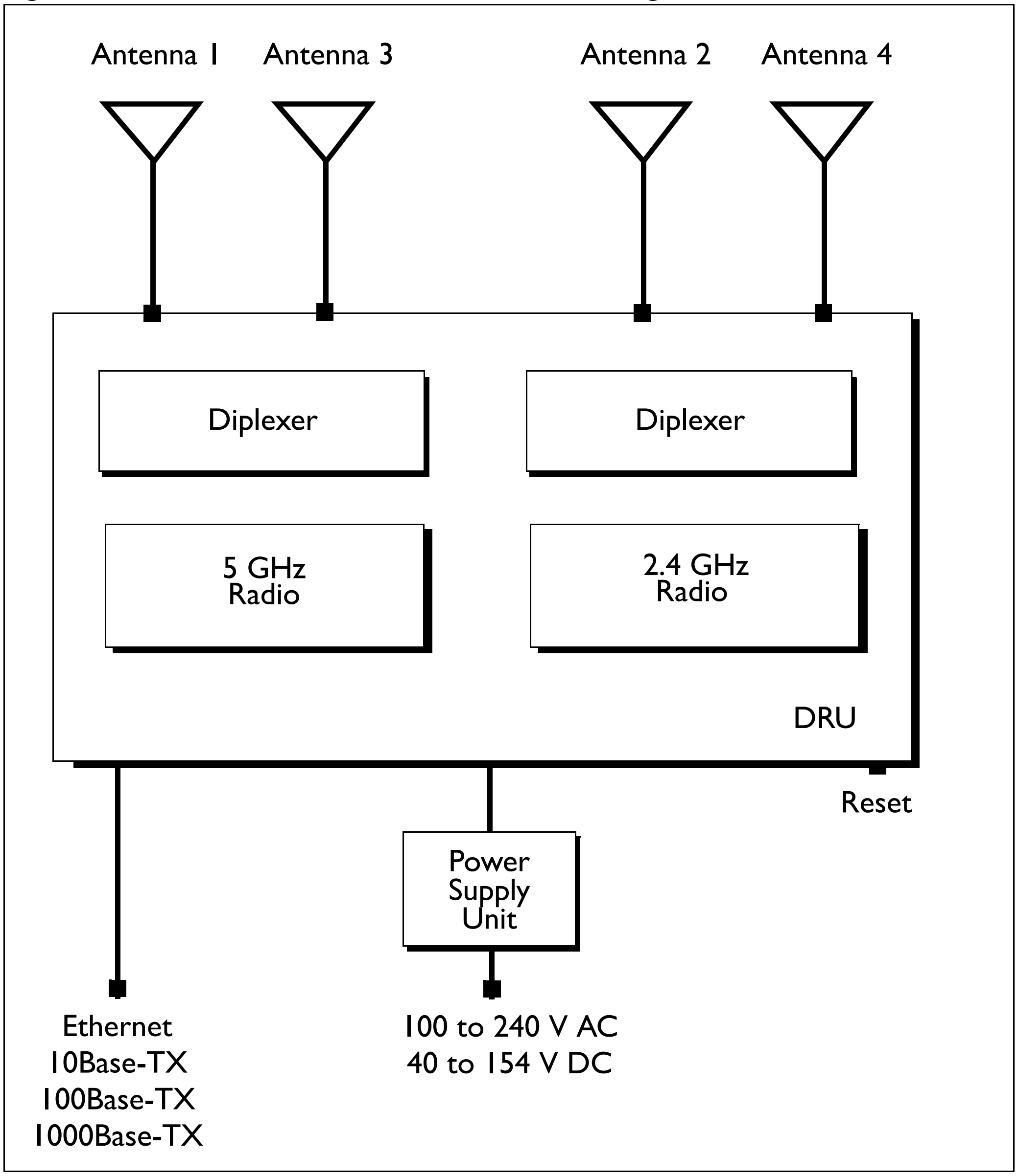
All the members of a multipoint-to-multipoint mesh use a proprietary algorithm based on RSTP to automatically control the creation of loops within the mesh. This loop management function is fully transparent to customers and under normal operating conditions, you do not need to modify any settings.

BelAir100N Hardware Description

Figure 5 on page 14 shows the relationship between the main BelAir100N hardware modules. The BelAir100N consists of the following modules:

- one Dual Radio Unit (DRU) providing:
  - —a wireline 10/100/1000 Base-TX Ethernet interface to the Internet
  - —a 2.4 GHz Wi-Fi radio and a 5 GHz Wi-Fi radio using enhanced performance links. Each radio can act as an Access Point (AP) or provide backhaul links. An AP provides user traffic wireless access to the BelAir100N. Backhaul links connect to other BelAir Networks radios to create a radio mesh.
- a Power Supply Unit (PSU)
- external antennas
- one environmental enclosure
- an external connector field

Figure 5: BelAir100N Hardware Module Block Diagram



BelAir100SN

The BelAir100SN is a Wi-Fi access point that meets IEEE 802.11n standards. It is fully interoperable with existing 802.11a/b/g standards, providing a transparent, wireless high speed data communication between the wired LAN and fixed or mobile devices.

The BelAir100SN can operate as a standalone device, or participate in a BelAir Networks mesh as an edge node or to terminate the mesh.

The 802.11n Wi-Fi radios provide user traffic wireless access to the BelAir100SN and can form point-to-point, point-to-multipoint, or multipoint-to-multipoint mesh backhaul links.

All the members of a multipoint-to-multipoint mesh use a proprietary algorithm based on RSTP to automatically control the creation of loops within the mesh. This loop management function is fully transparent to customers and under normal operating conditions, you do not need to modify any settings.

BelAir100SN Hardware Description

Figure 6 on page 16 shows the relationship between the main BelAir100SN hardware modules. The BelAir100SN consists of the following modules:

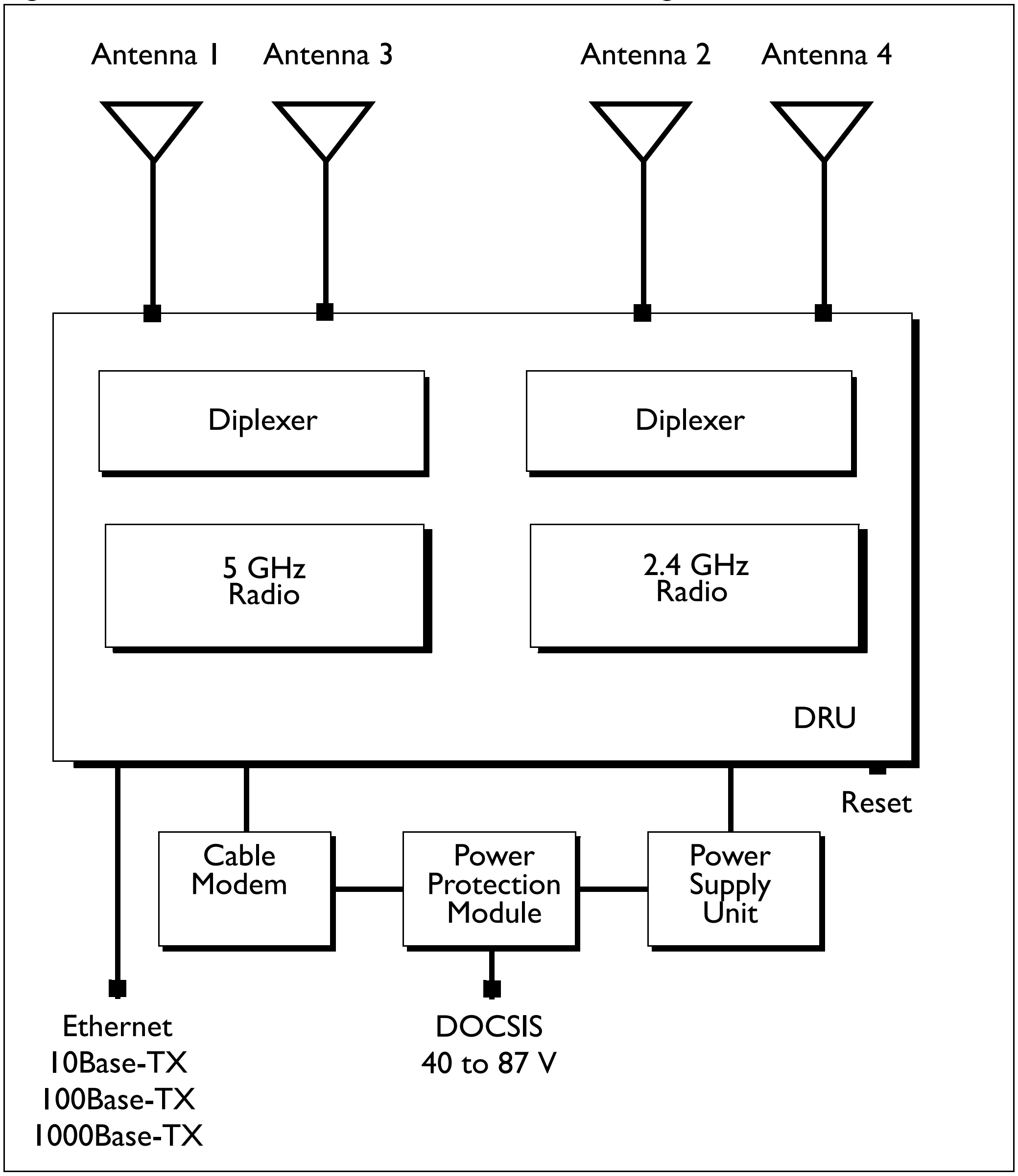
- one Dual Radio Unit (DRU) providing:

  —a wireline 10/100/1000 Base-TX Ethernet interface to the Internet

  —a 2.4 GHz Wi-Fi radio and a 5 GHz Wi-Fi radio using enhanced performance links. Each radio can act as an Access Point (AP) or provide backhaul links. An AP provides user traffic wireless access to the BelAir100SN. Backhaul links connect to other BelAir Networks radios to create a radio mesh.

- a Power Protection Module (PPM) providing a wireline DOCSIS interface and a plant interface for power
- a Cable Modem (CM)
- a Power Supply Unit (PSU)
- external antennas
- one environmental enclosure
- an external connector field

Figure 6: BelAir100SN Hardware Module Block Diagram



BelAir100SNE

The BelAir100SNE is an evolution of BelAir Networks' solution for cable operators who want a proven and scalable strand-mount Wi-Fi AP that integrates seamlessly with their current network and back office systems and can be up and running live in less than 15 minutes.

The BelAir100SNE incorporates dual 802.11n-2009 Wi-Fi 3x3 MIMO radios and a DOCSIS® 3.0 or Euro-DOCSIS 3.0 modem on this innovative and commercially proven AP.

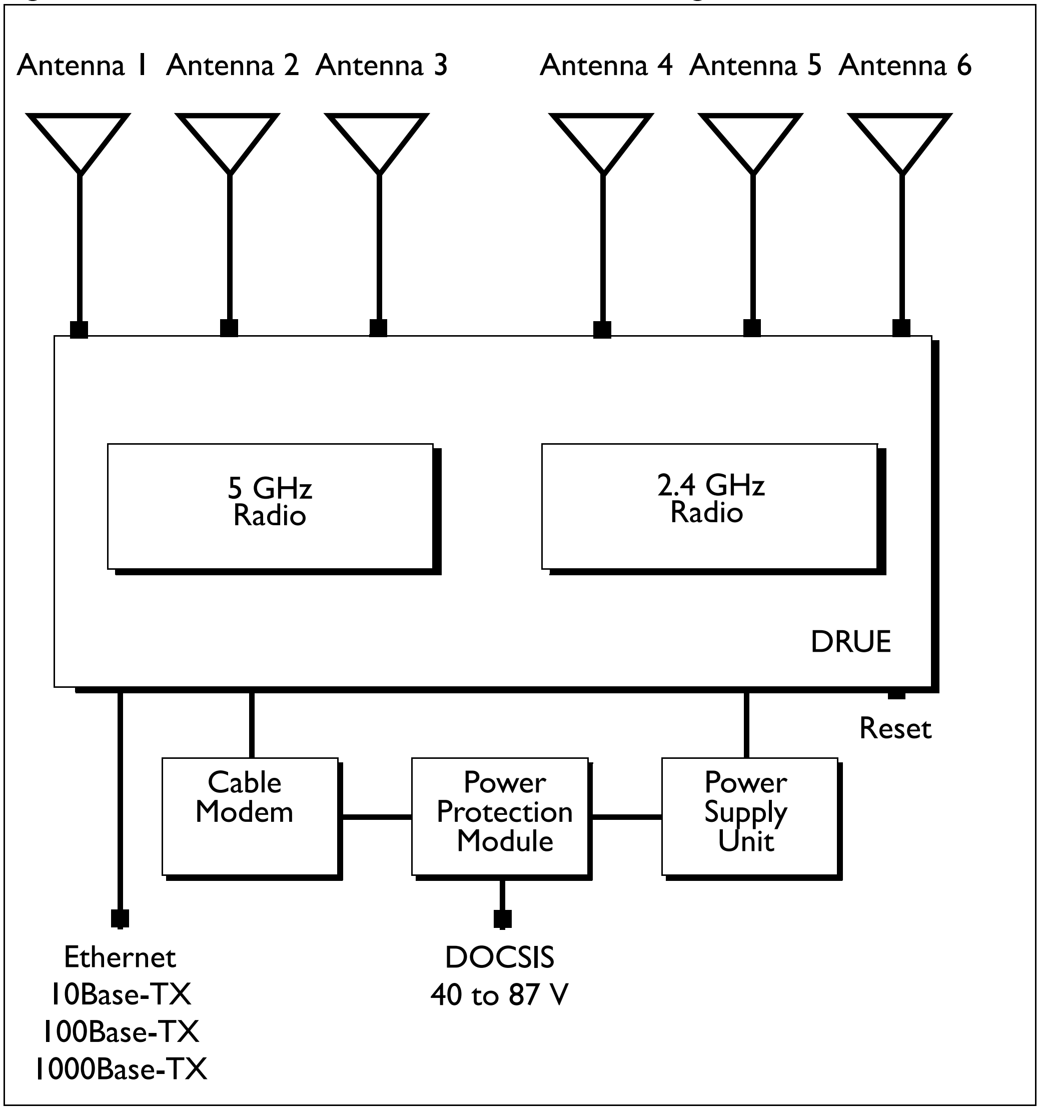
The BelAir100SNE leverages the BelAirOS Operating System to support network-wide mobility and quality of service (QoS), along with edge-based security and policy enforcement. With BelView network management, cable operators can manage up to 50,000 BelAir100SNE APs (or any combination of BelAir Networks APs) in a single network. Web-based monitoring, dashboard tools and smartphone apps provide real time network and user statistics. The BelAir100SNE also supports TR-069 to enable integration with the operator's existing network management system.

BelAir100SNE Hardware Description

Figure 7 on page 18 shows the relationship between the main BelAir100SNE hardware modules. The BelAir100SNE consists of the following modules:

- one Dual Radio Unit Evolved (DRUE) providing:
  - —a wireline 10/100/1000 Base-TX Ethernet interface to the Internet
  - —a 2.4 GHz Wi-Fi radio and a 5.8 GHz Wi-Fi radio using fully compliant 802.11n links. Each radio can act as an Access Point (AP) or provide backhaul links. An AP provides user traffic wireless access to the BelAir100SNE. Backhaul links connect to other BelAir Networks radios to create a radio mesh.
- a Power Protection Module (PPM) providing a wireline DOCSIS interface and a plant interface for power
- a Cable Modem (CM)
- a Power Supply Unit (PSU)
- external antennas
- one environmental enclosure
- an external connector field

Figure 7: BelAir100SNE Hardware Module Block Diagram



BelAir2100

The BelAir2100 Metrocell is a compact multi-radio base station with integrated wireless backhaul options for easy outdoor deployment. The BelAir2100 supports multiple licensed bands, Carrier Wi-Fi access and a range of integrated wireless and wireline backhaul options in a small, robust and easy to install base station that reduces small cell CapEx and OpEx in dense metropolitan areas.

BelAir2100 multiple licensed band radios allow mobile carriers with multiple macro RAN domain suppliers to achieve efficiencies by standardizing on one reference metrocell solution while ensuring smooth integration, fast installation and commissioning.

BelAir2100 is designed to mitigate interference and enable full RF interoperability between the licensed band and Wi-Fi access radios, as well as between the metrocell and the macro network. This includes features such as duplexers, filters and a network listen radio.

The BelAir2100 includes integrated dual IEEE 802.11n-2009 Carrier Wi-Fi radios that support Hotspot 2.0 (including 802.11u) standards for seamless secure roaming. The dual-band radios support the latest beam forming (TxBF), Maximum Ratio Combining (MRC), offer unmatched radio sensitivity, and with MIMO support up to 600 Mbps concurrent throughput. The Belair2100 antenna options include Diversity (3G), MIMO (LTE) and dual-band Wi-Fi pair with beam forming.

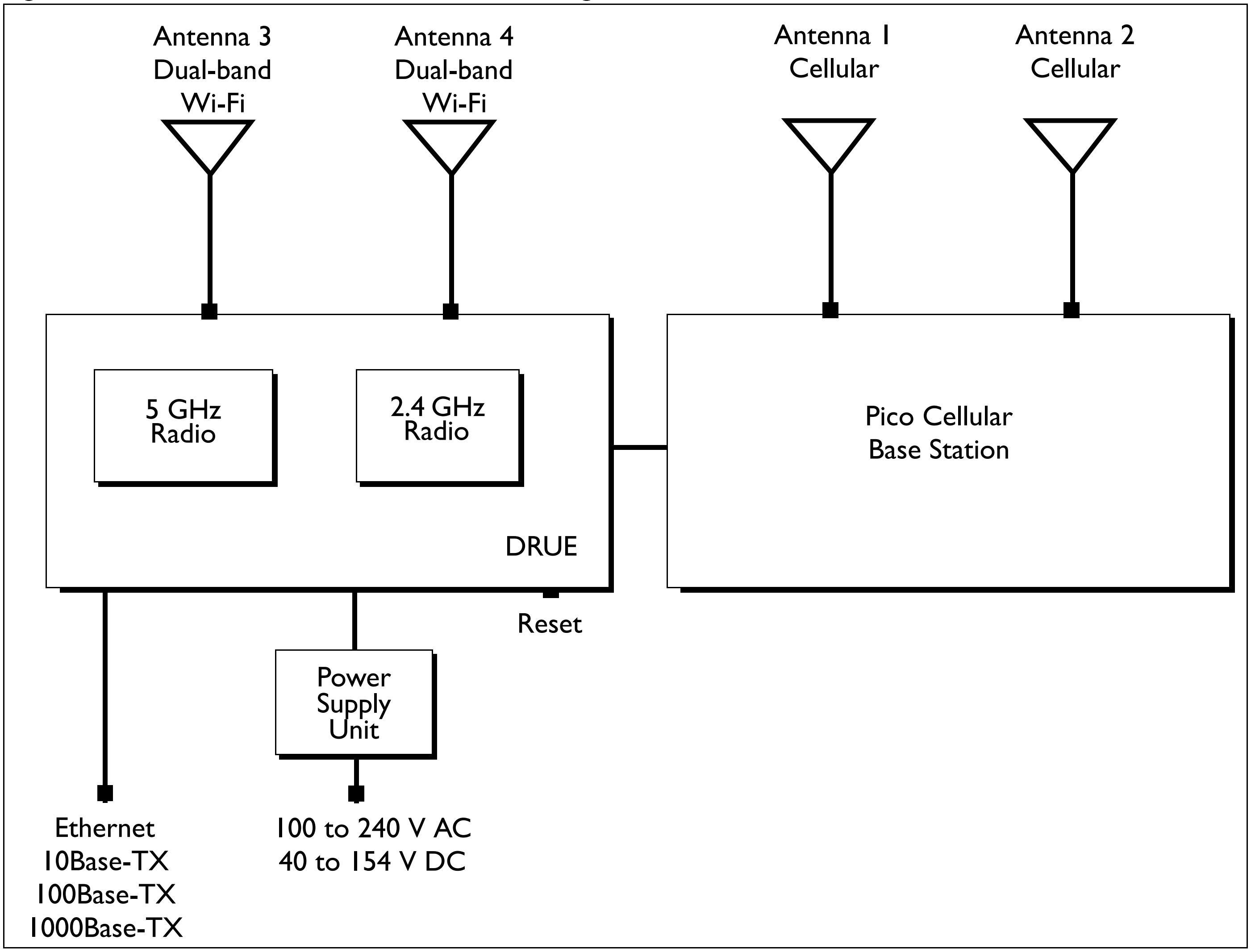
Integrated wireless and wireline backhaul options, including high performance switched mesh, allow location mounting flexibility and ease of network planning while maximizing performance and reducing egress requirements. The BelAir2100 can be wall, pole or roof mounted, and AC or DC powered.

BelAir2100 Hardware Description

Figure 8 on page 20 shows the relationship between the main BelAir2100 hardware modules. The BelAir2100 consists of the following modules:

- one Dual Radio Unit Evolved (DRUE) providing:
  - —a wireline 10/100/1000 Base-TX Ethernet interface to the Internet
  - —a 2.4 GHz Wi-Fi radio and a 5 GHz Wi-Fi radio using enhanced performance links. Each radio can act as an Access Point (AP) or provide backhaul links. An AP provides user traffic wireless access to the BelAir2100. Backhaul links connect to other BelAir Networks radios to create a radio mesh.
- one pico-cellular base station. Traffic from the pico-cellular base station is packetized and sent to DRUE to be routed according to VLAN settings.
- a Power Supply Unit (PSU)
- external antennas
- one environmental enclosure
- an external connector field

Figure 8: BelAir2100 Hardware Module Block Diagram



AP Configuration Interfaces

The following sections describe the configuration interfaces you can use to access and configure BelAir Networks APs:

- "Command Line Interface" on page 21
- "SNMP Interface" on page 21
- "Web Interface" on page 24

All three interfaces (CLI, SNMP and Web) have the same public IP address. All three also access the same AP database. That means that changes made with one interface are seen immediately through the other interfaces.

Command Line Interface

The CLI allows you to configure and display all the parameters of an AP, including:

- system parameters
- system configuration and status
- radio module configuration and status
- user accounts
- traffic statistics
- layer 2 functionality, such as those related to bridging and VLANs
- Quality of Service parameters
- alarm system configuration and alarms history

Each AP can have up to nine simultaneous CLI sessions (Telnet or SSH). For a description of basic CLI commands and tasks see "Command Line Interface Basics" on page 27.

SNMP Interface

The Simple Network Management Protocol (SNMP) provides a means of communication between SNMP managers and SNMP agents. The SNMP manager is typically a part of a network management system (NMS) such as HP OpenView, while the AP provides the services of an SNMP agent. Configuring the AP SNMP agent means configuring the SNMP parameters to establish a relationship between the manager and the agent.

The AP SNMP agent contains Management Information Base (MIB) variables. A manager can query an agent for the value of MIB variables, or request the agent to change the value of a MIB variable.

Refer to the following sections:

- "SNMP Configuration Guidelines" on page 42
- "SNMP Command Reference" on page 43

Integrating the AP with a Pre-deployed NMS

In addition to providing support for the SNMP MIBs described in Table 3, BelAir Networks provides a number of enterprise MIB definitions that you can integrate with your Network Management System (NMS). Table 4 on page 23 describes the SNMP MIBs. A copy of the SNMP MIBs is available from the BelAir Networks online support center at: www.belairnetworks.com/support/index.cfm.

Table 3: Standard SNMP MIBs

File Name	Description
BRIDGE-MIB.mib	implements RFC1493
IANAifType-MIB.mib	defines standard interface types assigned by the Internet Assigned Numbers Authority (IANA)
IEEE802dot11-MIB.mib	IEEE MIB to manage 802.11 devices
IF-MIB.mib	implements RFC2863
IP-MIB.mib	defines IP and ICMO data types
PerfHist-TC-MIB.mib	defines data types to support 15-minute performance history counts
RADIUS-ACC-CLIENT-MIB.mib	implements RFC2620
RADIUS-AUTH-CLIENT-MIB.mib	implements RFC2618
RSTP-MIB.mib	implements 802.1w RSTP
SNMP-COMMUNITY-MIB.mib	defines data types to support co-existence between SNMP versions
SNMP-FRAMEWORK-MIB.mib	implements RFC3411
SNMP-MPD-MIB.mib	implements RFC3412

Table 3: Standard SNMP MIBs (Continued)

File Name	Description
SNMP-NOTIFICATION-MIB.mib	implements RFC3413
SNMP-TARGET-MIB.mib	implements RFC3413
SNMP-USER-BASED-SM-MIB.mib	implements RFC3414
SNMPv2-CONF.mib	implements RFC1450
SNMPv2-MIB.mib	implements RFC1907
SNMPv2-SMI.mib	implements RFC1450
SNMPv2-TC.mib	implements RFC1450
SNMP-VIEW-BASED-ACM-MIB.mib	implements RFC3415

Table 4: BelAir Networks Enterprise MIBs

File Name	Description
BELAIR-CABLE-MODEM.mib BELAIR-CM-OEM.mib	defines DOCSIS cable modem data types
BELAIR-CABLE-MODEM.mib BELAIR-CM-OEM.mib	defines DOCSIS cable modem data types
BELAIR-IEEE802DOT11-CLIENT.mib BELAIR-IEEE802DOT11.mib	defines features that are not supported by the standard IEEE802.11 MIB
BELAIR-IP.mib	defines BelAir Networks IP data types
BELAIR-MESH.mib	defines BelAir Networks multipoint-to-multipoint data types
BELAIR-MOBILITY.mib	defines data types to support mobile backhaul mesh and point-to-point links
BELAIR-PHYIF-MAPPING.mib	defines data types to support universal slots
BELAIR-PRODUCTS.mib	defines product object IDs
BELAIR-RSTP.mib	defines RSTP data types
BELAIR-SMI.mib	defines BelAir Networks top level OID tree

Table 4: BelAir Networks Enterprise MIBs (Continued)

File Name	Description
BELAIR-SYSTEM.mib	defines basic OAM features such as software download, temperature and BelAir Networks alarms
BELAIR-TC.mib	defines BelAir Networks data types
BELAIR-TUNNEL.mib	defines L2TP data types
BELAIR-WRM.mib	defines BelAir Networks WiMAX data types

The procedure for importing the SNMP MIB definition files depends on the deployed NMS version. Refer to your NMS documentation for details.

Web Interface

BelAir Networks has verified that the AP Web interface operates correctly with the following web browsers:

- Microsoft Internet Explorer version 6.0, service pack 2
- Mozilla Firefox version 1.5, or later

Accessing the Web Interface

You can access the Web interface using either secure HTTP (HTTPS) or HTTP. Both HTTP and HTTPS are enabled when each AP is shipped. Each AP can have up to five simultaneous CLI sessions (HTTP or HTTPS).

By default, the AP Web interface has an associated time-out value. If the interface is inactive for 9 minutes, then you are disconnected from the interface. To reconnect to the interface, you need to log in again.

Accessing the System Page with Secure HTTP or with HTTP

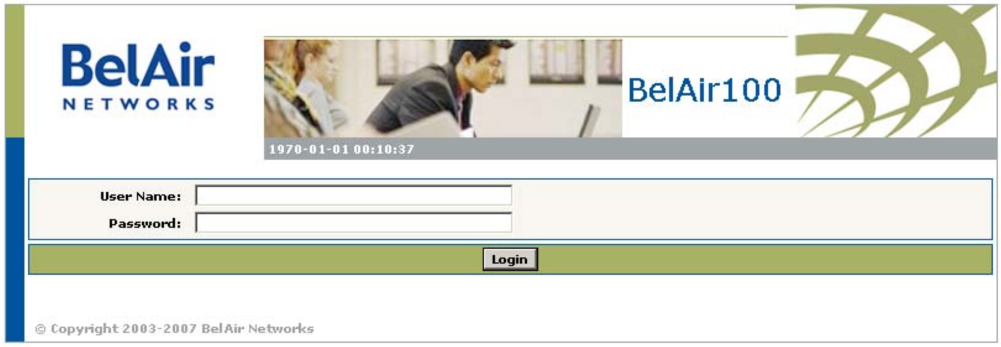
To log in to the AP Web interface and access the main page using HTTPS or HTTP, do the following steps:

1 Open your Web browser and specify the IP address of the AP you want to access.

The default IP address of each AP is: 10.1.1.10.

Figure 9 on page 25 shows the resulting Login page.

Figure 9: Typical Login Page



2 Enter a valid user name, such as root, and a valid password.

Note: The specified password is case sensitive.

Figure 10 shows a typical resulting main page for the Web interface.

Figure 10: Typical Web Interface Main Page

Stopping a Session

To stop a Web interface session, click on the Logout button located in the top right corner each page. See Figure 10 on page 25.

Additional Troubleshooting Tools

The Web interface provides the following tools to display radio performance metrics:

- a throughput meter
- histogram display of various performance metrics

These tools are only available with the Web interface. For full details, see "Web Radio Troubleshooting Tools" on page 277.

Command Line Interface Basics

Use this chapter to familiarize yourself with basic CLI tasks, including:

Connecting to the AP

You can connect to the AP default address using one of the following methods:

- through the AP radio interface
- by connecting directly to the Ethernet port on the AP
- by connecting through the cable modem, if it is equipped with one

CAUTION! Do not connect the AP to an operational data network before you configure its desired IP network parameters. This may cause traffic disruptions due to potentially duplicated IP addresses.

The AP must connect to an isolated LAN, or to a desktop or laptop PC configured to communicate on the same IP sub-network as the AP.

Using the Radio Interface

Use a desktop or laptop PC equipped with a wireless 802.11a, 802.11b, 802.11g or 802.11n compliant interface as required, configured with a static IP address on the same subnet as the default OAM IP address (for example, 10.1.1.1/24). For the required configuration procedure, refer to your PC and wireless interface configuration manuals or contact your network administrator. The PC will connect to the AP through the radio interface.

Connecting to the Ethernet Port

Use a cross-connect RJ45 cable to connect the Ethernet port of the AP.

Using the Cable Modem

The MAC address for the AP's cable modem should have been supplied to your System Administrator when the AP was installed so that an IP address could be assigned to it. Contact your system administrator to determine the IP address to use.

For a detailed procedure, refer to the AP Installation Guide.

Starting a CLI Session

Start a Telnet or secure shell (SSH) client and connect to the AP's IP address. If you are configuring the AP for the first time, you must use the default IP address (10.1.1.10). The AP prompts you for your user name and password.

The default super-user account is "root". The default password is "admin123".

If the login is successful, the AP CLI prompt is displayed. The default prompt is "#", if you login as root. Otherwise, the default prompt string is ">".

Note 1: The terminal session locks after four unsuccessful login attempts. To unlock the terminal session, you must enter the super-user password.

Note 2: CLI commands are not case sensitive (uppercase and lowercase characters are equivalent). However, some command parameters are case sensitive. For example, passwords and any Service Set Identifier (SSID) supplied with the *radio* commands are case sensitive. Also, all parameters of the *syscmd* commands are case sensitive.

Note 3: Later, you will see that you can configure the AP to have more than one interface with an IP address. For example, you can configure Virtual LANs and management interfaces each with their own IP address. If you do this, make sure your Telnet or secure shell (SSH) connections are to a management interface. This ensures maximum responsiveness for your session by keeping higher priority management IP traffic separate from other IP traffic.

SSH Session Example of Initial Login

With secure shell, the system prompts you twice for your password.

```
ssh -l root 10.1.1.10
root@10.1.1.10's password:
              BelAir Backhaul and Access Wireless Router
BelAir User: root
Password:
/#
```

Telnet Session Example of Initial Login

With Telnet, the system prompts you only once for your password.

```
telnet 10.1.1.10
              BelAir Backhaul and Access Wireless Router
BelAir User: root
Password:
/#
```

Command Modes

The CLI has different configuration “modes”. Different commands are available to you, depending on the selected mode.

Each card in the AP has at least one associated physical interface. Some examples of physical interfaces are a Wi-Fi radio or an Ethernet interface.

Use the *mode* command to display the modes that are available. Because each physical interface and each card in the AP has its own mode, displaying the modes also displays a profile summary of the AP. See Figure 11.

Figure 11: Sample Output of mode Command

```
/# mode
        /card
                /htme-1


        /interface
                /wifi-1-1        (HTMEv1 5GHz 802.11n)
                /wifi-1-2        (HTMEv1 2.4GHz 802.11n)
                /eth-1-1         (1000BASE-T)
                /lan-1           (1000BASE-T)
                /lan-2           (1000BASE-T)
                /lan-3           (1000BASE-T)
                /lan-4           (1000BASE-T)


        /mgmt


        /protocol
                /ip
                /nat
                /radius
                /rstp
                /snmp
                /sntp
                /te-syst         (tunnel)



        /qos


        /services
                /auto-conn
                /mobility


        /ssh
        /ssl
        /syslog
        /system
        /diagnostics
```

- The AP has one card. The HTME card is in slot 1.
- The AP has the following physical interfaces:
  - —Interface *wifi-1-1* is associated with the HTME 5.8 GHz radio.
  - —Interface *wifi-1-2* is associated with the HTME 2.4 GHz radio.
  - —Interface *eth-1-1* is associated with the HTME card's Ethernet interface.
  - —Interfaces *lan-1* to *lan-4* are associated with the HTME card's LAN interfaces.
- The *mgmt* mode allows you to control user accounts, which authentication to use, and whether you can access the AP with Telnet.
- You can control the IP, RADIUS, RSTP, SNMP, SNTP, L2TP and NAT protocols through the *protocol* mode and its submodes.
- You can control auto-connect and backhaul mobility through the *services* mode and its submodes.
- These modes allow you to control SSH, SSL, Syslog and system settings. You can also run diagnostics.

Root Mode (/)

This is the top or root level of the CLI commands.

Card Management Mode (/card/<card_type>-<n>)

Use this mode for all hardware card management functions.

<card_type> can be one of:

- *htm* - The High Throughput Module (HTM) card is available for the BelAir20 and the BelAir100i WCS.
- *htme* - The High Throughput Module Evolved (HTME) card is available for the BelAir20E and the BelAir20EO.
- *dru* - The Dual Radio Unit (DRU) card is available for the BelAir100N and the BelAir100SN.
- *drue* - The Dual Radio Unit Evolved (DRUE) card is available for the BelAir100SNE and the BelAir2100.
- *cm* - The Cable Modem (CM) card is available for the BelAir100SN and the BelAir100SNE.

<n> is the slot number.

Physical Interfaces Mode (/interface/<iface>-<n>-<m>)

Use this mode to configure the AP's physical interfaces.

<iface> can be one of:

- wifi - 802.11a/b/g/n HTM, HTME, DRU or DRUE radios
- eth - 1000Base-TX, HTM, HTME, DRU or DRUE Ethernet
- lan - 1000Base-TX, HTME LAN
- bts - pico-cellular base station

<n> is the slot number where the interface is located in the AP. <n> applies only when <iface> is *wifi* or *eth*.

<m> is port number. <m> is 1 for most interfaces. The HTM HTME, DRU and DRUE cards can have multiple ports representing multiple Wi-Fi radios operating different frequencies. Some configurations may have multiple Ethernet or LAN ports.

Management Mode (/mgmt)

Use this mode to configure user accounts, user authentication and Telnet access.

Protocol Mode (/protocol/<protocol>)

Use this mode to configure different protocols.

<protocol> can be one of:

- *ip* - IP parameters for AP and VLANs
- *nat* - Network Address Translation (NAT)
- *radius* - Remote Authentication Dial In User Service (RADIUS) user sessions
- *rstp* - Rapid Spanning Tree Protocol (RSTP)
- *snmp* - Simple Network Management Protocol (SNMP)
- *sntp* - Simple Network Time Protocol (SNTP)
- *tr069* - TR-069 describes the CPE WAN Management Protocol (CWMP)
- *te-<eng>* - L2TP tunnel engine (te). BelAir APs can have one tunnel engine per system (syst).

Services Mode (/services/<service>)

Use this mode to configure different services.

<service> can be one of:

- *auto-conn* - Auto-configuration
- *mobility* - Backhaul mobility

Administration Modes (/<admin>)

Use these modes for various administration tasks.

<admin> can be one of:

- *qos* - Quality of Service (QoS) parameters
- *ssh* - Secure Shell (SSH) parameters
- *ssl* - Secure Socket Layer (SSL) parameters
- *syslog* - SYSLOG messages
- *system* - System and AP configuration and administration
- *diagnostics* - Link diagnostics

Using Modes

You can move between modes with the *cd* command. For instance, you can move from *root* mode to *system* mode using the command:

```
/# cd /system
/system#
```

Note 1: The prompt changes to match the current mode. You can further customize the prompt to show the switch name or a 20-character string that you define.

Note 2: Access to a mode is only allowed if the user has sufficient privileges to execute commands in that mode.

When you access a given mode, only the commands pertaining to that mode are available. For example, accessing *snmp* mode provides access to SNMP commands. For a physical interface, this means that only the commands that apply to that specific type and version of interface are available when you access a particular physical interface. For example, if you access an HTMEv1 interface, only the commands that apply to an HTMEv1 Wi-Fi radio are available.

Entering *?* displays the commands that apply to the currently accessed mode. Entering *??* or *help* displays the commands that apply to the currently accessed mode plus common commands that are available in all modes.

Users may execute commands from other modes than the current one, by prefixing the desired command with the slash character '/' followed by the mode's name. For instance, entering:

```
/system# /protocol/snmp/show community
```

executes a command from *snmp* mode while in *system* mode.

Abbreviating Commands

You must enter only enough characters for the CLI to recognize the command as unique.

The following example shows how to enter the *mgmt* mode command *show telnet status*:

```
/mgmt# sh t s
```

Command History

You can use the *history* command to display a list of the last commands that you have typed.

Example

```
/# history
```

```
 8  h
 9  hi
10  ?
11  show user
12  cd /system
13  show loads
14  show sessions
15  cd /
16  cd interface/wifi-1-1/
17  ?
18  show
19  show ssid table
20  show statistics
21  history
```

Special CLI Keys

Command Completion

You can ask the CLI to complete a partially typed command or mode name by pressing the *tab* key. If the command or mode name cannot be completed unambiguously, the CLI presents you with a list of possible completions. For instance, entering:

```
/system# show co{tab}
```

produces the following output:

```
Available commands :
show communications
show config-download status
show coordinates
show country [detail]
```

Execution of the Last Typed Command

You may repeat the last command, by entering the *!* key twice, followed by carriage return.

Executing the Previous Commands

You may browse through the command history by using the up and down arrow keys of a VT100 or compatible terminal. You can also execute a certain command from the command history by entering the *!* key, followed by the command number (as displayed in the *history* command output) and carriage return.

Help Command

```
?
?? [<command>]
help [<command>]
```

These commands display:

- a list of commands available in the current mode
- help on a particular command available in the current mode
- help on commands starting with the given keyword in the current mode

Entering "??" is equivalent to entering "help".

Available Commands

Entering *?* displays the commands that apply to the currently accessed mode. For example:

```
/mgmt# ?

Available commands :
adduser <user-name> -p <passwd> [ -d <default-mode>] [-g <grp-name>]
deluser <user-name>
moduser <user-name> [ -p <passwd>] [ -d <default-mode>] [-g <grp-name>]
set authentication-login {local | radius <list>}
set telnet {enabled|disabled}
show authentication-login
show telnet status
show user
```

Entering *??* or *help* displays the commands that apply to the currently accessed mode plus common commands that are available in all modes. For example:

```
/mgmt# ??

Available commands :
adduser <user-name> -p <passwd> [ -d <default-mode>] [-g <grp-name>]
deluser <user-name>
moduser <user-name> [ -p <passwd>] [ -d <default-mode>] [-g <grp-name>]
set authentication-login {local | radius <list>}
set telnet {enabled|disabled}
show authentication-login
show telnet status
show user

alias [<replacement string> <token to be replaced>]
cd <path>
clear-screen
console lock
exit
help [ command ]
history
mode [<mode_name>]
passwd
ping <ip addr> [-l <size>]
run script <script file> [<output file>]
version
whoami
config-save [{active|backup} remoteip <server> remotefile <filename>
[{tftp | ftp [user <username> password <password>]}]]
config-restore remoteip <ipaddress> remotefile <filename> [{tftp | ftp
[user <username> password <password>]}] [force]
show date
```

```
su <username>
```

Keyword Help

Entering *??* or *help* followed by a keyword displays all possible commands starting with that keyword. For example:

```
/mgmt# ?? show

Available commands :
show authentication-login
    Description : show authentication login status and RADIUS servers 
configuration
show telnet status
    Description : shows the status of the telnet.
show user
    Description : List all valid users, along with their permissible mode.
show date
    Description : show current system date and time
```

Help for a Specific Command

When help is needed for a specific command, enter *??* or *help* followed by the command within quotes. For example:

```
/mgmt# help "adduser"

Available commands :
adduser <user-name> -p <passwd> [ -d <default-mode>] [-g <grp-name>]
    Description : Create a user.
```

Help with Abbreviations

When an abbreviation is used in the help string, all matching commands are listed with the description. For example:

```
/mgmt# ?? s

Available commands :
set authentication-login {local | radius <list>}
    Description : defines how login session will be authenticated.
set telnet {enabled|disabled}
    Description : enable or disable CLI access via the telnet protocol.
show authentication-login
    Description : show authentication login status and RADIUS servers 
configuration
show telnet status
    Description : shows the status of the telnet.
show user
    Description : List all valid users, along with their permissible mode.
show date
    Description : show current system date and time
su <username>
    Description : Substitute present user with the given user.
```

Saving your Changes

If you change any settings from the system defaults, you must save those changes to the configuration database to make sure they are applied the next time the AP reboots. Similarly, you can restore the entire configuration database from a previously saved backup copy.

Saving the Configuration Database

```
config-save [{active|backup} remoteip <ipaddress>
              remotefile <filename>
             [{tftp|ftp [user <usrname> password <pword>]}]]
```

This command allows you to save the current configuration of the entire AP. This includes all system, layer 2 and radio settings.

When used without its optional parameters, the *config-save* command saves the configuration database for the active software load to persistent storage. The stored configuration is automatically applied at the next reboot.

When used with its optional parameters, the *config-save* command also transfers the configuration database to a remote server.

If *active* is specified, the *config-save* command saves the configuration database for the active software load to persistent storage and then transfers it to a remote server. If *backup* is specified, the configuration database for the active software load is not saved. Instead, the configuration database for the active software load that was saved previously to persistent storage, is transferred to a remote server.

You can use either TFTP or FTP to communicate with the remote server. By default, the *config-save* command uses TFTP. If you specify FTP, you can also specify the username and password. The default FTP username is *anonymous* and the default FTP password is *root@<nodeip>*, where <nodeip> is the IP address of AP making the request. If you do not use the default FTP username, the FTP server must be configured to accept your username and password.

Restoring the Configuration Database

```
config-restore remoteip <ipaddress> remotefile <filename>
                  [{tftp|ftp [user <usrname> password <pword>]}]]
                   [force]
```

This command transfers the configuration database from a remote server to the active software load in persistent storage. This allows you to restore the entire configuration database from a previously saved backup copy.

Use the *reboot* command for the new configuration to take effect.

You can use either TFTP or FTP to communicate with the remote server. By default, the *config-restore* command uses TFTP. If you specify FTP, you can also specify the user name and password. The default FTP user name is *anonymous* and the default FTP password is *root@<nodeip>*, where <nodeip> is the IP address of AP making the request. If you do not use the default FTP username, the FTP server must be configured to accept your username and password.

The optional *force* parameter suppresses version checking on the configuration file that is being downloaded. You can use a backup copy that was created with a different version of software than the current software installed on the AP. If you do, BelAir Networks strongly recommends that you fully and thoroughly verify the configuration and operation of the AP after you reboot the system and before you save the restored configuration.

Example

```
/# cd system
/system# config-restore remoteip 122.45.6.123 remotefile unitA.conf
```

Common CLI Commands

In addition to any previously described commands, the following commands are always available, regardless of your current mode.

Terminating your CLI Session

```
exit
```

Use this command to terminate your own CLI session at any time.

Changing Your Password

```
passwd
```

This command lets you change your current password. First, you are asked to enter your old password. Then you must enter your new password twice, to verify that you have typed it correctly.

Note: The specified password is case sensitive, must consist of alphanumeric characters, must be at least six characters long, and cannot exceed 20 characters.

CAUTION! If you forget the super-user account password, you may be unable to use all the AP's management functions and you may need to reset the AP's configuration to factory defaults.

Example

```
passwd
Old Password:
Enter New Password:
Reenter the Password:

Password updated Successfully
```

Clearing the Console Display

```
clear-screen
```

This command clears your console display window.

Locking the Console Display

```
console lock
```

This command lock your console display window. You must enter your password to unlock it.

Displaying the Current Software Version

```
version
```

This command displays the version of the currently running software load.

Displaying the Current Date and Time

```
show date
```

This command displays the current date and time.

Example 1

The following example displays the current date and time when it is set manually.

```
/# show date
Current date: 2007-05-10 06:52:20
```

Example 2

The following example displays the current date and time when using a Simple Network Time Protocol (SNTP) server and a time offset of -4 hours and 30 minutes. See "Configuring the System Date and Time" on page 68 for details.

```
/# show date

Current date: 2006-07-21 13:15:16 (UTC)
Current date: 2006-07-21 08:45:16
```

Displaying Current User

```
whoami
```

This command displays current user.

Example

```
/# whoami
/# Current User is root
```

Switching User Accounts

```
su <username>
```

This command changes the user account you are currently using. To return to the original user account, use the *exit* command.

Example

```
/# whoami
Current User is  root
/# su guest
/> whoami
Current User is  guest
/> exit
```

```
/# whoami
Current User is  root
```

Replacing a Token by a String

```
alias [<replacement string> <token to be replaced>]
```

This command replaces the specified token by the given string. It is provided for customers writing scripts. See "Scripting Guidelines" on page 309.

Example

```
/# alias gu guest
```

Pinging a Host or Switch

```
ping <host> [-1 <size>]
```

This command pings a host machine or switch using the host name or IP address.

The following options are supported:

-l size specifies the size of the ping request packets to be sent.

Examples

The following example shows typical ping output:

```
/# ping 10.1.1.100 -l 128
PING 10.1.1.100 (10.1.1.100): 128 data bytes
136 bytes from 10.1.1.100: icmp_seq=0 ttl=128 time=2.0 ms
136 bytes from 10.1.1.100: icmp_seq=1 ttl=128 time=1.2 ms
136 bytes from 10.1.1.100: icmp_seq=2 ttl=128 time=1.0 ms
--- 10.1.1.100 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 1.0/1.4/2.0 ms
```

Starting a Telnet Session

```
telnet <ip address> [<port_number>]
```

This command lets you start a Telnet session to another machine, such as another AP, by specifying the IP address. By default t, Telnet uses port 23. You can also specify an alternate port number.

Radio Configuration Summary

```
show interface summary
```

This command displays a summary of the configuration of all radio interfaces.

Example

The following example shows a typical output for a BelAir20.

```
/# show interface summary
wifi-1-1
  Radio description:............ HTMv1 5GHz 802.11n
  Admin state: ................. Enabled
  Channel: ..................... 149
  Access:
```

```
    AP admin state: ............ Enabled
  Backhaul:
    link admin state: .......... Enabled
    link id: ................... BelAirNetworks
    topology: .................. mesh
wifi-1-2
  Radio description:............ HTMv1 2.4GHz 802.11n
  Admin state: ................. Enabled
  Channel: ..................... 6
  Access:
    AP admin state: ............ Enabled
  Backhaul:
    link admin state: .......... Disabled
    link id: ................... BelAirNetworks
    topology: .................. mesh
```

AP Access Methods

When an AP is shipped from the factory, all access methods (CLI, SNMP, Telnet, HTTP, HTTPS, SSH and TR-069) are enabled. You can use these interfaces to configure the system's IP networking parameters.

This chapter describes the CLI commands you can use to configure these access methods.

Note: Some access methods, such as HTTP and HTTPS, are configured while in SSL mode.

This chapter contains the following sections:

SNMP Configuration Guidelines

This section describes how to configure the AP to communicate to either an SNMPv1/v2 server or an SNMPv3 server.

SNMPv1/v2 Servers

To configure an SNMP community, use the *set community* command described in "Communities" on page 44.

For sending traps, use the *set trap* command described in "Traps" on page 45 to configure the AP with the parameters of the destination SNMP manager.

Refer to "SNMP Command Reference" on page 43 for detailed descriptions of all SNMP commands.

SNMPv3 Servers

To configure an SNMP user, use the *set user* command described in "Users" on page 45.

For sending notifications, use the *set notify* command described in "Notifications" on page 46 to configure the AP with the parameters of the destination SNMP manager.

Refer to "SNMP Command Reference" on page 43 for detailed descriptions of all SNMP commands, including entities that need to be predefined.

SNMP Naming Restrictions

SNMP community names, user names, and notification names must not contain the following characters:

—bar (|)

—semicolon (;)

—percent (%)

—double quotation mark (")

SNMP Command Reference

The following sections show you how to configure SNMP functions.

SNMP Agent

```
/protocol/snmp/set snmp-agent {enabled | disabled}
/protocol/snmp/show snmp-agent
```

The *set snmp-agent* command enables or disables SNMP access.

SNMP Configuration

```
/protocol/snmp/show config [{v2 | v3 | all}]
```

Use the *show config* command to display the current SNMP configuration. Passwords are only displayed to users with *root* privileges. See "User Privilege Levels" on page 52 for details.

Example 1

```
/protocol/snmp# show config v2

EngineId: 80003d9805000d67091448

Community configuration:
------------------------
Index Name                           IP Address      Privilege
----- ------------------             --------------- -----------
1     public                         0.0.0.0         ReadOnly
2     private                        10.1.1.70       ReadWrite


Trap configuration:
-------------------
Index IP address      Community                         Version
```

```
----- -------------- --------------                   -------
1     10.1.1.70      public                           v1v2
```

Example 2

```
/protocol/snmp# show config v3
```

```
EngineId: 80003d9805000d67006902

User configuration:
-------------------
User Name                       IP address      Auth Password           Privacy  Password        Privilege
-------------------------       --------------- ---- ---------------    -------- --------------- ---------
Test                            0.0.0.0         MD5  md5md5md5          DES_CBC  TEST            ReadWrite


Notification configuration:
-------------------
Name                            Type   IP address      Timeout Retry Auth Password          Privacy  Password
---------------                ------ ---------------  ------- ----- ---- ---------------  -------  ---------
TRAP                             trap  10.1.1.70        1250    2     MD5  md5md5md5         DES_CBC  TRAP
```

Communities

```
/protocol/snmp/set community <CommunityIndex>
                         community-name <name> ipaddr <ip_addr>
                         privilege {readonly|readwrite}
/protocol/snmp/delete community <CommunityIndex>
/protocol/snmp/show community
```

The *set community* command configures the SNMP community security. You can configure up to 10 communities. The community is assigned with privileges.

The *delete community* command deletes the specific community information.

The *show* command displays the SNMP community configuration.

Assigning an IP address of 0.0.0.0 to an SNMP community of an AP allows AP access by all managers configured for that community. See “Example 1” on page 44. To limit access to a single manager, enter the manager’s IP address. See “Example 2” on page 44.

Example 1

```
/protocol/snmp# set community 1 community-name belair ipaddr 0.0.0.0 privilege readonly
```

In this example, all managers configured with the SNMP community of *belair* can access the AP for read only functions.

Example 2

```
/protocol/snmp# set community 1 community-name belair200 ipaddr 10.10.10.11 privilege readonly
/protocol/snmp# set community 2 community-name belair100 ipaddr 20.20.20.20 privilege readwrite
/protocol/snmp# set community 3 community-name belcom ipaddr 30.30.30.30 privilege readonly
```

In the previous example, the manager at IP address 20.20.20.20 configured with the SNMP community of *belair100* has read-write access to the AP.

Example 3

```
/protocol/snmp# show community

Index Name                                IP Address      Privilege
----- ------------------                  --------------- -----------
1     public                              0.0.0.0         ReadOnly
2     private                             10.1.1.70       ReadWrite
```

Traps

```
/protocol/snmp/set trap <index> mgr-addr <ip_addr>
                          community <name> version {v1|v2|both}
/protocol/snmp/delete trap <index>
/protocol/snmp/show trap
```

The *set trap* command configures the parameters of the SNMPv2 trap manager. You can configure up to 10 traps.

The *delete trap* command deletes the specified trap manager information.

The *show trap* command displays the SNMPv2 trap manager configuration information.

Example 1

```
/protocol/snmp# set trap 1 mgr-addr 40.40.40.40 community bel1 version v1
/protocol/snmp# set trap 2 mgr-addr 41.41.41.41 community bel2 version v2
```

Example 2

```
/protocol/snmp# show trap

Index IP address      Community                        Version
----- --------------- ---------------                  -------
1     10.1.1.70       public                           v1v2
```

Users

```
/protocol/snmp/set user <UserName> ipaddr <IP_addr>
                 access {readonly | readwrite}
                [auth {md5 | sha} <password> [priv-DES <passwd>]]
/protocol/snmp/delete user <UserName>
/protocol/snmp/show user
```

The *set user* command defines an SNMPv3 user. You can define up to 10 users, each with different authentication and privacy settings.

The *ipaddr* parameter specifies the IP address associated with this user. The *access* parameter specifies the level of access granted to this user.

The *<password>* parameter is the password required by the user to access SNMP data. A user must supply this password if using a MIB browser.

The AP uses DES encryption to encrypt SNMP packets. The *priv-DES* parameter specifies the encryption key required to encrypt or decrypt the packet.

The *delete user* command deletes the definition of the specified SNMP user.

The *show* command displays the configured users. Passwords are only displayed to users with *root* privileges. See “User Privilege Levels” on page 52 for details.

Example 1

```
/protocol/snmp# set user v3md5 ipaddr 0.0.0.0 access readwrite auth md5 md5md5md5
```

Example 2

```
/protocol/snmp# show user

User Name             IP address          Auth Password Privacy  Password  Privilege
--------------        ---------------     ---- ---------------   --------  ---------
v3md5                 0.0.0.0             MD5  md5md5md5 None     none     ReadWrite
```

Notifications

```
/protocol/snmp/set notify <NotifyName> type {Trap | Inform}
                          ipaddr <IP_addr> [timeout <1-1500>]
                          [retries <1-3>] [auth {md5 | sha}
                           <password> [priv-DES <passwd>]]
/protocol/snmp/delete notify <NotifyName>
/protocol/snmp/show notify
```

The *set notify* command enables notifications to be sent to an SNMPv3 manager for the specified notification name. You can configure up to 10 notification names.

The *ipaddr* parameter specifies the IP address associated with this notification.

The *timeout* parameter specifies how many seconds to wait for an acknowledgement before resending the SNMP packet. The *retries* parameter specifies the number of times to resend the SNMP before declaring a failure.

The *<password>* parameter is the password associated with this notification.

The AP uses DES encryption to encrypt SNMP packets. The *priv-DES* parameter specifies the encryption key required to encrypt or decrypt the packet.

The *delete notify* command disables notifications from being sent for the specified notification name.

The *show notify* command displays the current SNMP notify configuration. Passwords are only displayed to users with *root* privileges. See “User Privilege Levels” on page 52 for details.

Example 1

```
/protocol/snmp# set notify trap1 type trap ipaddr 10.1.1.70
```

Example 2

```
/protocol/snmp# show notify
Name             Type   IP address      Timeout Retry Auth Password        Privacy Password
---------------- ------ --------------  ------- ----- ---- --------------- ------- -------------
trap1            trap   10.1.1.70       1500    3     None none            None    none
trap2            trap   10.1.1.70       1250    3     None none            None    none
trap3            trap   10.1.1.70       1250    2     None none            None    none
trap4            trap   10.1.1.69       1500    3     SHA  shasha          None    none
trap5            trap   10.1.1.69       1500    3     MD5  md5md5          None    none
trap6            trap   10.1.1.11       1500    3     None none            None    none
trap7            trap   10.1.1.12       1250    3     None none            None    none
trap8            trap   10.1.1.12       1250    3     MD5  md5md5          DES_CBC JEKTEST
trap9            trap   10.1.1.9        1250    3     MD5  md5md5          DES_CBC bob
trap10           trap   10.1.1.8        50      1     MD5  md5md5          DES_CBC bob
```

Authentication Traps

```
/protocol/snmp/set authentication-trap {enable|disable}
/protocol/snmp/show authentication-trap status
```

These commands enable or disable the ability to send authentication traps.

Engine Identifier

```
/protocol/snmp/show engineid
```

This command displays the current engine identifier.

SNMP Statistics

```
/protocol/snmp/show statistics
```

This command displays SNMP statistics.

Example 1

```
/protocol/snmp# show statistics

Packets In:  0
     Bad SNMP Version errors: 0
     Unknown community name:  0
     Set on read-only:        0
     Get request PDUs:        0
     Get Next PDUs:           0
     Set request PDUs:        0

Packets Out: 0
     Too big errors:          0
     No such name errors:     0
     Bad value errors:        0
     General errors:          0
     Trap PDUs:               7
     Drops:                   0

Informs:
     Requests generated:      0
     Responses received:      0
     Messages Dropped:        0
     Requests awaiting Ack:   0
```

```
USM:
     Decryption errors:       0
     Unknown user name:       0
     Unknown engine ID:       0
     Invalid security level:  0
```

Telnet

```
/mgmt/telnet {enable|disable}
/mgmt/show telnet status
```

The *telnet* command enables or disables Telnet access to the AP.

The *show* command displays the status of the Telnet interface.

Example 1

```
/#cd /mgmt/
/mgmt# telnet enable
```

Example 2

```
cd /mgmt/
/mgmt# show telnet status

Telnet: Enabled
```

HTTP

```
/ssl/set http {enable|disable}
/ssl/show http status
```

These commands enable or display the HTTP interface. The *show* command displays the current status.

Secure HTTP

```
/ssl/set secure-http {enable|disable}
/ssl/show secure-http status
```

These commands enable or display the secure HTTP interface. The *show* command displays the current status.

SSH

The following sections show you how to configure the Secure Shell (SSH) functions.

SSH Access

```
/ssh/show ssh status
```

This command displays the status of the SSH interface.

SSL

The following sections show you how to configure the Secure Socket Layer (SSL) functions.

Displaying Server Certificate

```
/show ssl server-cert
```

This command displays the server-certificate for SSL.

Configuring the Server Certificate

To configure the server certificate:

1 Create the RSA key pair. See "Creating RSA Key Pair" on page 49.

2 Create a certificate request. See "Creating Certificate Request" on page 49.

The certificate request is displayed on the screen.

3 Copy the certificate request to a file and send it to the Certificate Authority (CA) that will generate the certificate.

4 When the CA responds with the certificate, configure the AP SSL configuration to use it. See "Configuring the Server Certificate" on page 49.

5 Save the SSL configuration. See "Saving an SSL Configuration" on page 49.

Creating RSA Key Pair

```
/ssl/ssl gen key {rsa} <no. of bits>
```

This command creates a new RSA key pair. The input value of *no of bits* can be 512 or 1024.

Example

```
/#cd ssl
/ssl# ssl gen key rsa 1024
```

Creating Certificate Request

```
/ssl/ssl gen cert-req algo rsa sn <SubjectName>
```

This command creates a certificate request using the RSA key pair and *SubjectName*. The subject name is the identification of the switch or the switch's IP address.

Example

```
/#cd ssl
/ssl# ssl gen cert-req algo rsa sn 10.1.1.10
```

Configuring the Server Certificate

```
/ssl/ssl server-cert
```

This command imports a server certificate provided by a CA.

When you use this command, you are prompted to enter the certificate. To do so, open the certificate and copy its contents to the CLI.

Note: The application that you use to open the certificate may insert additional line breaks and spaces at the end of each line of the certificate. Make sure to remove these extra line breaks and spaces when you copy the certificate to the CLI.

Saving an SSL Configuration

```
/ssl/ssl save
```

This command saves the SSL configuration.

Example

```
/#cd ssl
/ssl# ssl save
```

TR-069

TR-069 describes the CPE WAN Management Protocol (CWMP) required for communications between a CPE device, such as a BelAir Networks AP, and an Auto-configuration Server (ACS).

This section describes how to configure the AP to communicate with an ACS.

Only the following BelAir Networks APs support TR-069: BelAir20, BelAir100i WCS, BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100.

Configuring ACS Communications

```
/protocol/tr069/set acs-configuration url <hostname>
                            user <username> password <password>
/protocol/tr069/set inform {enabled ([interval <seconds>])
                           [disabled}
/protocol/tr069/set cpe-configuration url <hostname>
                                      user <username>
                                      password <password>
                                      [port <1024-65535>]
/protocol/tr069/set dos-attack {requests <1-1000>
                                interval <1-900>}
/protocol/tr069/set state {enabled | disabled}
/protocol/tr069/show config
```

The *set acs-configuration* command specifies the ACS to communicate with:

- The *url* parameter specifies the host for the ACS. The default value is *http://211.110.60.3:8080/TMS/acs*.
- The *user* parameter specifies the user name to login to the ACS. The default value is *tmsadmin*.
- The *password* parameter specifies the password to login to the ACS. The default value is *tmsadmin123*.

The *set inform* command specifies how often the AP sends *inform* messages to the ACS. The *interval* parameter ranges from 60 to 900 seconds. By default, *inform* messages are sent every 300 seconds.

The *set cpe-configuration* command specifies the parameters by which the ACS can log into the CPE device, such as the BelAir Networks AP:

- The *url* parameter specifies the DNS or IP address to reach the CPE device.
- The *user* parameter specifies the user name to login to the CPE device. The default value is *admin*.
- The *password* parameter specifies the password to login to the CPE device. The default value is *password*.

- The optional *port* parameter allows you to use a particular port to communicate with the CPE device. The default value is 7788.

The *set state* command enables or disables ACS communications. By default, ACS communications are disabled.

The *show config* command displays the current TR-069 configuration.

Example

```
/protocol/tr069# show config

ACS Configuration
=================
URL      : http://172.16.1.166:8082
User     : tms
Password : tms
Inform   : Enabled
Interval : 300 secs

CPE Configuration
=================
URL      : http://10.1.1.10:7788
User     : admin
Password : password
DoS      : 10 requests in 10 secs
```

User and Session Administration

This chapter describes user administration functions with the following topics:

- "User Privilege Levels" on page 52
- "User Accounts" on page 55
- "Configuring Authentication for User Accounts" on page 56
- "CLI and Web Sessions" on page 58

User Privilege Levels

User accounts on an AP can be assigned the following three privilege levels:

- An *observer* user can execute only the following commands:
  —most *show* commands
  —the *help* and *?* commands
  —the *passwd* command
  —the *clear-screen* and *exit* commands
  —the *cd* and *mode* commands
  —the *history* command
  —the *whoami* command
  —the *ping* command
- A *normal* user can execute any CLI command, except those reserved for the super-user.
- The *super-user* can execute any CLI command. Table 5 on page 52 lists the CLI commands that are reserved for the super-user.

Each AP can have any number of observer users and normal users, but only one super-user account, called *root*.

Table 5: Super-user commands

Common Commands
`config-restore remoteip <ipaddress> remotefile <filename> [{tftp|ftp [user <usrname> password <pword>]}]] [force]`

Table 5: Super-user commands (Continued)

Mgmt Commands
`adduser <user-name> -p <passwd> [-d <mode>] [-g <group>]`
`deluser <user-name>`
`moduser <user-name> [ -p <passwd>] [ -d <mode>] [-g <group>]`
`show user`
`set telnet {enabled|disabled}`
`set authentication-login {local | radius <list>}`
`show authentication-login`
System Commands
`set country <country_name>`
`set global-session-timeout <period>`
`terminate session <session_index>`
`upgrade load remoteip <serverIPaddress> remotepath <serverSubDir> [{tftp|ftp [user <usrname> password <pword>]}]]`
`cancel upgrade`
`reboot [{force}]`
`commit load`
`set next-load {A|B|current|inactive}`
`syscmd restoreDefaultConfig`
/Card/<card_type>-n Commands
`reboot [{force}]`
/Protocol/IP Commands
`set interface {system | vlan <vlan_id>} static <ip addr> <mask> [delay-activation]`
`set interface {system | vlan <vlan_id>} dynamic fallback-ip <address> <mask> accept-dhcp-params {enabled|disabled} [delay-activation]`

Table 5: Super-user commands (Continued)

`renew ip {system | vlan <vlan_id>}`
SSL Mode Commands
`set http {enable|disable}`
`set secure-http {enable|disable}`
`show http status`
`show secure-http status`
`show server-cert`
`ssl gen cert-req algo rsa sn <SubjectName>`
`ssl gen key {rsa} <no. of bits>`
`ssl save`
`ssl server-cert`
Syslog Mode Commands
`logserver {enable [<ip address>] | disable}`
`monitor logging {enable | disable}`
`loglevel {debug|info|notice|warn|error|critical|alert|emerg}`
/Protocol/SNMP Mode Commands
`set snmp-agent {enabled | disabled}`

`set community <CommunityIndex>`
`community-name <name> ipaddr <ip_addr>`
`privilege {readonly|readwrite}`

`delete community <CommunityIndex>`
`set trap <index> mgr-addr <ip_addr>` `community <name> version {v1|v2|both}`
`delete trap <index>`

`set user <UserName> ipaddr <IP_addr>`
`access {readonly | readwrite}`
`[auth {md5 | sha} <password> [priv-DES <passwd>]]`

`delete user <UserName>`

Table 5: Super-user commands (Continued)

`set notify <NotifyName> type {Trap | Inform} ipaddr <IP_addr> [timeout <1-1500>] [retries <1-3>] [auth {md5 | sha} <password> [priv-DES <passwd>]]`
`delete notify <NotifyName>`
`set authentication-trap {enable | disable}`

User Accounts

```
/mgmt/adduser <user-name> -p <passwd> [-d <mode>]  [-g <group>]
/mgmt/deluser <user-name>
/mgmt/moduser <user-name> [-p <passwd>] [-d <mode>] [-g <group>]
/mgmt/show user
```

The *adduser* command creates a new user account.

The *deluser* command deletes a user account. The default login, “root”, cannot be deleted.

The *moduser* command modifies the parameters of a user account. For this command, the *group* parameter does not apply to changes to the *root* account.

The *show user* command lists all valid user accounts, the mode in which they start their session and their maximum privilege level. For example, under *Groups,* normal users display *NORMAL OBSERVER* while the *root* account displays *root NORMAL OBSERVER*.

The *mode* parameter sets the command mode that a user accesses when they log in. If unspecified, it defaults to a slash (/) so the user begins their session in root mode. Users with observer privileges must start their sessions in root mode.

The *group* parameter specifies the user account’s privilege level. It can be *OBSERVER* or *NORMAL*. If unspecified, the user account has observer privileges.

To use this command, you must be in *mgmt* mode.

Note 1: The specified password is case sensitive, must consist of alphanumeric characters, must be at least six characters long, and cannot exceed 20 characters. Changes the super-user account require that you provide the super-user password.

Note 2: The specified group is case sensitive.

If you use a RADIUS server to authenticate users as they login, you must specify the user’s privilege level in the RADIUS *Reply-Message* field. Specifically, the *Reply-Message* field must contain in plain text one of the following: *root*, *NORMAL* or *OBSERVER*. These entries in RADIUS are case sensitive, so make sure the user privilege levels are entered exactly as specified. If the privilege levels are unspecified in RADIUS, then the AP provides the user with *observer* privileges.

Example 1

```
/mgmt# adduser testuser -p userpwd - d system
```

Example 2

```
/mgmt# deluser xyz
```

Example 3

In the following example, the user *guest* begins their session in *interface* mode and their password is changed to “guest123”.

```
/mgmt# moduser guest –p guest123 –d interface
```

Example 4

```
/mgmt# show user
USER                          MODE                GROUPS

root                          /                   root NORMAL OBSERVER
user1                         /                   OBSERVER
user2                         /                   OBSERVER
user3                         interface           NORMAL OBSERVER
```

Configuring Authentication for User Accounts

You can use a RADIUS server to authenticate users as they login to their accounts. This applies to all user accounts including *root*.

Authentication Mode

```
/mgmt/set authentication-login {local|radius <list>}
/mgmt/show authentication-login
```

These commands determine how the AP authenticates users.

The *local* setting means that the AP uses the locally stored password and user account information to authenticate the user. This is the default setting.

The *radius* setting means that the AP uses a RADIUS server to authenticate the user. The *list* parameter specifies the index used in the RADIUS server list. Refer to “RADIUS Servers” on page 57.

Example 1

```
/mgmt# set authentication-login radius 1,2
```

Example 2

```
mgmt# show authentication-login

Authentication Login is radius

Radius Authentication server table
-------------------------------------
 Index                            : 1
 Radius Server Address            : 10.1.3.254
 UDP port number                  : 1812
 Radius Client Address            : 10.1.3.48
 Timeout                          : 3
--------------------------------------------
 Index                            : 2
 Radius Server Address            : 10.1.3.253
 UDP port number                  : 1812
 Radius Client Address            : 10.1.3.48
 Timeout                          : 3
--------------------------------------------
```

RADIUS Servers

```
/protocol/radius/set server <server-idx> <IP_addr>
                            <shared-secret>
                            [authport <server-port>]
                            [acctport <acct-port>]
                            [interface {system | vlan <vlan_id>}]
                            [timeout <seconds>]
                            [reauthtime <seconds>]
/protocol/radius/set server-state <server-idx> {enabled|disabled}
/protocol/radius/del server <server-idx>
/protocol/radius/show servers
```

These commands allow you to specify a list of RADIUS servers that you can use to authenticate users. The list can contain up to 10 servers.

The *IP_addr* parameter specifies the IP address of the RADIUS server.

The *shared-secret* parameter specifies the password for access to the RADIUS server.

The *authport* parameter ranges from 0 to 65535. It specifies the UDP port number of the RADIUS server (typically 1812).

The *acctport* parameter ranges from 0 to 65535. It specifies the UDP port number for RADIUS accounting data (typically 1813).

The *interface* parameter specifies the interface to associate the AP RADIUS client to. This can be the AP's system interface or any VLAN interface. The *vlan_id* parameter ranges from 1 to 3015 and from 3018 to 4045. The default value is *system*.

The *timeout* parameter ranges from 2 to 300. It specifies the interval (in seconds) after which the RADIUS client considers that the remote server has timed out if a reply is not received. The default value is 10 seconds.

The *reauthtime* parameter ranges from 0 to 50000000. It specifies the RADIUS re-authentication time (in seconds). This forces the AP to check all connected clients with the RADIUS server (that is, make sure they are still allowed to access the network) at the specified interval. You only need to configure this parameter if it is not specified on the RADIUS server. Setting the interval to zero disables this feature. The maximum interval time is 2147483647. If you enter a higher number, the value is set to its maximum.

Note: Make sure the user's privilege level are correctly specified in the RADIUS *Reply-Message* field. Refer to "User Accounts" on page 55.

Example 1

```
/protocol/radius# set server 3 172.16.1.20 my-secret12345 authport 1812 acctport 1813 interface
system timeout 15 reauthtime 1
```

Example 2

```
/protocol/radius# set server-state 3 enabled
```

CLI and Web Sessions

The AP allows you to manage CLI and Web session, such as listing and terminating sessions as well as configuring the idle timeout period.

Session Management

```
/system/show sessions
/system/terminate session <session_index>
```

The *show sessions* command lists all active CLI and Web interface sessions. The current session is flagged with an asterisk besides its session index number.

The *terminate session* command allows you to terminate any CLI or Web session.

Example

```
/system# show sessions
index  user      type     IP address       since      last-cmd   timeout   tssh       logging
-----  --------  -------  ---------------  ---------  ---------  --------- ---------  ---------
 1     root      telnet   10.9.9.14          0:27:57    0:01:43    0:30:00  inactive  active
 9     root      telnet   10.9.9.14          0:22:09    0:00:00    0:30:00  inactive  active
11[*]  root      web      10.9.9.14          0:13:51    0:13:51    1:00:00
```

In this example, the current session is session 11 with an idle period set at 1 hour.

Configuring the Session Timeout Interval

```
/system/set global-session-timeout <period>
/system/set session-timeout <period>
/system/show global-session-timeout
```

By default, a CLI session is automatically disconnected if it is idle for longer than 30 minutes. These commands allows you to change the idle period, preventing unwanted disconnections. The idle period is specified in minutes. Setting a period of 0 prevents any automatic disconnection.

The *set global-session-timeout* command changes the idle period of all CLI sessions. Its <period> parameter ranges from 1 to 1440; that is up to 24 hours. You cannot specify 0 as the global session idle period. You must be logged in as *root* to use this command.

The *set session-timeout* command changes the idle period of only the current CLI sessions. Its <period> parameter ranges from 0 to 1440; that is up to 24 hours. The session timeout period overrides the global timeout period.

The new idle period takes effect immediately and to all current and future sessions; until changed with these commands again.

The *show* command displays the settings for the global timeout period. To see the setting for the session, use the */system/show sessions* command.

Example

```
/system# set idle-timeout 60
```

CLI Prompt Customization

```
/system/set prompt selection [default|string|switch-name}
/system/set prompt string <20-char_string>
/system/show prompt
```

The *set prompt selection* command customizes the prompt for CLI sessions. The choices are as follows:

- *default*, where the CLI prompt includes the current command mode only
- *switch-name*, where the CLI prompt includes the current command mode and the first eight characters of the switch name described in "System Identification Parameters" on page 67
- *string*, where the CLI prompt includes the current command mode and the 20-character string as defined by the *set prompt string* command. The string can consist of any 20 ASCII characters, except for the semicolon (;).

The *show prompt* command displays the current prompt settings.

Examples

```
/system#set prompt string BelAir-128-50-46-189
/system#set prompt selection string
[BelAir-128-50-46-189]/system#system switch BA20E-A
[BelAir-128-50-46-189]/system#set prompt selection switch-name
[BA20E-A]/system#set prompt selection switch-name
[BA20E-A]/system#set prompt selection default
/system# show prompt

User-defined string: BelAir-128-50-46-189

prompt selection: default
```

IP Settings

This chapter contains procedures for managing AP IP parameters as follows:

- "Displaying IP Parameters" on page 61
- "Configuring IP Parameters" on page 62
  - —"Configuring Dynamic IP Addressing" on page 62
  - —"Renewing the IP Address" on page 63
  - —"Auto-IP" on page 63
  - —"Setting a Static IP Address and Subnet Mask" on page 64
  - —"Static IP Routes" on page 64
- "Configuring the Domain Name System Lookup Service" on page 65
- "Configuring IP Address Notification" on page 65

CAUTION! The AP uses internal IP addresses in the range of 192.168.1.x, 192.168.2.x and 192.168.3.x. As a result, do not configure the AP to use any IP addresses within these ranges.

Displaying IP Parameters

```
/protocol/ip/show config
```

The */protocol/ip/show config* command displays a detailed view of the system's IP configuration.

Example

```
/protocol/ip# show config
Interfaces:
                                    Address     Configured/     Configured/     Accept
           Current         Current          Alloc       Fallback        Fallback        DHCP
 Interface Address         Netmask          Type      D  Address         Netmask         Parameters

-------------------------------------------------------------------------------------------------
 System    10.9.9.20       255.255.255.0    Static      10.9.9.20       255.255.255.0   Disabled

AutoIP:    Enabled

Routes:
 Destination     Netmask         Gateway         Interface         Active
 --------------- --------------- --------------- ----------------- ------
  No static routes currently configured

DNS:
 Domain name lookup:                 disabled
 Configured domain name:
```

```
Configured primary DNS server:      0.0.0.0
Configured secondary DNS server:    0.0.0.0
```

Configuring IP Parameters

You can configure:

- dynamic IP addressing
- a static IP address and subnet mask, as well as static IP routes.

Configuring Dynamic IP Addressing

```
/protocol/ip/set interface {system | vlan <vlan_id>} dynamic
                  fallback-ip <address> <mask>
                  accept-dhcp-params {enabled|disabled}
                 [delay-activation]
/protocol/ip/del ip vlan <vlan_id>
```

The *set interface* command specifies that a Dynamic Host Configuration Protocol (DHCP) server provides IP addresses for the AP. This includes IP addresses for the AP's management interface as well as any VLANs it may have. If you specify a new VLAN, then that VLAN is created. The *del ip vlan* command deletes VLAN IP parameters previously created with the *set interface* command.

The *vlan_id* parameter ranges from 1 to 3015 and from 3018 to 4045.

If the IP address is dynamically set, BelAir Networks recommends that you also configure the *switch name*, *location* and *contact* parameters. These parameters then allow you to identify the AP if you later need to do a remote CLI session. Refer to "System Identification Parameters" on page 67.

In addition to providing the IP address, the DHCP server can be used to supply additional parameters including:

- a TFTP server and a script file name
- DNS server IP address and a domain name
- a SNTP server list and time offset

The *accept-dhcp-params* parameter controls whether the AP accepts additional parameters from the DHCP server or not. Refer to "DHCP Options" on page 78 for details.

The *delay-activation* parameter specifies that the new IP parameters do not take effect until after you execute a *config-save* command. BelAir Networks recommends that you always specify *delay-activation* if you change the system IP parameters. Otherwise you will need to start a new CLI session using the new IP address to execute the *config-save* command to save your changes.

Note 1: DHCP servers usually have the ability to assign a default route to DHCP clients. Make sure that the DHCP server assigns only one default route, even you are using many different IP interfaces on the same AP (for example, a management IP interface and a VLAN IP interface).

Note 2: You must configure the DHCP server lease time to be one minute or longer.

Note 3: If the network contains APs with static IP addressing and APs with dynamic IP addressing, make sure the DHCP server does not issue addresses that been previously issued statically.

Example

```
/protocol/ip# set interface system dynamic fallback-ip 92.121.68.34
255.255.255.255 accept-dhcp-params disabled delay-activation
```

The previous command changes the system interface to:

- accept a dynamic IP address, and no other parameters, from a DHCP server
- if the DHCP server cannot be reached, use an IP address of 92.121.68.34 and an IP mask of 255.255.255.255

The changes do not take effect until you use the *config-save* command to save your changes.

Renewing the IP Address

```
/protocol/ip/renew ip {system | vlan <vlan_id>}
```

This command is used when the AP is configured to dynamically receive IP addresses. See "Configuring Dynamic IP Addressing" on page 62.

Issuing this command causes the DHCP server to renew the IP address of the AP's management interface or of the VLAN. The *vlan_id* parameter ranges from 1 to 3015 and from 3018 to 4045.

CAUTION! Using this command may cause the DHCP server to change the IP address of the AP's management interface. If this happens you may need to reconnect to the AP using the new IP address.

Auto-IP

```
/protocol/ip/set auto-IP {enabled | disabled}
```

This command lets you configure the auto-IP feature which complements the fallback IP when you configure dynamic IP addressing. Auto-IP is useful when multiple APs have been configured with the same fallback IP.

The auto-IP feature automatically configures the AP to have a specific default IP address based on the AP's MAC address if it cannot get an IP address from the DHCP server or when it is in factory default mode.

When auto-IP is enabled, the default IP address is *169.254.1.x* with a mask of *255.255.0.0*; where *x* is the last byte of the AP's MAC address. When you can connect a laptop directly to the AP, the laptop also auto-configures itself with an IP address 169.254.x.x and a mask of 255.255.0.0 if it is in DHCP mode. You can then use the laptop to start a CLI session into the AP with its 169.254.1.x address.

The default setting is *enabled*.

Setting a Static IP Address and Subnet Mask

```
/protocol/ip/set interface {system | vlan <vlan_id>}
                                      static <ip addr> <mask>
                                     [delay-activation]
/protocol/ip/del ip vlan <vlan_id>
```

The *set interface* command specifies that the AP uses static IP addressing for the AP's management interface as well as any VLANs it may have. If you specify a new VLAN, then that VLAN is created. The *vlan_id* parameter ranges from 1 to 3015 and from 3018 to 4045. The *del ip vlan* command deletes VLAN IP parameters previously created with the *set interface* command.

The *delay-activation* parameter specifies that the new IP parameters do not take effect until after you execute do a *config-save* command. BelAir Networks recommends that you always specify *delay-activation* if you change the system IP parameters. Otherwise you will need to start a new CLI session using the new IP address to execute the *config-save* command to save your changes.

Example

```
/protocol/ip# set interface system static 92.121.68.34 255.255.255.255
delay-activation
```

The previous command changes the system interface to have a static IP address of 92.121.68.34 and an IP mask of 255.255.255.255. The changes do not take effect until you use the *config-save* command to save your changes.

Static IP Routes

```
/protocol/ip/add route <dest ip addr> <dest mask> gw <gateway>
/protocol/ip/del route <dest ip addr> <dest mask> gw <gateway>
```

The *ip route add* command adds extra static IP routes. If your APs needs to communicate with an IP interface from another sub-network, you must add the appropriate routes to the remote IP interface. Contact your administrator to obtain the IP address and mask of the remote IP interface.

The *ip route del* command deletes a static route.

Use the *gateway* parameter to specify the IP address of the network gateway.

Configuring the Domain Name System Lookup Service

```
/protocol/ip/set dns server {primary | secondary} <ip_address>
/protocol/ip/del dns server {primary | secondary}
/protocol/ip/set dns domain name <customer.com>
/protocol/ip/del dns domain name
```

The AP provides a Domain Name System (DNS) lookup service by providing a DNS client that resolves computer names to IP addresses. If the local DNS server fails, a query to the public network is made.

The *set dns server* command specifies the IP address of a primary and secondary DNS server. The *del dns server* command erases the current IP address.

The *set dns domain name* command specifies the default domain name required to perform Fully Qualified Domain Name requests. The *del dns domain name* command erases the current domain name.

The IP addresses of the DNS servers and the default domain name can also be specified automatically through DHCP. See "DHCP Options" on page 78.

Configuring IP Address Notification

```
/protocol/ip/set ip-addr-notification {enabled | disabled}
```

When this setting is *enabled*, the AP sends out its IP addresses as traps to the configured trap destinations every 60 minutes. The notification interval is not currently configurable. By default, this setting is *disabled*.

System Settings

This chapter contains procedures for managing AP parameters as follows:

Country of Operation

```
/system/show country [detail]
/system/set country <country_code>
```

Note: These commands apply only to BelAir Networks APs purchased outside of the United States of America and its territories. For APs purchased in the United States of America and its territories, the AP's country code is *US* and cannot be changed.

These commands allow you to adjust the radios in your AP to conform to the regulatory requirements for your country. This includes valid radio channel ranges as well as transmit power levels and the use of Dynamic Frequency Selection (DFS), a regulatory requirement in some jurisdictions.

The *show country* command displays the current country of operation. Specifying the *detail* parameter also displays both the name and the ISO 3066 identity code for all supported countries.

The *set country* sets the country of operation for your AP. The <country_code> parameter is the ISO 3066 identifier for the country as listed by the *show country detail*. The default value is *US*.

CAUTION! Improper setting of an AP's country setting may exceed regulatory requirements and void the operator's right to operate the radio equipment.

Contact BelAir Networks for details regarding country specific approvals. Additional country settings are also available by contacting BelAir Networks.

System Identification Parameters

```
/system/set system-id ([switch <name>] [contact <firm>]
                             [location <place>])
/system/show system-id
```

These commands let you manage system identification parameters such as switch name, switch contact information and physical switch location. The <name> parameter is limited to 32 characters.

Example

The following example sets the switch name to *BA20E* the contact information to *BelAirNetworks* and its location to *PoleNumber1*.

```
/system# system-id switch BA20E contact BelAirNetworks location
PoleNumber1
```

Custom Fields

```
/system/set custom ([field1 <random_str>][field2 <random_str>]
                    [field3 <random_str>][field4 <random_str>]
                   [field5 <random_str>])
/system/show custom fields
```

These commands let you manage the contents of up to five data fields that you can use to store any information of your choosing. Each field can store up to 50 characters except for custom field 1 which is limited to 32 characters. Custom field data is saved with the AP's configuration data.

Example

```
/system# show custom fields
Custom Field 1:    Mesh main node
```

```
Custom Field 2:    Used for experiments
Custom Field 3:    Zone 3 master
Custom Field 4:    Services customer xyz
Custom Field 5:    First in service
```

Configuring the System Date and Time

The system date and time can be configured:

- manually
- using a Simple Network Time Protocol (SNTP) server

In both cases, you can use an offset to convert the displayed Coordinated Universal Time (UTC) to local time.

The IP addresses of the SNTP servers and the time offset can also be specified automatically through DHCP. See "DHCP Options" on page 78.

Manual Date and Time Configuration

```
/system/set date <YYYY-MM-DD> [time <hh:mm:ss>]
/system/set time <hh:mm:ss>
/system/set time offset <hour_offset:minute_offset>
/system/show date
/system/show timeoffset
```

The *set date* and *set time* commands set the current date and time. The value must be formatted as follows:

- YYYY is the year
- MM is the month
- DD is the date
- hh specifies the hour
- mm specifies the minutes
- ss specifies the seconds

You must enter the exact date and time format as specified; that is, four digits for the year and two digits for the month, day, hour, minutes and seconds.

The *set time offset* command configures an offset that is used to convert the displayed UTC time to local time. The *hour_offset* portion of the parameter ranges from -12 to +13. The *minute_offset* portion of the parameter ranges from 0 to 59.

Example 1

```
/system# set date 2004-02-10 time 06:50:00
```

Example 2

```
/system# set time 08:45:00
```

Example 3

```
/system# set time offset -4 30
```

Example 4

```
/system# show date
Current date: 2011-08-11 23:04:46 (UTC)

Current date: 2011-08-11 17:04:46
```

Managing an SNTP Server

```
/protocol/sntp/set ip-address {primary|secondary}
                            {<host> | disabled}
/protocol/sntp/set timeoffset <hour_offset:minute_offset>
/protocol/sntp/set status {enabled | disabled}
/protocol/sntp/show {config | status}
```

The AP supports the Simple Network Time Protocol (SNTP) by providing an SNTP client that can synchronize the AP date and time with any SNTP compatible external time server.

The *set ip-address* command lets you identify a primary and secondary SNTP server by specifying its host name or IP address, or disable this functionality. If the SNTP client cannot synchronize the AP date and time with the primary SNTP server, it attempts to synchronize with the secondary AP.

The *set timeoffset* command configures an offset that is used to convert the displayed UTC time to local time. The *hour_offset* portion of the parameter ranges from -12 to +13. The *minute_offset* portion of the parameter ranges from 0 to 59.

The *set status {enable/disable}* command enables or disables the SNTP client. To use this service, you must configure the IP address of at least one SNTP server either manually or through DHCP. When the SNTP client is enabled, the AP's clock is reset to use UTC.

The *show status* and the *show config* commands display whether the SNTP process is running or not and the effective (actual) information used by the SNTP client as well as the information stored by the AP. Differences may be caused by the setting of the *accept-dhcp-params* parameter. See "DHCP Options" on page 78.

Example 1

```
/protocol/sntp# set ip-address primary 10.1.1.2
```

Example 2

```
/protocol/sntp# set timeoffset -4 30
```

Example 3

```
/protocol/sntp# show status
SNTP process is running

Effective SNTP Timeoffset:
===========================
SNTP Timeoffset origin: SNTP schema

SNTP Time Offset: 6:00

Effective SNTP server:
======================
SNTP Servers origin: SNTP schema
Active Server: Primary - 0.pool.ntp.org
SNTP server Primary      : 0.pool.ntp.org
SNTP server Secondary    : 1.pool.ntp.org
DHCP timeserver Primary  : 0.0.0.0
DHCP timeserver Secondary: 0.0.0.0
```

GPS Coordinates

For the BelAir20, BelAir100i, BelAir20E, BelAir20EO, BelAir100N, BelAirSN and the BelAir2100:

```
/system/set coordinates [latitude <-90,+90> ] [longitude <-180,+180>]
/system/show coordinates
```

For the BelAir100SNE:

```
/system/set coordinates {auto|{manual {copygps|[[latitude <-90,+90>]
                                        [longitude <-180,+180>]]}}}
/system/set gps admin-state [enable|disable]
/system/show gps status
/system/show coordinates
```

These commands allow you to specify the exact geographic location of an AP. You can then use the Global Positioning System (GPS) coordinates to locate an AP in the field.

The BelAir100SNE has additional GPS commands as follows:

- The *set coordinates auto* command lets you use the AP's built-in antenna and GPS satellites to automatically determine the AP's location. To use this functionality, you must first enable the GPS admin state.
- The *set gps admin-state* command allows you to control the use of the automatic GPS coordinate detection system. To disable the admin state, the

coordinate detection system must be in *manual* mode. By default, the admin state is enabled.

- The *set coordinates manual* command lets you manually enter the AP's latitude and longitude coordinates. Once entered, these values are stored locally. Alternatively, you can use the *set coordinates manual copygps* command to locally store the coordinates determined by the AP's automatic GPS system.
- The *show gps status* command displays the admin state, the coordinate mode, the GPS running status and the number of detected satellites. The GPS running status can be one of the following:

  —*idle*, the AP's GPS admin state is disabled

  —*init*, the AP's GPS admin state is enabled and its automatic coordinate detection system is initializing

  —*syncing*, the AP is searching for GPS satellites

  —*synced*, the AP has found GPS satellites and can determine GPS coordinates

The *show coordinates* command displays the AP's coordinates. For the BelAir100SNE, the show coordinates command also shows the coordinate mode. When in *auto* mode, these are determined automatically by GPS satellites. When in *manual* mode, these are the values stored locally on the AP.

Example - BelAir20E

```
/system# set coordinates latitude 76 longitude -120
/system# show coordinates
latitude: ...............   76.000000
longitude: ..............   -120.000000
```

Example - BelAir100SNE

```
/system# show coordinates
coordinate mode: ........   manual
latitude: ...............   76.000000
longitude: ..............   -120.000000

/system# set coordinates auto

/system# show coordinates
coordinate mode: ........   auto
latitude: ...............   37.819412
longitude: ..............   -122.478439

/system# show gps status

GPS status:
```

```
admin state: ................   Enabled
coordinate mode: ............   auto
running status: .............   synced
available satellites: .......   8
```

LED Control

You can use the following commands to control the LED behavior of the AP:

- "Find Me Function" on page 72
- "LED Enable or Disable" on page 72

Find Me Function

```
/system/find-me {start|stop}
```

This command helps you determine the physical location of an AP.

When you start the *find me* function, the AP's power LED starts a green and red flashing cycle.

LED Enable or Disable

```
/system/show visual-indicators-status
/system/set visual-indicators {off | enable}
```

This command applies to the BelAir20, BelAir100i WCS, BelAir20E and the BelAir20EO only. It lets you turn enable or disable the LEDs of an AP.

Setting the Network Egress Point

```
/system/show system-egress-point
/system/set system-egress-point {yes {direct|indirect gateway-ip <ip_addr>}|no}
```

In a BelAir Networks network, an AP can act as an egress point to an outside network, usually the Internet, for the backhaul traffic of many other APs. The other APs may be connected to the egress AP through point-to-point, point-to-multipoint or multipoint-to-multipoint links.

This command lets you specify whether or not the current AP has such an egress point, and the type of connection.

- Use *direct* when the AP is connected directly to the outside network through its Ethernet port or a DSL modem.
- Use *indirect* when the AP is connected to the outside network through a Wi-Fi link, WiMAX link, or third-party device. In such cases, you must supply the IP address of the device that is connected to the outside network.

The default setting is *yes direct*.

Enabling Wi-Fi Band Steering

```
/system/show wifi-band-steering
/system/set wifi-band-steering {enabled | disabled}
```

Wi-Fi band steering applies to dual-band (2.4 GHz and 5 GHz) wireless clients. If enabled, the AP attempts to direct any dual-band Wi-Fi clients it detects to use the 5 GHz radio.

Note: Band steering may not always be successful depending on operational conditions. In such cases, the dual-band client decides whether to use the 5 GHz radio or the 2.4 GHz radio.

To configure the AP for dual-band wireless clients, you must configure two identical SSIDs: one for the 2.4 GHz and one for the 5 GHz radio. All settings must be the same. Refer to "Configuring SSIDs" on page 134.

The default setting is *enabled*.

Limiting Broadcast Packets

```
/system/show broadcast-filter config
/system/set broadcast-filter rate <brcst_filter_rate>
/system/set broadcast-filter status {enable|disable}
```

In a BelAir Networks network, each AP limits the rate at which broadcast packets are sent. The *show broadcast-filter* command displays the current broadcast rate.

Note: If you reset the AP to its factory defaults, the *show broadcast-filter* command may display a status of *Enabled* and a rate of 0. In such cases, the feature is actually disabled.

The *set broadcast-filter rate* command lets you set the maximum rate at which broadcast packets are sent in packets/second. The <brcst_filter_rate> parameter ranges from 100 to 1000. The default setting is 200.

Use the *set broadcast-filter status* command to disable broadcast packet filtering.

See also:

- "Filtering Broadcast and Multicast Packets" on page 141
- "Broadcast to Unicast Packet Conversion" on page 142

Example

```
/system# show broadcast-filter config

 Broadcast Filter Configuration
--------------------------------------------
```

```
Broadcast Filter Status        :Enabled
Broadcast Filter Rate          :200
```

Limiting DHCP Packets from Clients

```
/system/show dhcp-filter config
/system/set dhcp-filter rate <dhcp_filter_rate>
```

If you detect clients that send abnormally high rates of DHCP packets, then use this command to limit the number that are sent to the DHCP server.

The *set dhcp-filter rate* command lets you set the maximum rate (in packets/ second) at which DHCP packets are sent to the server. The <dhcp_filter_rate> parameter ranges from 0 to 100. A value of 0 means that all DHCP packets are sent to the server. For any other value, the AP limits DHCP packets for any given client to that rate. The default setting is 0.

Displaying AP Inventory Information

```
/system/show phyinv
```

This command displays the manufacturing parameters (name, serial number and part version numbers) of the equipment parts contained in an AP.

Example - BelAir20E

```
/system# show phyinv
System Name:    BA20E-11

Type        Class       Serial number          Assembly code                BA order code
BelAir20    indoor      K000000001             BA20E

Physical Inventory Table
Slot  Card type        Version  Serial number    Assembly code
   1  HTME             1.1.1    K000000001       B2XH131AA-A A01

Physical Interface Table
Name        Type                       Slot  Card type    Description
wifi-1-1    Wifi 802.11                   1  HTME         HTMEv1 5GHz 802.11n
wifi-1-2    Wifi 802.11                   1  HTME         HTMEv1 2.4GHz 802.11n
eth-1-1     Ethernet                      1  HTME         1000BASE-T
lan-1       Ethernet                      1  HTME         1000BASE-T
lan-2       Ethernet                      1  HTME         1000BASE-T
lan-3       Ethernet                      1  HTME         1000BASE-T
lan-4       Ethernet                      1  HTME         1000BASE-T
```

Example - BelAir100SNE

```
/system# show phyinv
System Name:    BelAir100SNE

Type        Class       Serial number          Assembly code              BA order code
BelAir100   strand      K002188591             BelAir100SNE               1SNLD8AB11

Physical Inventory Table
```

```
Slot   Card type        Version  Serial number     Assembly code
   1   DRUE             1.1.1    K002188591        B2XH105AA-A A01
   9   CM               3.0.0                      BRG35503Bel

Physical Interface Table
Name         Type                     Slot  Card type    Description
wifi-1-1     Wifi 802.11                 1  DRUE         DRUEv1 2.4GHz 802.11n
wifi-1-2     Wifi 802.11                 1  DRUE         DRUEv1 5GHz 802.11n
eth-1-1      Ethernet                    1  DRUE         1x1000baseTx  [Electrical: Single]
cm-9-1       DOCSIS cable-modem          9  CM           Cable Modem
```

Defining a Maintenance Window

```
/system/set maintenance-window {{enabled {hh:mm hh:mm} | disabled }}
/system/show maintenance-window
```

Use these commands to define and enable a maintenance window where generated alarms do not count against the alarm threshold. For details, see "Setting the Tunnel Down Alarm Threshold" on page 223. For the BelAir100SN and the BelAir100SNE, see also "Setting the Cable Modem Interface Down Alarm Threshold" on page 98.

By default, the maintenance window is enabled and runs from midnight (00:00) to 7 am (07:00).

Specified window start and end times are rounded down to the nearest 15-minute increment.

Example

```
/system# set maintenance-window enabled 00:14 03:20
```

The previous command sets the maintenance window to run from midnight (00:00) to 3:15 am.

Temperature Display

```
/system/show environment
```

The *show environment* command applies to the BelAir100N, BelAir100SN, BelAir100SNE, and the BelAir2100. It displays the AP's the internal temperature (in degrees Celsius).

Example

```
/system# show environment
  Temperature
       Ambient: 36.5 Celsius
  Power supply
        Source: Unable to determine main power status
  Battery
         State: BelAir100SN does not support battery monitor.
```

Displaying System Up Time

```
/system/show sysuptime
```

This command displays the time the system has been operating.

Example

```
/system# show sysuptime
System Up Time: 234 days, 16:45:32.34
```

Displaying the Running Configuration

```
/system/show running-configuration
```

This command displays the configuration that the AP is currently operating with. It executes a series of *show* commands with results displayed on the CLI screen. Use the scroll bar of the Telnet or SSH window to see any particular section of the output.

Restarting the AP

```
/system/reboot [{force}]
/system/show restart-reason
```

The *reboot* command restarts the entire AP. You must confirm your intent before the AP is rebooted.

Under some circumstances, a reboot may be prevented because of processing from other user sessions. Use the *force* parameter to override these restrictions and restart the AP regardless.

The *show restart-reason* command displays the reason for the last restart.

See also "Restarting a Card" on page 88.

Example

```
/system# show restart-reason

 Previous reboot was a cold restart initiated by user.
```

Creating and Using Script Files

You can use script files to:

- make repetitive tasks quicker and easier to do
- automate the configuration of an AP when it starts up. See "AP Auto-configuration" on page 78.

To help create your scripts, follow the guidelines in "Scripting Guidelines" on page 309.

Enabling or Disabling Session Logging

```
/system/set session-logging {enable | disable}
```

When session logging is enabled, all commands entered during a CLI session are recorded in a command log file. However, if you run repetitive scripts, you may want to disable logging to avoid filling the file with the same sets of commands.

This command allows you to enable or disable session logging. The default setting is *enable*. Use the */system/show sessions* command to see the current setting.

Use the */syslog/export logs* command to access the command log file. For a detailed description, refer to "Using Syslog" on page 258.

Local and Remote Configuration

```
/system/show local-configuration-overwrite
/system/set local-configuration-overwrite {active | inactive}
```

The AP can be configured remotely with BelView NMS or with a BelAir8000 Controller.

This command allows you to control whether configuration commands issued locally with the CLI or Web interface can overwrite configuration settings issued remotely:

- When *active*, local configurations from the CLI or Web can overwrite settings issued remotely.
- When *inactive*, local configurations from the CLI or Web cannot overwrite settings issued remotely.

The default setting is *inactive*.

AP Auto-configuration

With auto-configuration, the AP can automatically obtain a script file after it powers up. The AP then configures itself based on the content of the file. Auto-configuration minimizes the amount of manual intervention required to pre-configure the AP before you install it. To create a valid script file, refer to the guidelines listed in “Creating and Using Script Files” on page 76.

The following sections describe the different ways you can automatically supply a script file to the AP:

- “DHCP Options” on page 78
- “DNS” on page 81
- “Configuration Download Profile” on page 82

All methods are independent, but can be used in conjunction with each other. For example, you can use DHCP options to download a script file that configures the configuration download profile. You then use the configuration download profile to download a second script file for the rest of the AP.

DHCP Options

With this method, the AP uses the exchange of DHCP packets with a DHCP server as a means of exchanging information during startup. The AP uses DHCP Options 12, 60, 55 and 43 to retrieve extra information during startup and to supply the DHCP server with information about itself.

The AP provides the system identifier host name through DHCP Option 12 and the vendor class identifier *BelAir Networks* through DHCP Option 60.

Through DHCP Option 55, the DHCP server provides the AP with the following parameters in addition to basic IP parameters (address, subnet mask and default route) described in “Configuring Dynamic IP Addressing” on page 62:

- TFTP server IP address and script file name. These parameters cause a TFTP session to be created and the script file to be downloaded and executed during startup.
- DNS domain name. Only one domain name is valid at any one time per AP and not per interface. See “Configuring the Domain Name System Lookup Service” on page 65.

- DNS server IP addresses. Up to two DNS servers are supported. See "Configuring the Domain Name System Lookup Service" on page 65.
- IP address for a time server. Two time servers are supported for use by the SNTP service. See "Managing an SNTP Server" on page 69.
- time offset value used by the SNTP service. See "Managing an SNTP Server" on page 69.

Through DHCP Option 43, the AP provides the DHCP server with the following parameters about the itself:

- assembly code, as shown with the */system/show phyinv* command
- serial number, as shown with the */system/show phyinv* command
- MAC address
- version of the active software load, as shown with the */system/show loads* command
- GPS coordinates, as shown with the */system/show coordinates* command
- switch name, as shown with the */system/show system-id* command
- custom field 1, as shown with the */system/show custom fields* command

You can use the information from DHCP Option 55 to configure the AP management interface or one of its VLAN interfaces.

After the AP receives these parameters, it configures the interface in question. At startup, it downloads the script file from the TFTP server and executes it.

DHCP options can only be enabled for one interface. For example, if you enable DHCP options for the management interface, you are prevented from enabling them for a VLAN interface until you first disable them for the management interface.

By default, the AP accepts all parameters provided by the DHCP server. However, you can configure the AP to accept or reject any individual parameter. By accepting only specific parameters, you can control how much of the AP is auto-configured. For example, if you do not want to use a script file from the TFTP server, you can set the *accept-tftp-download* parameter to *disabled*. See "Accepting Specific DHCP Parameters" on page 80.

Data provided by the DHCP server overrides any data configured locally. During operation, if the DHCP server provides updated data, the AP continues operation with the updated data.

Pre-requisites

To use DHCP options, your DCHP server must be configured to supply the information requested by the AP. In particular, make sure of the following:

- Your DHCP server supplies a list of SNTP servers instead of NTP servers and that they are listed in order of preference.
- Your DHCP server assigns only one default route, even you are using many different IP interfaces on the same AP (for example, a management IP interface and a VLAN IP interface).

Configuring and Using DHCP Options

To use DHCP options, you must:

1 Set the default IP address assignment of an interface to *dynamic* and set the *accept-dhcp-params* parameter to *enabled*. See “Configuring Dynamic IP Addressing” on page 62.

2 Specify which specific parameters to accept from DHCP server. See “Accepting Specific DHCP Parameters” on page 80.

The AP then contacts the DHCP server to request the parameters.

Accepting Specific DHCP Parameters

```
/protocol/ip/set dhcp-accept ([dns-domain {enabled|disabled}]
                              [dns-server {enabled|disabled}]
                              [tftp-download {enabled|disabled}]
                              [time-server {enabled|disabled}]
                              [time-offset {enabled|disabled}])
```

These commands control whether the individual parameters supplied by the DHCP server are accepted or not by the AP. To use this command you must first set the default IP address assignment for the interface to *dynamic* and set the *accept-dhcp-params* parameter to *enabled*. See “Configuring Dynamic IP Addressing” on page 62.

By default, the AP accepts all parameters from the DHCP server; that is, each of these parameters is set to *enabled*.

The *dns-domain* parameter controls the domain name option used to perform DNS requests. Only one domain name is valid at any one time per AP. See “Configuring the Domain Name System Lookup Service” on page 65.

The *dns-server* parameter controls DNS server IP addresses. Up to two DNS servers are supported. See “Configuring the Domain Name System Lookup Service” on page 65.

The *tftp-download* parameter controls two DHCP options: TFTP server IP address and script file. Enabling this option causes a TFTP session to be created and the script file to be downloaded and executed during startup.

The *time-server* parameter controls the IP address for a time server. Two time servers are supported. This information is used by the SNTP service. See "Managing an SNTP Server" on page 69.

The *time-offset* parameter controls the time offset value that is used by the SNTP service. See "Managing an SNTP Server" on page 69.

The TFTP server IP address and the script file are downloaded and executed only during a startup. If the script on the server changes, it is not sent to the AP until the next time the AP reboots or starts up.

If DNS and SNTP data on the DHCP server changes, then it is sent to the AP whenever the AP renews DHCP information. The new DNS and SNTP data then takes effect immediately.

In all cases, DNS and SNTP data provided by the DHCP server overrides any data configured locally.

DNS

With this method, the AP uses DNS to connect to an FTP server containing a script file to be executed during startup.

When the AP starts up with factory default settings, it looks for a DHCP server to assign its IP address.

If the DHCP server provides a TFTP server IP address and script file name, then the AP performs auto-configuration based on these values. See "DHCP Options" on page 78.

If DHCP server does not provide a TFTP server IP address and script file name, then the AP obtains the script file based on DNS information from the DHCP server as follows:

1 The AP uses DHCP to obtain the DNS server IP address and domain name from the DHCP server.

2 The AP attempts to open a session to an FTP host called *bnconfigserv* using local DNS settings. The host name *bnconfigserv* is hard-coded in the AP and cannot be changed. If unsuccessful, it opens an FTP session to *bnconfigserv.<domain_name>* (for example, *bnconfigserv.belairnetworks.com*). In either case:

—The FTP username used by the AP is *bn_%02x_%02x_%02x_%02x_%02x_%02x*. For example, if the MAC address of the AP is *00:0d:67:0c:21:76*, then the username on the FTP server is *bn_00_0d_67_0c_21_76*. The username must be in lower case and must exist in the FTP server.

—The FTP password used is the md5sum of the username. To obtain this, do *echo <username> | md5sum*. Omit the spaces and dash at the end of the md5sum output.

3 In the FTP home directory for the user, the AP looks for a script file named *bn_config.cfg*.

Configuration Download Profile

With the configuration download profile you specify:

- the filename of the script file
- the server from which to get the script file
- a user-name and password

You can specify the server by either its IP address or its name. If both are specified, the IP address has precedence. The default name is *belairconfig.com*.

The script file is downloaded and executed only during a startup. If the script on the server changes, it is not sent to the AP until the next time the AP reboots or starts up.

Pre-requisites

To use a configuration download profile, your server must be configured with the appropriate user accounts and passwords. The account must contain a valid script file.

Also, if you identify the server with a name, you need a DNS server to resolve names to IP addresses.

Using a Configuration Download Profile

```
/system/set config-download [server <name_or_ip_addr>]
                    [auto-conf-protocol {ftps|ftp|tftp]
                    [filename <filename>]
                    [user <user_name>]
                    [password <pword>]
                     {enabled|disabled}
/system/show config-download status
```

These commands provision the configuration download profile.

The server may be identified by supplying either its IP address or providing its name. The default server name is *belairconfig.com*. The default protocol is FTPS. The default user name and password is *anonymous*. The default filename is *auto-config.txt*. By default, the configuration download file is disabled.

Example

```
/system#show config-download status

config-download adminStatus: enabled
config-download server:        0.0.0.0
config-download servername:    belairconfig.com
config-download user-name:     auto-config.txt
config-download password:      anonymous
config-download filename:      auto-config.txt
config-download protocol:      ftp
```

Card Settings

This chapter contains the following topics that describe card operations:

This chapter applies to all cards except the cable modem. For cable modem operations, see "Cable Modem Configuration" on page 96.

Table 6 lists the location of documentation for physical interface parameters.

Table 6: Physical Interface Parameter Settings

Physical Interface Type	Refer to...
Wi-Fi	• "Wi-Fi Radio Configuration Overview" on page 101 • "Configuring Wi-Fi Radio Parameters" on page 103 • "Configuring Wi-Fi Access Point Parameters" on page 123 • "Wi-Fi AP Security" on page 146 • "Wi-Fi Backhaul Link Configuration" on page 161 • "Mobile Backhaul Mesh" on page 169 • "Mobile Backhaul Point-to-point Links" on page 173
Ethernet (1000Base-TX)	• "Ethernet or LAN Interface Settings" on page 91

Table 6: Physical Interface Parameter Settings

Physical Interface Type	Refer to...
Pico-cellular base station	• "BTS Card Commands" on page 89 • *BelAir2100 Cellular Reference Guide*

Determining which Cards are in an AP

```
/mode
/card/mode
```

Use the *mode* command to determine <card_type> and <n>.

Example 1 - BelAir20E

```
/# mode
        /card
                /htme-1
        /interface
                /wifi-1-1       (HTMEv1 5GHz 802.11n)
                /wifi-1-2       (HTMEv1 2.4GHz 802.11n)
                /eth-1-1        (1000BASE-T)
                /lan-1          (1000BASE-T)
                /lan-2          (1000BASE-T)
                /lan-3          (1000BASE-T)
                /lan-4          (1000BASE-T)
        /mgmt
        /protocol
                /ip
                /radius
                /rstp
                /snmp
                /sntp
                /te-syst        (tunnel)
        /qos
        /services
                /auto-conn
                /mobility
        /ssh
        /ssl
        /syslog
        /system
        /diagnostics
```

Example 2 - BelAir100SNE

```
/# mode
        /card
                /drue-1
                /cm-9
        /interface
                /wifi-1-1    (DRUEv1 2.4GHz 802.11n)
```

```
                /wifi-2-1    (DRUEv1 5GHz 802.11n)
               /eth-1-1     (1x1000baseTx  [Electrical: Single])
        /mgmt
        /protocol
                /ip
                /radius
                /rstp
                /snmp
                /sntp
                /te-syst        (tunnel)
        /qos
        /services
                /auto-conn
                /mobility
        /ssh
        /ssl
        /syslog
        /system
        /diagnostics
```

Example 3 - BelAir20E

```
/card# mode
        /htme-1
```

Example 4 - BelAir100SNE

```
/card# mode
        /drue-1
```

Displaying Card Information

The following sections describe commands that display card parameters.

Displaying the Card Physical Data

```
/card/<card_type>-<n>/show info
```

This command applies to all cards types except *bts*. This command displays various physical aspects of the card.

Example 1 - BelAir20E

```
/card/htme-1# show info

Slot Type Version Serial Number   Assembly Code
==== ==== ======= =============== ===============
1    htme 1       844000010       B2CH103AA-A A01
```

Example 2 - BelAir100SNE

```
/card/drue-1# show info

Slot Type Version Serial Number   Assembly Code
==== ==== ======= =============== ===============
1    drue 1       K002188591      B2XH105AA-A A01
```

Displaying the Card Physical Interfaces

```
/card/<card_type>-<n>/show interfaces
```

This command applies to all cards types except *bts*. This command displays the physical interfaces that the card provides.

Example 1 - BelAir20E

```
/card/htme-1# show interfaces
htme: has the following interfaces:
        wifi-1-1
        wifi-1-2
        eth-1-1
        lan-1
        lan-2
        lan-3
        lan-4
```

Example 2 - BelAir100SNE

```
/card/drue-1# show interfaces
dru: has the following interfaces:
        wifi-1-1
        wifi-1-2
        eth-1-1
```

Displaying the Card CPU and Memory Usage

```
/card/<card_type>-<n>/show cpuocc
/card/<card_type>-<n>/show meminfo
```

These commands apply to all cards types except *bts*. The *show cpuocc* command displays the card's CPU idle rate. The sh*ow meminfo* displays card memory usage data.

Examples - BelAir20E

```
/card/htme-1# show cpuocc

CPU-idle:  97.0
```

In the previous example, the card CPU is 97% idle and 3% occupied

```
/card/htme-1# show meminfo

MemTotal:         125068 kB
MemFree:           54996 kB
Buffers:               0 kB
Cached:            31424 kB
SwapCached:            0 kB
Active:            19808 kB
Inactive:          20784 kB
Active(anon):      11856 kB
Inactive(anon):        0 kB
Active(file):       7952 kB
Inactive(file):    20784 kB
Unevictable:           0 kB
Mlocked:               0 kB
HighTotal:             0 kB
HighFree:              0 kB
```

```
LowTotal:         125068 kB
LowFree:           54996 kB
SwapTotal:             0 kB
SwapFree:              0 kB
Dirty:                 0 kB
Writeback:             0 kB
AnonPages:          9196 kB
Mapped:             9876 kB
Shmem:              2688 kB
```

Note: The type and amount of card memory usage data may vary depending on the card's software version.

Card Administrative State

For the BelAir20 and BelAir100i WCS:

```
/card/<card_type>-<n>/show state
```

For the BelAir20E, BelAir20EO, BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100:

```
/card/<card_type>-<n>/show state
/card/<card_type>-<n>/set state {enabled | disabled}
```

These commands apply to all cards types except *bts*. These commands manage the card's administrative state.

Example - BelAir20E

```
/card/htme-1# show state
Admin:Up  Status:running
```

Restarting a Card

```
/card/<card_type>-<n>/reboot [{force}]
```

This command applies to the BelAir20E, BelAir20EO, BelAir100N, BelAir100SN, and BelAir100SNE. It restarts a specific card. You must confirm your intent before the card is rebooted.

Under some circumstances, a reboot may be prevented because of processing from other user sessions. Use the *force* parameter to override these restrictions and restart the card regardless.

Card CPU and Memory Performance Monitoring Statistics

```
/card/<card_type>-<n>/show pm
                         {fifteen-min|day}[{{<0-96>|<0-7>}|all]
```

This command displays a card's CPU and memory performance measurements either for a specific time interval or for a series of time intervals. The valid parameter options are:

- *fifteen-min*, *fifteen-min 0* to *fifteen-min 96*
- *day*, *day 0* to *day 7*

Specifying *fifteen-min* is equivalent to specifying *fifteen-min 0* and means the current 15-minute interval. Specifying *day* is equivalent to specifying *day 0* and means the current day, excluding data from the current 15-minute period.

Specifying *all* displays the statistics for all periods.

Example 1 - BelAir20E

```
/card/htme-1#show pm fifteen-min

Int   Peak CPU   Avg CPU   Peak Mem    Avg Mem
      Util (%)   Util (%)  Util (kb)   Util (kb)
0       7.0        7.0      69904      69744
1       7.0        7.0      69804      69744
2       7.0        7.0      69776      69744
3       7.0        7.0      69872      69744
4       7.0        7.0      69776      69776
5       7.0        7.0      69804      69744
6       7.0        7.0      69808      69744
7       7.0        7.0      69776      69744
8       7.0        7.0      69776      69682
9       7.0        7.0      69704      69672
10       7.0        7.0      69704      69672
11       7.0        7.0      69672      69672
12       7.0        7.0      69704      69672
13       7.0        7.0      69704      69672
```

Example 2 - BelAir20E

```
/card/htme-1#show pm fifteen-min 7

Host Resource PMs:
        Interval type:                historical 15 min
        Interval number:                  7
        Peak CPU Occ.    (%)            7.0
        Avg CPU Occ.     (%)            7.0
        Peak Memory Utilization       69776
        Average Memory Utilization    69744
```

Example 3 - BelAir20E

```
/card/htme-1#show pm day

Int   Peak CPU   Avg CPU   Peak Mem    Avg Mem
      Util (%)   Util (%)  Util (kb)   Util (kb)
0       7.0        7.0      71100      69188
1      39.0        7.4      69028      68908
```

BTS Card Commands

```
/card/bts-1/show status
/card/bts-1/reset bts power
/card/bts-1/set admin-state {enabled-nat | enabled-bridge | disabled}
```

These commands apply only to the BelAir2100.

The *show status* command displays the support configuration and the current card status.

The *reset bts power* command removes BTS power for 5 seconds.

The *set admin-state* enables or disables BTS operation. If enabled, the BTS can operate as a NAT gateway or as a bridge.

See also the *BelAir2100 Cellular Reference Guide.*

Ethernet or LAN Interface Settings

The HTM, HTME, DRU or DRUE card inside the AP has an Ethernet port that can be used as an egress point for the AP. The HTME card also provides LAN ports.

This chapter describes how to configure the Ethernet or LAN ports provided by your AP's card. The following topics are covered:

- "Managing the Ethernet or LAN Interface Settings" on page 91
- "Managing Egress AP Traffic" on page 92
- "Changing Ethernet or LAN Interface Admin State" on page 93
- "Ethernet or LAN Port Statistics" on page 94
- "Ethernet or LAN Port Performance Monitoring Statistics" on page 94

Managing the Ethernet or LAN Interface Settings

For the BelAir20 and BelAir100i WCS:

```
/interface/eth-<n>-<m>/set ethernet {auto|{speed {10|100}
                              {mode {full-duplex|half-duplex}}}}
/interface/eth-<n>-<m>/show status
```

For the BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100:

```
/interface/eth-<n>-<m>/show status
```

For the BelAir20E and BelAir20EO:

```
/interface/eth-<n>-<m>/show status
/interface/lan-<n>/show status
```

The *set ethernet* command controls the operational settings of the Ethernet interface. The *auto* setting causes the interface to automatically discover the correct settings to communicate with the other Ethernet device. If you do not use the *auto* setting, you can manually set the interface speed to either 10 or 100 Mbps and the mode to either full or half-duplex.

The *show status* command displays the current operational Ethernet interface settings. The current operational settings are a result of the negotiation that occurs with another Ethernet device and may be different than that configured locally.

Example

```
/interface/eth-1-1# show status
Type               : 1x1000baseTx  [Electrical: Single]
Admin Status       : Enabled
Link State         : Up
Speed              : 100 Mbps
Mode               : Full Duplex
Auto-Negotiation : Enabled
Mac Address        : 00:0D:67:0C:23:38
```

Managing Egress AP Traffic

In a BelAir Networks network, the Ethernet or LAN port of an AP can act as an egress point for the backhaul traffic of many other APs. The other APs may be connected to the egress AP through point-to-point, point-to-multipoint or multipoint-to-multipoint links.

VLAN Conversion

For the BelAir20, BelAir100i WCS, BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100:

```
/interface/eth-<n>-<m>/show pvid
/interface/eth-<n>-<m>/set pvid {<vlan_id>|untagged}
/interface/eth-<n>-<m>/set reverse-pvid {<vlan_id>|untagged}
```

For the BelAir20E and BelAir20EO:

```
/interface/eth-<n>-<m>/show pvid
/interface/eth-<n>-<m>/set pvid {<vlan_id>|untagged}
/interface/eth-<n>-<m>/set reverse-pvid {<vlan_id>|untagged}
/interface/lan-<n>/show pvid
/interface/lan-<n>/set pvid {<vlan_id>|untagged}
/interface/lan-<n>/set reverse-pvid {<vlan_id>|untagged}
```

These commands let you convert the VLAN tagging of traffic entering or leaving the Ethernet or LAN port of an egress AP:

- The *set pvid* command applies when traffic between APs uses VLAN IDs and these VLAN IDs must be removed before the traffic leaves the AP through the Ethernet or LAN port to the external network. If you use the *set pvid* command and specify a VLAN ID, untagged VLAN packets coming from external network through the Ethernet or LAN port are converted to tagged packets with the specified VLAN ID before they are sent to the APs. Similarly, packets that are tagged with the specified VLAN ID are sent to the external network through Ethernet or LAN port as untagged VLAN packets.
- The *set reverse-pvid* command applies when traffic between APs is untagged and must be tagged with a VLAN ID before it leaves the AP through the Ethernet or LAN port to the external network. If you use the *set reverse-pvid* command and specify a VLAN ID, untagged VLAN packets coming from APs are converted to tagged packets with the specified VLAN

ID before they are sent through the Ethernet or LAN port to the external network. Similarly, packets that are tagged with the specified VLAN ID arriving from the external network through the Ethernet or LAN port are converted to untagged packets before being sent to the APs.

If you specify the keyword *untagged* instead of VLAN ID, then packets are not converted as they enter or leave the Ethernet or LAN port of the egress AP. The default setting is *untagged*.

VLAN Filtering

For the BelAir20, BelAir100i WCS, BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100:

```
/interface/eth-<n>-<m>/show vlans
/interface/eth-<n>-<m>/add vlan {<vlan_id>|untagged}
/interface/eth-<n>-<m>/delete vlan {<vlan_id>|untagged}
/interface/eth-<n>-<m>/show vlans
```

For the BelAir20E and BelAir20EO:

```
/interface/eth-<n>-<m>/add vlan {<vlan_id>|untagged}
/interface/eth-<n>-<m>/delete vlan {<vlan_id>|untagged}
/interface/lan-<n>/show vlans
/interface/lan-<n>/add vlan {<vlan_id>|untagged}
/interface/lan-<n>/delete vlan {<vlan_id>|untagged}
```

You can create a list containing up to four VLAN IDs to control which traffic enters or leaves the Ethernet or LAN port of an egress AP. Only packets that are tagged with a VLAN ID in the list are allowed to enter or leave the Ethernet or LAN port of the egress AP.

These commands let you manage list of VLAN IDs. By default, the list is empty meaning that all traffic is allowed to enter or leave the Ethernet or LAN port of the egress AP. If you add a VLAN ID to the list, then only traffic belonging to that VLAN can enter or leave the Ethernet or LAN port of the egress AP. If you add the keyword *untagged* to the list, then only untagged traffic can enter or leave the Ethernet or LAN port of the egress AP.

Changing Ethernet or LAN Interface Admin State

```
/interface/eth-<n>-<m>/set admin-state {enable|disable}
/interface/lan-<n>/set admin-state {enable|disable}
```

This command applies to the BelAir20E or BelAir200EO. It controls the state of the Ethernet or LAN interface:

- When set to *enable*, the Ethernet or LAN interface is in the operational state and the associated port LED is green.
- When set to *disable*, the Ethernet or LAN interface and its associated functions are disabled and the associated LED is off.

The default is *enabled*.

Use the corresponding *show status* command to view the current admin state of the Ethernet or LAN interface.

Ethernet or LAN Port Statistics

For the BelAir20, BelA100i WCS, BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100:

```
/interface/eth-<n>-<m>/show statistics
```

For the BelAir20E and BelAir20EO:

```
/interface/eth-<n>-<m>/show statistics
/interface/lan-<n>/show statistics
```

This command displays various statistics about the traffic on the AP's Ethernet or LAN port.

Example

```
/interface/eth-1-1# show statistics

Statistics:

Rx
  Packets            : 13196
  Bytes              : 866242
  Dropped            : 0
  Errors             : 0

Tx
  Packets            : 1298
  Bytes              : 97713
  Dropped            : 0
  Errors             : 0
```

Ethernet or LAN Port Performance Monitoring Statistics

For the BelAir20, BelA100i WCS, BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100:

```
/interface/eth-<n>-<m>/show pm {fifteen-min|day}[{<0-96>|<0-7>}|all]
```

For the BelAir20E and BelAir20EO:

```
/interface/eth-<n>-<m>/show pm {fifteen-min|day}[{<0-96>|<0-7>}|all]
/interface/lan-<n>/show pm {fifteen-min|day}[{<0-96>|<0-7>}|all]
```

This command displays an Ethernet or LAN port's performance measurements either for a specific time interval or for a series of time intervals. The valid parameter options are:

- *fifteen-min*, *fifteen-min 0* to *fifteen-min 96*

- *day*, *day 0* to *day 7*
- *all*, all performance measurements.

Specifying *fifteen-min* is equivalent to specifying *fifteen-min 0* and means the current 15-minute interval. Specifying *day* is equivalent to specifying *day 0* and means the current day, excluding data from the current 15-minute period.

Example

```
/interface/eth-7-1# show pm fifteen-min 1

Ethernet PMs: Interval type: historical 15 min    Interval number: 1

Received                                Transmitted
Octets:                   530          Octets:                151848
Packets:                    2          Packets:                 2577
Unicast Packets:            0          Unicast Packets:            0
Multicast Packets:          0          Multicast Packets:          0
Broadcast Packets:          0          Broadcast Packets:          0
```

Cable Modem Configuration

This chapter applies to the BelAir100SN or BelAir100SNE. It describes how to do the following cable modem operations:

- "Displaying the Cable Modem Information" on page 96
- "Displaying the Cable Modem Configuration" on page 96
- "Displaying the Cable Modem Status" on page 97
- "Configuring Attenuation" on page 97
- "Setting the Cable Modem Interface Down Alarm Threshold" on page 98
- "Rebooting the Cable Modem" on page 99
- "Cable Modem Statistics" on page 99
- "Cable Modem Performance Monitoring Statistics" on page 100

Displaying the Cable Modem Information

```
/card/cm-<n>/show info
```

This command displays the addresses and firmware version of the cable modem.

Example

```
/card/cm-9# show info
MAC address                 : 00:05:CA:76:41:FC
IP address                  : 10.12.12.101
Software version            : 1.4.0.20BelAir
PPM version                 : 3
Status                      : Operational
```

Displaying the Cable Modem Configuration

```
/card/cm-<n>/show config
```

This command displays the configuration settings of the cable modem.

To adjust the downstream and upstream attenuation values, see "Configuring Attenuation" on page 97.

Example

```
/card/cm-9# show config

Downstream
   Attenuation              : 0 dB (Auto)
   State                    : Out-Of-Lock (Valid CM State)
   Target                   : 0 dBmV  +/-7 dB
Upstream
```

```
Attenuation               : 2 dB (Manual)
State                     : Manual
Target                    : 25 dBmV  +/-1 dB
```

Displaying the Cable Modem Status

```
/card/cm-<n>/show status
```

This command displays the operational parameters of the cable modem. For proper operation, the status must be as follows:

- the *QAM lock*, *FEC sync*, and *MPEG sync* fields must be *yes*.
- the *weak signal* field must be *no*.
- the *downstream power* and the *upstream power* must be in the range specified in the DOCSIS 3.0 specification.
- the signal-to-noise ratio (SNR) must be 23.5 or higher when the QAM mode is 64 and must be 30.0 or higher when the QAM mode is 256.

To adjust the downstream and upstream power values, see "Configuring Attenuation" on page 97.

Example

```
/card/cm-9# show status

Modem status                : Operational

Channel                           1         2         3         4
   Downstream freq (MHz)    :   699       645       657       663
   Timing offset (PPM)      :     0         0         0         0
   Carrier offset (Hz)      : -16548    -13034    -15819    -14321
   QAM mode                 :   256       256       256       256
   QAM lock                 :   yes       yes       yes       yes
   FEC Sync                 :   yes       yes       yes       yes
   MPEG Sync                :   yes       yes       yes       yes
   Weak signal              :    no        no        no        no
   Upstream power (dBmV)    :  57.0      -1.0      -1.0      -1.0
   Downstream power (dBmV)  : -17.7     -19.0     -19.1     -19.2
   Downstream SNR (dB)      :  29.1      28.4      28.5      28.7
```

Configuring Attenuation

```
/card/cm-<n>/set attenuation {upstream|downstream}
             { mode {auto|manual [<att_val>]}
             | parameters target <target_val> delta <delta_val> }
```

This command lets you set the upstream or downstream attenuation applied to the cable modem's RF signal path. You can use manual or automatic attenuation settings. For manual settings, specify the *<att_val>* parameter, which ranges from 0 to 20 in 1 dB steps. The default value setting is 0 dB.

Set the *auto* parameter to use automatic attenuation. With automatic attenuation, the cable modem monitors the upstream or downstream power level and automatically adjusts attenuation to attempt to bring the signal level to *in-lock* range. Refer to the DOCSIS 3.0 specification for specific definitions of *in-lock* ranges for upstream and downstream signals.

As with manual attenuation, automatic attenuation can vary the attenuation level from 0 to 20 dB, in 1 dB steps.

If you want to use automatic attenuation, but with different target and in-lock values than those in the DOCSIS 3.0 specification, use the *parameters* parameter to specify the new values. The *target* parameter specifies the new target attenuation value. The *delta* parameter specifies the margin of attenuation on each side of the target to be considered in-lock. The default values are:

- For upstream, the default target is 45 dB with a delta of 5 dB, meaning that the in-lock range is from 40 dB to 50 dB.
- For downstream, the default target is 0 dB with a delta of 7 dB, meaning that the in-lock range is from -7 dB to + 7dB.

The acceptable input values for *<target_val>* and *<delta_val>* for upstream are:

- *<target_val>* + *<delta_val>* cannot exceed 50 dB
- *<target_val>* - *<delta_val>* cannot be less than 20 dB

The acceptable input values for *<target_val>* and *<delta_val>* for downstream are:

- *<target_val>* + *<delta_val>* cannot exceed +15 dB
- *<target_val>* - *<delta_val>* cannot be less than -15 dB

After configuring attenuation, use the */card/cm-<n>/show status attenuation* command to verify that the power levels are within their proper operating ranges.

Setting the Cable Modem Interface Down Alarm Threshold

```
/card/cm-<n>/show alarm-threshold
/card/cm-<n>/set alarm-threshold
                             {disabled | enabled <num_of_alarms>}
```

Typically, an *Interface Down* alarm is generated when a cable modem interface fails to respond. However, if there are intermittent issues with the cable modem interface, it may take time to identify and correct the root cause. During this period, multiple *Interface Down* alarms would be generated.

Enabling the alarm threshold reduces the number of *Interface Down* alarms generated per calendar day. If the threshold is reached, the system generates instead a single *Excess Cable Modem Interface Down Events* alarm and stops generating additional *Interface Down* alarms. The *Interface Down* events are still tracked through the tunnel's performance monitoring statistics, allowing you to analyze the behavior.

The *<num_of_alarms>* parameter ranges from 2 to 50. By default, the alarm threshold is enabled with a setting of *5*, meaning that the *Excess Cable Modem Interface Down Events* alarm is generated once 5 *Interface Down* events occur in a day.

Alarms generated during a maintenance window do not count against the alarm threshold. For details see, "Defining a Maintenance Window" on page 75.

Rebooting the Cable Modem

```
/card/cm-<n>/reboot [set-default]
```

Use this command to reboot the cable modem. Use the *set-default* parameter to return the cable modem settings to factory defaults.

Cable Modem Statistics

```
/card/cm-<n>/show statistics
                    {all|up_channel|signal_quality|uptime|status}
```

This command applies to the BelAir100SN and the BelAir100SNE. It displays additional data that can be retrieved from the cable modem:

- *all*, all data
- *up_channel*, display up channel data
- *signal_quality*, display signal quality data
- *uptime*, display cable modem up time
- *status*, display cable modem status data

Example

```
/card/cm-9#show statistics all

Signal quality
 Unerroreds              : 2140459029 2140178006 2140177890 2140176599
 Correcteds              :        356        156        195        447
 Uncorrectables          :       4917       2309       2393       3421
 Signal Noise            :        350        354        352        349
 Microreflections        :         41         41         42         39
Status
 TxPower                 :        505          0          0          0
```

```
 Resets                     :        3
 LostSyncs                  :        1
 InvalidMaps                :        0
 InvalidUcds                :        0
 InvalidRangingResps        :        0
 InvalidRegistrationResps:           0
 T1Timeouts                 :        0
 T2Timeouts                 :        0
 UsT3Timeouts               :        0          0          0          0
 UsT4Timeouts               :        0          0          0          0
 RangingAborteds            :        0          0          0          0
 DocsisOperMode             :        3
Up Channel
 Frequency                  : 28000000          0          0          0
 Width                      : 28000000          0          0          0
 TxTimingOffset             :     1243          0          0          0
Up time
 9days20h:27m:37s
```

Cable Modem Performance Monitoring Statistics

```
/card/cm-<n>/show pm {fifteen-min|day}[{{<0-96>|<0-7>}|
    all{availability|signal_quality <channel>|resets|ranging <channel>}]
```

This command This command applies to the BelAir100SN and the BelAir100SNE. It displays a cable modem's performance measurements either for a specific time interval or for a series of time intervals. The valid parameter options are:

- *fifteen-min*, *fifteen-min 0* to *fifteen-min 96*
- *day*, *day 0* to *day 7*

Specifying *fifteen-min* is equivalent to specifying *fifteen-min 0* and means the current 15-minute interval. Specifying *day* is equivalent to specifying *day 0* and means the current day, excluding data from the current 15-minute period.

Specifying *all* displays the statistics for all periods. With *all*, you can select from the following types of data: *availability*, *signal_quality <channel>*, *resets*, or *ranging <channel>*.

Example 1

```
/card/cm-9#show pm fifteen-min 1

Interval type            : historical 15 min
Interval number          : 1
Unavailable Seconds      : 410
```

Example 2

```
/card/cm-9#show pm day

Interval type            : current 24 hour
Interval number          : 0
Unavailable Seconds      : 56210
```

Wi-Fi Radio Configuration Overview

Available Wi-Fi Radios

Table 7 on page 101 lists the available BelAir Networks Wi-Fi radios.

Table 7: BelAir Networks Wi-Fi Radio Summary

Radio Module	Operating Frequency	AP	Can Operate as Access Point?	Supported Backhaul Topologies
HTMv1	2.4/5.8 GHz	BelAir20	Yes	mp-to-mp p-to-mp p-to-p
HTMv1	2.4/2.3 GHz WCS	BelAir100i	Yes	mp-to-mp p-to-mp p-to-p
HTMEv1	2.4/5.8 GHz	BelAir20E	Yes	mp-to-mp p-to-mp p-to-p
HTMEv3	2.4 GHz	BelAir20E	Yes	mp-to-mp p-to-mp p-to-p
HTMEv2	2.4/5.8 GHz	BelAir20EO	Yes	mp-to-mp p-to-mp p-to-p
HTMEv4	2.4 GHz	BelAir20EO	Yes	mp-to-mp p-to-mp p-to-p
DRUv1 DRUv2 DRUv4 DRUv5	2.4/5.8 GHz	BelAir100N BelAir100SN	Yes	mp-to-mp p-to-mp p-to-p

Table 7: BelAir Networks Wi-Fi Radio Summary (Continued)

Radio Module	Operating Frequency	AP	Can Operate as Access Point?	Supported Backhaul Topologies
DRUv3	2.4 GHz	BelAir100N BelAir100SN	Yes	mp-to-mp p-to-mp p-to-p
DRUEv1 DRUEv2	2.4/5.8 GHz	BelAir100SNE BelAir2100	Yes	mp-to-mp p-to-mp p-to-p

Configuration Process

Use the following process to configure a Wi-Fi radio:

1 Configure basic radio parameters. See "Configuring Wi-Fi Radio Parameters" on page 103.

2 Configure AP parameters, if required. See "Configuring Wi-Fi Access Point Parameters" on page 123 and "Wi-Fi AP Security" on page 146.

3 Configure backhaul parameters. See "Wi-Fi Backhaul Link Configuration" on page 161.

4 Configure mobile backhaul mesh parameters. See "Mobile Backhaul Mesh" on page 169

Configuring Wi-Fi Radio Parameters

This chapter describes how to display and configure Wi-Fi radio parameters, including:

- "Displaying Wi-Fi Radio Configuration" on page 104
- "Displaying Configuration Options" on page 105
- "Operating Channel" on page 105
- "Antenna Gain" on page 108
- "Transmit Power Level" on page 110
- "Link Distance" on page 111
- "Dynamic Frequency Selection" on page 111
- "Collision Aware Rate Adaptation" on page 112
- "WCS Duty Cycle Control" on page 112
- "Rate Aware Fairness" on page 112
- "Enhanced Throughput" on page 112
- "802.11n Aggregation" on page 113
- "Minimum Association Thresholds" on page 113
- "Doing an RF Survey" on page 113
- "Changing Wi-Fi Interface Admin State" on page 117
- "Wi-Fi Interface Statistics" on page 117
- "Wi-Fi Performance Monitoring Statistics" on page 118

To configure parameters that are specific to Wi-Fi Access Points (APs), see "Configuring Wi-Fi Access Point Parameters" on page 123.

To configure parameters that are specific to backhaul radios, including the different types of backhaul links, see "Wi-Fi Backhaul Link Configuration" on page 161.

See also:

- "Configuring Wi-Fi Access Point Parameters" on page 123

- "Wi-Fi AP Security" on page 146
- "Wi-Fi Backhaul Link Configuration" on page 161
- "Mobile Backhaul Mesh" on page 169

Displaying Wi-Fi Radio Configuration

```
/interface/wifi-<n>-<m>/show config
                              [{all|access|backhaul|qos|mobile}]
```

This command displays various aspects of the radio's configuration.

Example - BelAir20E

```
/interface/wifi-1-1# show config all
Slot: 1, Card Type: htme, revision: 1, Port: 1, Radio: HTMEv1 5GHz
802.11n
admin state: ................. Enabled
channel: ..................... 149
  mode: ...................... ht40plus
  mimo: ...................... 3x3
  tx power: .................. 18.0 (dBm per-chain), 23.0 (dBm total)
antenna location: ............ External Port
antenna index: ............... 1
antenna gain: ................ 5.0  (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:0c:21:90
Access:
  AP admin state: ............ Enabled
  secure addresses (vlan): ... none
  client blacklist: .......... none
  dhcp unicast: .............. Disabled
  deauth dos defense: ........ Disabled
  client auth trap: .......... Disabled
Misc:
  rts-cts threshold: ......... 100
  broadcast filter status: ... Disabled
  broadcast filter rate: ..... 200
QOS:
  wmm: ....................... Enabled
  uapsd: ..................... Enabled
  mapping: ................... UP/DSCP
  voice acm: ................. Disabled
  video acm: ................. Disabled
Common Backhaul:
  privacy: ................... AES
  key: .......................
  mesh-min-rssi............... -100 (dbm)
Stationary Backhaul:
  link admin state: .......... Disabled
  link id: ................... BelAirNetworks
  topology: .................. mesh
Mobile Backhaul:
  mobile admin state: ........ Disabled
  mobile link id: ............
  mobile link role: .......... ss
```

```
Blacklist:
  No blacklist entries
Link Failure Detection: ...... Disabled
Backhaul T1 Bandwidth limit:.. Disabled
```

Displaying Configuration Options

```
/interface/wifi-<n>-<m>/show available-config-options
```

This command displays valid channel, antenna gains and transmit power values for your AP. The displayed values vary depending on the country of operation.

Example - BelAir20E

```
/interface/wifi-1-1# show available-config-options
Channels:
--------------------------------------------------------------------
[Mode=ht20]
  36   37   38   39   40   41   42   43   44   45
  46   47   48
[Mode=ht40+]
  36   37   38   39   40   41   42   43   44
[Mode=ht40-]
  40   41   42   43   44   45   46   47   48
[Mode=ht20]
  149  150  151  152  153  154  155  156  157  158
  159  160  161  162  163  164  165
[Mode=ht40+]
  149  150  151  152  153  154  155  156  157
[Mode=ht40-]
  153  154  155  156  157  158  159  160  161

External antenna gain list:
--------------------------------------------------------------------
  0.00  5.00  9.00

Tx power values for channel [149] and antenna gain [5]:
--------------------------------------------------------------------
  18  17  16  15  14  13  12  11  10  9
```

Operating Channel

```
/interface/wifi-<n>-<m>/set channel {<channel-number>
                            [secondary <channel-number>]
                            [channel-bandwidth {5000|2500]
                       [channel-mode ht20|ht40plus|ht40minus|20] |
                      auto [background-scan {enabled | disabled}]}
/interface/wifi-<n>-<m>/re-scan-channel
```

Note: The specific syntax and options for the *set channel* command varies depending on the type of radio being configured. Use the */interface/wifi-<n>-<m>/?* command to display the options and syntax that apply to you.

The *set channel* command lets you specify the channel settings for a Wi-Fi radio. Use the *show available-config-options* command to display valid channel numbers. The displayed values vary depending on the country of operation. Refer to your RF plan and site survey to determine which value you should use.

CAUTION! Improper setting of channel, antenna gain and transmit power may exceed regulatory requirements and void the operator's right to operate the radio equipment. Refer to the *Radio Transmit Power Tables* to determine valid combinations of channel, antenna gain and transmit power for your country.

If the AP is a member of a multipoint-to-multipoint mesh cluster, the channel must be set to match the one used by the multipoint-to-multipoint mesh cluster.

If an AP is equipped with many radios for backhaul, their channels must be separated by at least 35 MHz (that is, seven channel numbers) to avoid radio interference resulting in poor data communication quality. For example, channel numbers 53 and 61 can be used together, but not 53 and 59.

The *secondary* parameter applies to any radio supplying Dynamic Frequency Selection (DFS), a regulatory requirement in some jurisdictions. The *secondary* parameter sets an optional secondary channel for use with DFS. The default value is 0, instructing DFS to operate as if the secondary channel is the same as the primary channel. If you change the channel number from the default value and if you do not specify a secondary channel, then your secondary channel is set to be the same as your primary channel. DFS behaves the same way regardless of whether your secondary channel is the same as the primary channel or whether your secondary channel is 0. Refer to your RF plan and site survey to determine if you need to set a secondary channel other than 0 or your primary channel.

The *channel-bandwidth* parameter applies to the WCSv1 only. It sets the bandwidth of the channel you want to use. The specified bandwidth is in kHz.

The *channel-mode* parameter applies to all 2.4 and 5.8 GHz radios. It sets the 802.11n channel mode.

SNMP limitations prevent the display of WCSv1 channel names, such as A1L or B2U on SNMP devices, such as BelView NMS. Instead, such devices display the equivalent channel number. Table 8 provides the mapping between the channel name (displayed by the CLI) and the channel number (displayed by SNMP queries).

Table 8: WCS 2.3 GHz Channel Name to Number Mapping

Channel Number (SNMP Query)	Channel Name (CLI Display)
1	A1L

Table 8: WCS 2.3 GHz Channel Name to Number Mapping (Continued)

Channel Number (SNMP Query)	Channel Name (CLI Display)
2	A1
3	A1U
6	B1L
7	B1
8	B1U
11	C
43	D
46	A2L
47	A2
48	A2U
51	B2L
52	B2
53	B2U

The *auto* and *background-scan* parameters apply all 2.4 GHz and 5 GHz radios. The *auto* parameter causes the radio to search for surrounding APs. At startup, the system scans all channels in a given channel mode to collect several parameters. The channel providing the best quality is selected.

The *background-scan* parameter assists the auto feature in determining the channel settings to use. By default background scan is disabled.

If background scan is enabled, the system periodically does an off-channel scan of a foreign channel where it collects more channel quality data.

After a sufficient number of background scans have occurred, the system re-calculates the best channel to use based on:

- the most recent data for the home channel and all foreign channels
- the historic data of all foreign channels

If a foreign channel is at least 20% better the home channel, then the system switches to the new channel.

The *re-scan-channel* command causes the radio to perform another search.

See also:

- “Country of Operation” on page 66
- the *Radio Transmit Power Tables*

Antenna Gain

For the BelAir20, BelAir100i WCS, BelAir20E, BelAir20EO and BelAir100SNE:

```
/interface/wifi-<n>-<m>/set antenna-gain <gain>
```

For the BelAir100N and BelAir100SN:

```
/interface/wifi-<n>-<m>/set antenna gain <gain>
                                        [port {dedicated|shared}]
```

For the BelAir2100:

```
/interface/wifi-<n>-<m>/set antenna gain <gain>
```

This command lets you specify the gain of the antenna installed with your AP. Use the *show available-config-options* command to display valid gain values (in dBi). The displayed values vary depending on the country of operation and the channel in use.

You must set the *<gain>* parameter to match the gain of the antenna installed in your AP. For all countries except Korea, the default access antenna gain is 8 dBi. For Korea, the default access antenna gain is 6 dBi.

CAUTION! This caution applies only to the BelAir20, BelAir100i WCS, BelAir20EO, BelAir100N, BelAir100SN and BelAir100SNE. Improper setting of channel, antenna gain and transmit power may exceed regulatory requirements and void the operator’s right to operate the radio equipment. Refer to the *Radio Transmit Power Tables* to determine valid combinations of channel, antenna gain and transmit power for your country.

Use the *set antenna-gain <gain>* command for your AP’s 2.4 GHz DRU radio. Use the *set antenna gain <gain> port {dedicated|shared}* command for your AP’s 5 GHz DRU radio.

Your AP’s 5 GHz DRU radio offers two sets of ports to connect antennas. If you use single-band (5 GHz) antennas, set the *port* parameter to *dedicated* and connect your antennas to port 3 and 4 of your AP. If you use dual-band (2.4 and 5 GHz) antennas, set the *port* parameter to *shared* and connect your antennas to port 1 and 2 of your AP. Refer to Figure 12 on page 109 for the

BelAir100SN. Refer to Figure 13 for the BelAir100N. The setting for the *port* parameter affects the maximum transmit power setting for your 5 Ghz radio.

Figure 12: BelAir100SN Connector Fields

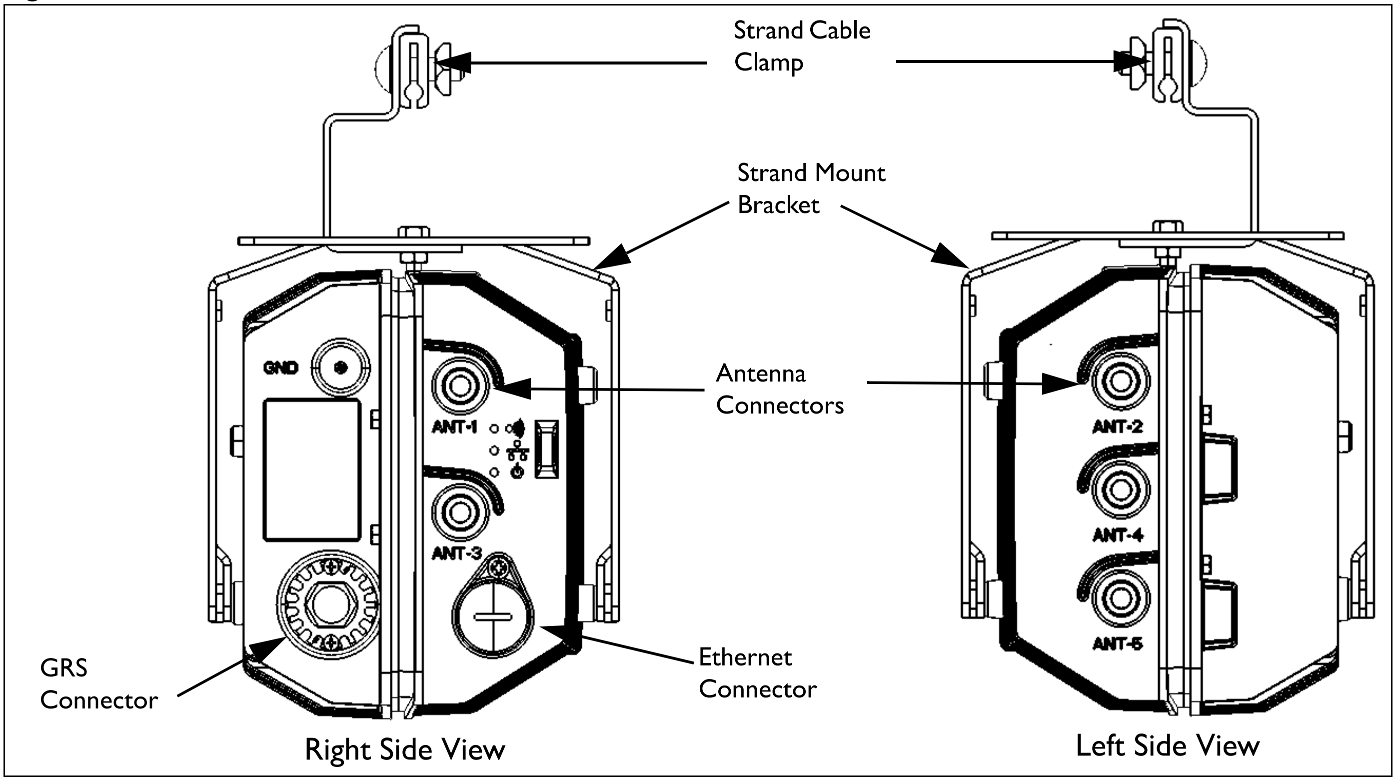
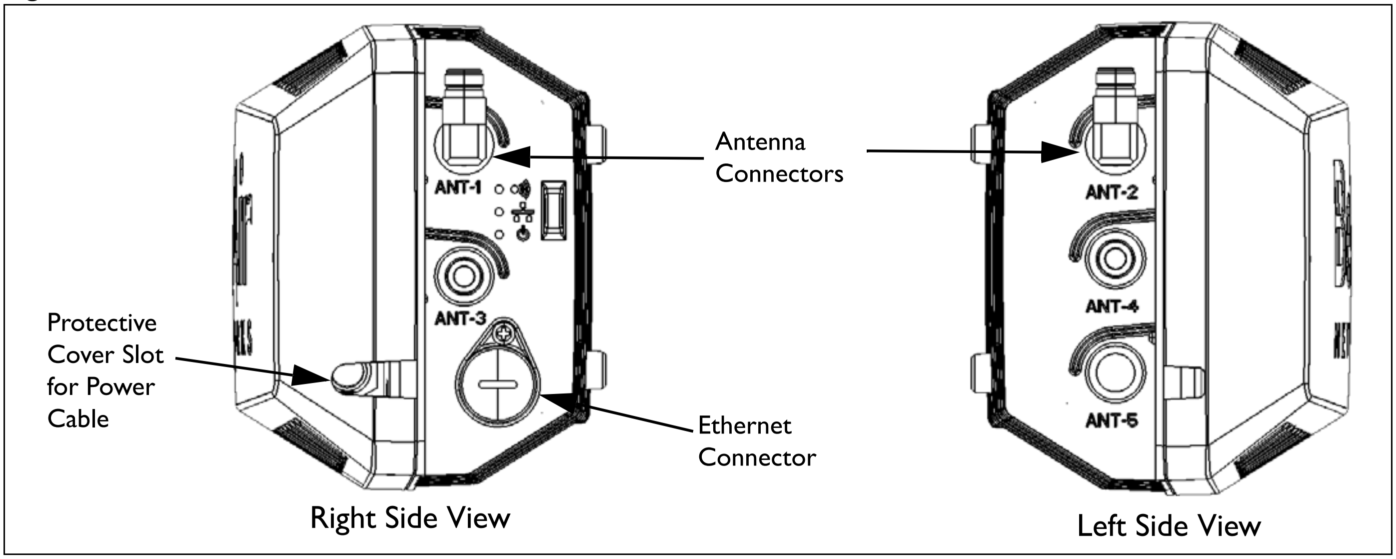


Figure 13: BelAir100N Connector Fields



See also:

- "Country of Operation" on page 66
- "Operating Channel" on page 105
- the *Radio Transmit Power Tables*

Transmit Power Level

```
/interface/wifi-<n>-<m>/set tx-power
                      {<tx-power-value> [secondary <tx-power-value>]|
                        maximum-tx-power}
/interface/wifi-<n>-<m>/set tx-power
                      {{<tx-power-value> [secondary <tx-power-value>]
                       [tx-power-optimize
                      {{enable [target-rssi <rssi_level>]
                       [max-tx-power <max_power>]}|disable}]} |
                        maximum-tx-power }
```

This command sets the transmit power for a Wi-Fi radio. On all radios you can specify specific power values with <tx-power-value> or select *maximum-tx-power* which tells the radio to operate at the maximum transmit power allowed for your configuration.

The range of <tx-power-value> is limited to be valid for your country of operation, physical channel in use, and type of antenna that is installed. Use the *show available-config-options* command to display valid transmit power values (in dBm). The displayed values vary depending on the country of operation and channel in use. If you enter a value for <tx-power-value> outside its valid range, the AP issues a warning and instead uses an appropriate minimum or maximum power setting for the radio.

The default setting is to have the radio transmit at maximum power.

The *secondary* parameter applies only to 5.8 GHz radios. It sets the transmit power for an optional secondary channel for use with Dynamic Frequency Selection (DFS), a regulatory requirement in some jurisdictions. The default is to have the same transmit power level for both the primary and secondary channel. Refer to your RF plan and site survey to determine if you need to set a different power level for the DFS secondary channel.

For BelAir20EO APs equipped with a 2.4 GHz and a 5.8 GHz radio, you can also use the *tx-power-optimize* parameter on the 5.8 GHz radio to enable automatic transmit power control. This feature negotiates the minimal power to maintain the maximum modulation rate.

If *tx-power-optimize* is enabled, <tx-power-value> is the default power level. You must also specify the target RSSI level for the other end of the link and the maximum power level that the link can transmit.

During operation, the RSSI level of the remote end of the link is monitored and compared to the target RSSI level. If they are sufficiently different, the transmit power level is adjusted. The <max_power> parameter limits the output of the radio.

Automatic transmit power control operates only on the local end of the link. To operate on both ends of a link, you must enable *tx-power-optimize* on both ends of the link.

CAUTION! Improper setting of the transmit power may exceed regulatory requirements and void the operator's right to operate the radio equipment.

See also:

- "Country of Operation" on page 66
- "Operating Channel" on page 105
- "Antenna Gain" on page 108

Link Distance

```
/interface/wifi-<n>-<m>/set link-distance <distance>
```

This command adjusts the AP's MAC timers to compensate for the additional time to receive acknowledgements because the other AP is farther. The *distance* parameter has a range of 0 to 40 and is specified in kilometers. The default value is 1 km.

Dynamic Frequency Selection

```
/interface/wifi-<n>-<m>/show dfs
```

This command does not apply to platforms that do not have a 5.8 GHz radio, such as the BelAir20E-10.

This command displays current Dynamic Frequency Selection (DFS) settings, a regulatory requirement in some jurisdictions. DFS is automatically implemented depending on the country of operation.

See also:

- "Country of Operation" on page 66
- "Operating Channel" on page 105
- "Transmit Power Level" on page 110

Example

```
/interface/wifi-1-1# show dfs

DFS admin state          : enabled
current channel          : 53

    channel                 DFS        radar      holdoff-time
```

```
       #                  required    detected    remaining
------------------        ---------  ----------  ------------
 primary:    53              no          no          0 (sec)
 secondary:  53              no          no          0 (sec)
```

Collision Aware Rate Adaptation

```
/interface/wifi-<n>-<m>/set advanced-collision-ctrl
                                                  {enable|disable}
```

Collision Aware Rate Adaptation (CARA) is an advanced algorithm that turns RTS on and off when it detects a collision. This allows frames that failed due to the collision to get through without compromising the transmission rate (that is, the RTS is sent at 1mpbs and clears the channel of collisions for the high rate data packet).

By default, CARA is enabled.

WCS Duty Cycle Control

```
/interface/wifi-<n>-<m>/set duty-cycle-control {enable|disable}
```

This command applies to the WCSv1 only.

This command enables or disables the 38% transmit duty cycle control mechanism required by FCC regulations.

By default, WCS duty cycle control is enabled.

Rate Aware Fairness

```
/interface/wifi-<n>-<m>/set rate-aware-fairness {enable|disable}
```

Rate aware fairness is a transmission algorithm that chooses dynamic retreat and progress thresholds based on the transmission rate of the station being transmitted to, and the size of the packet.

Normally, when the AP has a client with a slower connection, all other clients are throttled down to that same rate. Rate Aware Fairness overcomes this issue by trying to give clients equal amounts of air-time instead of equal numbers of packets.

By default, rate aware fairness is disabled.

Enhanced Throughput

```
/interface/wifi-<n>-<m>/set enhanced-throughput {enable|disable}
```

This command applies to the WCSv1 only.

This command enables a performance enhancement method called *Fast Frames* which aggregates frames together before transmitting them as a single frame carrying more data.

By default, enhanced throughput is enabled.

802.11n Aggregation

```
/interface/wifi-<n>-<m>/set tx-aggr {enable|disable}
```

This command applies to the HTM and DRU only.

This command enables or disables transmit aggregation for the radio. Transmit aggregation is an 802.11n feature where multiple MSDUs or MPDUs are packed together to reduce the overhead and average them over multiple frames, thus increasing the user level data rate.

The default setting is *enable*.

Minimum Association Thresholds

```
/interface/wifi-<n>-<m>/set rcv-rssi-filter
              {disabled | enabled accept <value> discard <value>}
```

This command applies to the BelAir20, BelAir20E, BelAir20EO, BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100. It defines RSSI thresholds used for client associations:

- A device can associate only if its Received Signal Strength Indicator (RSSI) is equal or greater than the *accept* threshold.
- A device is forced to disassociate if its RSSI is continuously weaker than the *discard* threshold.

The *accept* value ranges from -40 to -100 dBm. The default value is -100 dBm.

The *discard* value ranges from -70 to -106 dBm. The default value is -106 dBm.

The *accept* threshold must be at least 6 dBm stronger than the *discard* threshold.

Doing an RF Survey

```
/interface/wifi-<n>-<m>/show rf-survey [{ap [chan {others|all}]|
                                          backhaul|
                                          all}]
                                         [mac {belair|others}]
                                         [sort mac]
```

This command allows you to determine potential backhaul configuration problems or rogue access points. It displays several information items for all Wi-Fi radios it can currently detect.

The output is different, depending on whether you specify *ap* or *backhaul*. See the following subsections for details:

- "AP RF Survey" on page 114

- "Backhaul RF Survey" on page 115
- "All RF Survey" on page 117
- "Sorting the Output" on page 117
- "Filtering the Output" on page 117

Specifying *all* displays both AP and backhaul RF surveys.

AP RF Survey

Rogue access points (APs) may be installed on a corporate network by employees using low-cost equipment they purchased themselves. The rogue APs are often installed inside the corporate firewall with even the most basic security settings disabled, thus creating the potential for network security breaches. A rogue device may also be connected to a totally separate wired network that happens to be near corporate facilities but is still accessible to client devices within the enterprise.

For public networks, numerous Wi-Fi networks may exist "underneath" the public network, being in or near the coverage area.

In some cases, a rogue AP may present a security concern. In all cases, rogue APs are a source of interference and capacity degradation for the network.

Use the *show rf-survey ap* command to detect rogue access points (APs). In this case, the *rf-survey* command displays the following information items for every AP "visible" to a radio for the current channel in use:

- the AP's MAC address
- the channel number it is using
- the Remote Signal Strength Indication (RSSI) of the link in dBm
- the age of the association (number of seconds since last signal was received from the MAC address)
- the BSS configuration type, either *infra* (for infrastructure) or *adhoc*
- whether privacy is enabled or not
- its SSID

Using a *show rf-survey* is equivalent to using *show rf-survey ap*.

When you use *show rf-survey ap*, you can filter the output as follows:

- *show rf-survey ap chan others* displays only the APs using channels other than the one you are using.
- *show rf-survey ap chan all* displays all channels and all detected APs.

The *ap chan others* and *ap chan all* options display data collected with the *set channel background-scan* command. Background scanning is not service-affecting and clients should not be disconnected. To use these options, the *background-scan* option must be enabled. See "Operating Channel" on page 105.

Note: If you want to detect rogue APs that use a different channel than the one used by your BelAir Networks radio, then you can choose to change your radio's channel and repeat this command to detect all possible rogue APs. However, changing a radio's channel is service affecting and could disrupt client access. See "Operating Channel" on page 105 for the command to changing a radio's channel. BelAir Networks recommends that you use instead the *show rf-survey ap chan all* which provides equivalent information but is not service affecting. See "Filtering the Output" on page 117 for details.

Example

```
/interface/wifi-1-1# show rf-survey ap

mac addr          ch  rssi age bss privacy ssid
----------------- --- ---- --- --- ------- ----------------
00:07:85:B3:73:94 149 -90  11  ifr no      tsunami
00:0D:67:10:F0:BF 149 -68  8   ifr yes     BelAir-Visitor
00:0D:67:10:F0:BD 149 -67  8   ifr yes     BelAir-HotSpot

noise floor (chain 1-2): ............. -89 (dbm),     -92 (dbm)
```

In the previous example, two of the devices visible to the BelAir Networks radio have SSIDs that start with *BelAir* indicating the network being deployed with BelAir Networks equipment. A third device has an SSID *tsunami*, indicating a potential rogue AP. By examining the MAC address, you can interpret that the rogue is a Cisco AP. The rogue is transmitting on channel 149 with no encryption and has a fairly low RSSI. This rogue is located within the field of view of the AP that is performing the rogue query. The rogue likely interferes most with the BelAir Networks APs.

Backhaul RF Survey

Use the *show rf-survey backhaul* command to troubleshoot potential backhaul configuration problems. In this case, the *rf-survey* command displays a list of all visible backhaul links sharing the same channel that the radio is using. The output can include APs that are configured with:

- different mesh or link identifiers
- different privacy settings
- different topologies

The output may show *undef* as the type of privacy, meaning that the AP cannot determine the type of privacy used by that link.

Example 1 - Point-to-point Topology

```
/interface/wifi-4-1# show rf-survey backhaul

mac               ch  rssi age priv topo role linkIdx  identifier                 state role identifier
                     (dbm) (s)       [S]  [S]  12345678 [S]                        [M]   [M]  [M]
----------------- --  ---- --- ---- ---- ---- -------- ----------------------    ----- ---- ------------
00:0D:67:08:63:31 157 -42  0   none p2p  --   -------- BelAirNetworks              dis

noise floor (chain 1-2): ............. -86 (dbm),     -91 (dbm)
```

Example 2 - Multipoint-to-multipoint Topology

```
/interface/wifi-3-1# show rf-survey backhaul

mac               ch  rssi age priv topo role linkIdx  identifier                 state role identifier
                     (dbm) (s)       [S]  [S]  12345678 [S]                        [M]   [M]  [M]
----------------- --  ---- --- ---- ---- ---- -------- ----------------------    ----- ---- ------------
00:0D:67:00:B3:55 167 -76  0   aes  mesh --   -------- BelAirNetworks              dis
00:0D:67:00:C9:A8 167 -58  0   aes  mesh --   -------- BelAirNetworks              dis
00:0D:67:00:E3:A3 167 -52  0   aes  mesh --   -------- BelAirNetworks              dis

noise floor (chain 1-2): ............. -86 (dbm),     -91 (dbm)
```

Example 3 - Point-to-multipoint Topology, Base Station

This example shows a backhaul RF survey from an AP that is a stationary base station connected to two stationary subscriber stations. The AP also sees another AP but does not make a connection to it due to different topology (p2p).

```
/interface/wifi-2-1# show rf-survey backhaul

mac               ch  rssi age priv topo role linkIdx  identifier                 state role identifier
                     (dbm) (s)       [S]  [S]  12345678 [S]                        [M]   [M]  [M]
----------------- --  ---- --- ---- ---- ---- -------- ----------------------    ----- ---- ------------
00:0D:67:00:49:EA 167 -52  0   aes  star ss   1------- BelAirNetworks              dis
00:0D:67:00:B3:55 167 -90  0   aes  p2p  --   -------- BelAirNetworks              dis
00:0D:67:00:C9:A8 167 -75  0   aes  star ss   --1----- BelAirNetworks              dis

noise floor (chain 1-2): ............. -86 (dbm),     -91 (dbm)
```

Example 4 - Point-to-multipoint Topology, Subscriber Station

This example shows a backhaul RF survey from one of the stationary subscriber stations of Example 3.

```
/interface/wifi-2-1# show rf-survey backhaul

mac               ch  rssi age priv topo role linkIdx  identifier                 state role identifier
                     (dbm) (s)       [S]  [S]  12345678 [S]                        [M]   [M]  [M]
----------------- --  ---- --- ---- ---- ---- -------- ----------------------    ----- ---- ------------
00:0D:67:00:B3:55 167 -73  0   aes  star bs   111----- BelAirNetworks              dis
00:0D:67:00:C9:A8 167 -58  0   aes  p2p  --   -------- BelAirNetworks              dis
00:0D:67:00:E3:A3 167 -53  0   aes  star bs   --1----- BelAirNetworks              dis

noise floor (chain 1-2): ............. -86 (dbm),     -91 (dbm)
```

Example 5 - Mobile Backhaul Mesh Links

This example shows a backhaul RF survey for an AP providing mobile backhaul mesh links.

```
/interface/wifi-2-1# show rf-survey backhaul

mac               ch  rssi age priv topo role linkIdx  identifier              state role identifier
                     (dbm) (s)      [S]  [S]  12345678 [S]                      [M]  [M]  [M]
----------------- --  ---- --- ---- ---- ---- -------- ----------------------   ----- ---- ------------
00:0D:67:00:C9:A8 167 -79  0   aes  --   --   -------- BelAirNetworks            ena  ss   mtest1
00:0D:67:00:49:EA 167 -66  0   aes  mesh --   -------- BelAirNetworks            ena  bs   mtest1
00:0D:67:00:E3:A3 167 -80  0   aes  mesh --   -------- BelAirNetworks            ena  bs   mtest1

noise floor (chain 1-2): ............. -86 (dbm),     -91 (dbm)
```

All RF Survey

Use the *show rf-survey all* command to display a list of all visible backhaul links and all visible APs, except those sharing the same channel that the radio is using.

Filtering the Output

The *mac* option allows you to filter the output:

- *mac belair* displays only BelAir Networks APs; that is, only devices with BelAir Networks MAC addresses
- *mac others* displays only APs that do not have BelAir Networks MAC addresses.

Sorting the Output

Use the *sort mac* option to sort the output in descending order by MAC address.

Changing Wi-Fi Interface Admin State

```
/interface/wifi-<n>-<m>/set admin-state {enable|disable}
```

This command controls the state of the Wi-Fi interface including all links. When set to *enable*, the Wi-Fi interface is in the operational state. When set to *disable*, the Wi-Fi interface and all associated functions are disabled. The default is *disabled*.

Use the */interface/wifi-<n>-<m>/show config* command to view the current admin state of the Wi-Fi interface.

Wi-Fi Interface Statistics

```
/interface/wifi-<n>-<m>/show statistics
```

This command displays the statistics for a Wi-Fi interface.

Example

```
/interface/wifi-1-1# show statistics
MSDU Statistics:
   RX: .................. 0
   TX: .................. 133805
```

```
   RX Mcast: ............ 0
   TX Mcast: ............ 133805
   Access Rx Fail Rate (frames/min): 0
   Access Rx Dup Rate (frames/min):  0
   Access Rx OOR Rate (frames/min):  0
   Access Tx Fail Rate (frames/min): 0
MPDU Statistics:
   RX: .................. 17694466
   TX: .................  1104110
   FCS Errors: .......... 0
   WEP Undecryptable: ... 0
   RTS Success: ......... 235053
   RTS Failures: ........ 0
   ACK Failures: ........ 0
   Failed: .............. 0
   Retries: ............. 0
   Multiple Retries: .... 0
   Frame Dups: .......... 0
Privacy Rejected Statistics:
   Transmit: ............ 0
   Plain: ............... 0
   Encrypted: ........... 0
   No Key: .............. 0
DoS Statistics:
   deauth attacks: ...... 0
Backhaul Link Statistics:
Link Rx_Pkts     Tx_Pkts     Rx_Bytes    Tx_Bytes    Rx_Errs  Tx_Errs
---- -------     -------     --------    --------    -------  -------
1    131828      405913      15326450    35360815    0        0
```

Wi-Fi Performance Monitoring Statistics

```
/interface/wifi-<n>-<m>/show pm {fifteen-min|day}
             [{<0-96>|<0-7>|all{msdu|mpdu|error-rate|
               rx-modulation|tx-modulation|aggr|duty-cycle}}]
```

This command displays a radio's performance measurements either for a specific time interval or for a series of time intervals. The valid parameter options are:

- *fifteen-min*, *fifteen-min 0* to *fifteen-min 96*, *fifteen all msdu*, *fifteen all mpdu*, *fifteen all error-rate*, *fifteen all rx-modulation*, *fifteen all tx-modulation* or *fifteen all aggr*
- *day*, *day 0* to *day 7*, *day all msdu*, *day all mpdu*, *day all error-rate*, *day all rx-modulation*, *day all tx-modulation* or *day all aggr*

Note: Depending on the type and vintage of radio, not all statistics may be available.

Specifying *fifteen-min* is equivalent to specifying *fifteen-min 0* and means the current 15-minute interval. Specifying *day* is equivalent to specifying *day 0* and means the current day, excluding data from the current 15-minute period.

When specifying a specific time interval

The output displays various statistics for that interval, including:

- MAC Service Data Unit (MSDU) statistics, including the delivery error rate and the transmit on air error rate for transmitted packets
- MAC Protocol Data Unit (MPDU) statistics, including the delivery error rate and the transmit on air error rate for data packets and management packets
- the number of packets received and transmitted at various modulation rates
- the number of packets transmitted in each of the QoS traffic priority queues
- a series of 802.11n aggregate statistics

MSDUs are received at the MAC layer and then either fragmented or concatenated with other recently received MSDUs to form an MPDU.

When specifying *all* intervals

The output displays a radio's performance measurements in table format for a series of day or 15-minute time intervals. Each interval is displayed as a row. Individual statistics are displayed as columns.

The data in the table varies, depending on your selection, as follows:

- Selecting *msdu* displays the MSDU statistics:

  — *TxSOk* is the number of packets successfully transmitted.

  — *TxMulticast* is the number of multicast packets transmitted.

  — *TxDropped* is the number of dropped transmit packets.

  — *TxFailed* is the number of failed transmit packets.

  — *RxSOk* is the number of packets successfully received.

  — *RxMulticast* is the number of multicast packets received.

  — *RxDropped* is the number of dropped received packets.

  — *RxFailed* is the number of failed received packets.

- Selecting *mpdu* displays the MPDU statistics:

  — *TxOk* is the number of packets successfully transmitted.

  — *TxFailed* is the number of failed transmit packets.

  — *AckFailed* is the number of failed acknowledge packets.

—*MgtTxOk* is the number of management packets successfully transmitted.

—*MgtTxFailed* is the number of failed management transmit packets.

—*MgtAckFailed* is the number of failed management acknowledge packets.

- Selecting *error-rate* displays the error rates for MSDU and MPDU statistics:

—*Tx Error Rate (delivery)* is the percent of dropped and failed packets over the total number of packets transmitted.

—*Tx Error Rate (on air)* is the percent of failed packets over the total number of packets transmitted.

—*Data Tx Error Rate (delivery)* is the percent of dropped and failed packets over the total number of transmitted data packets.

—*Data Tx Error Rate (on air)* is the percent of failed packets over the total number of transmitted data packets.

—*Mgmt Tx Error Rate (delivery)* is the percent of dropped and failed packets over the total number of transmitted management packets.

—*Mgmt Tx Error Rate (on air)* is the percent of failed packets over the total number of transmitted management packets.

- Selecting *rx-modulation* displays the number of packets received at each modulation rate.
- Selecting *tx-modulation* displays the number of packets transmitted at each modulation rate.
- Selecting *aggr* displays the 802.11n aggregate statistics.
- Selecting *duty-cycle* displays:

—for the WCS radio, the number of times the transmitter was throttled to prevent the duty-cycle target from being exceeded

—for all other radios. the percentage of time the radio is transmitting, receiving or has a busy channel

Example 1

```
/interface/wifi-2-1# show pm fifteen-min
```

For non-WCS radios, the output is as follows:

```
Radio Performance - Interval type: current 15 minute    Interval number: 0
MSDU stats:
```

```
    TxOk:              15714    RxOk:            140462
    TxMulticast:           0    RxMulticast:          0
    TxDropped:             0    RxDropped:            0
    TxFailed:           1525    RxFailed:         10190
    Tx Error Rate: (delivery)    9  (on air)    9

MPDU stats:
    TxOk:              15714    MgtTxOk:           1843    RxOk:              140462
    TxFailed:           1525    MgtTxFailed:       1525    RxFramesErr:        10184
    AckFailed:          3104    MgtAckFailed:         0    RxFrameAbort:           6
                                  RxNotForUs:      3533      RxPhyAbort:      105593
    TxRetries(1,2,3,4,>4):  54 1525 0 0 0
    Data Tx Error Rate: (delivery)    9  (on air)   17
    Mgmt Tx Error Rate: (delivery)   46  (on air)    0

No. Rx & Tx Frames at modulation rate (mbps aaa):
    Rx  54.0:             89    Tx  54.0:             0
    Rx  48.0:             60    Tx  48.0:             0
    Rx  36.0:             15    Tx  36.0:             0
    Rx  24.0:           3580    Tx  24.0:             0
    Rx  18.0:             39    Tx  18.0:             0
    Rx  12.0:           1753    Tx  12.0:             0
    Rx   9.0:            241    Tx   9.0:             0
    Rx   6.0:           8055    Tx   6.0:             0
    Rx  11.0:           3279    Tx  11.0:             0
    Rx   5.5:             24    Tx   5.5:             0
    Rx   2.0:              9    Tx   2.0:             0
    Rx   1.0:         123318    Tx   1.0:         17239
No. RX Frame Counts
   Rate (Mbps)     Rx-ok       Duplicate   w/ Retry    w/o Retry   Failed      SNR Out of Range

No. Tx Frames on data queue (priority highest=3 ... lowest=0):
    Queue 3:               0       Queue 1:           0
    Queue 2:            1684       Queue 0:           0

Aggregation stats:
    TxSingleMsdu:              0    TxAggrMsdu:               0     TxAggrAmpdu:              0
    TxAggrMsduOk:              0    TxAggrAmpduOk:            0
    TxAggrRetry:               0    TxAggrMaxRetry:           0     TxDropped:                0
    RxMsdu:                    0    RxMsduOk:                 0
    TxBars:                    0    RxBars:                   0     RxBarExchange             0
Tx Busy Indicator:
    Average:       4             Max:       5            Min:       4
Rx Busy Indicator:
    Average:       45            Max:       46           Min:       45
Channel Busy Indicator:
    Average:       52            Max:       53           Min:       51
```

For WCSv1 radios, the final section of the output is as follows:

```
Tx Duty Cycle Control stats:
    Average:       0            Max:       1            Min:       0          Limit Events:        0
```

```
Rx Busy Indicator:
    Average:        0           Max:        0             Min:        0
Channel Busy Indicator:
    Average:        0           Max:        1             Min:        0
```

Example 2 - Non-WCS radios

```
/interface/wifi-2-1# show pm fifteen-min all duty-cycle
```

int	TxAverage	TxMax	TxMin	RxAverage	RxMax	RxMin	ChAverage	ChMax	ChMin
0	4	5	4	45	46	45	52	53	51
1	4	5	4	44	46	41	50	52	48
2	4	5	4	43	45	42	49	51	48
3	4	5	4	44	46	44	51	52	50
4	4	5	4	44	45	42	50	52	49
5	4	5	4	42	44	42	48	50	48
6	4	5	4	44	46	43	50	52	49
7	4	5	4	43	45	41	49	52	48
8	4	5	4	44	45	43	50	52	49
9	4	5	4	44	46	43	50	52	50
10	4	5	4	45	46	44	51	52	51
11	4	5	4	44	46	43	51	53	50
12	4	5	0	38	46	6	44	53	7
13	0	0	0	3	6	0	3	7	0

Example 3 - WCS radios

```
/interface/wifi-2-1# show pm fifteen-min all duty-cycle
```

int	TxAverage	TxMax	TxMin	Limit Events	RxAverage	RxMax	RxMin	ChAverage	ChMax	ChMin
0	0	1	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0	0	0

Configuring Wi-Fi Access Point Parameters

This chapter describes how to display and configure Wi-Fi Access Point (AP) parameters, including:

- “ARP Filtering” on page 143
- “ARP to Unicast Conversion” on page 143
- “802.11b Protection” on page 144
- “Wi-Fi Client Statistics” on page 144

See also:

- “Configuring Wi-Fi Radio Parameters” on page 103
- “Wi-Fi AP Security” on page 146
- “Wi-Fi Backhaul Link Configuration” on page 161
- “Mobile Backhaul Mesh” on page 169

Displaying AP Configuration

Use the *show config access* command to display the current AP configuration. See “Displaying Wi-Fi Radio Configuration” on page 104 for details.

Example - BelAir20E

```
/interface/wifi-1-1# show config access
Slot: 1, Card Type: htme, revision: 1, Port: 1, Radio: HTMv1 5GHz
802.11n
admin state: ................. Enabled
channel: ..................... 149
  mode: ...................... ht40plus
  mimo: ...................... 3x3
  tx power: ................. 18.0 (dBm per-chain), 23.0 (dBm total)
antenna location: ............ External Port
antenna index: ............... 1
antenna gain: ................ 5.0  (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:0c:21:90
Access:
  AP admin state: ............ Enabled
  secure addresses (vlan): ... none
  client blacklist: .......... none
  dhcp unicast: .............. Disabled
  deauth dos defense: ........ Disabled
  client auth trap: .......... Disabled
Misc:
  rts-cts threshold: ......... 100
  broadcast filter status: ... Disabled
  broadcast filter rate: ..... 200
```

AP Custom Rates

```
/interface/wifi-<n>-<m>/show custom-rates
/interface/wifi-<n>-<m>/set custom-rates {disabled |
                            enabled [{add|del} [b <rate_string>]
                                               [g <rate_string>]
                                              [ht <rate_string>]}
```

These commands let you customize the modulation rates used by your 802.11n radio by building a list of rates to include. Putting a rate on the list allows the radio to use that rate.

The *show* command displays modulation rates that are currently on the list; that is, the rates that the radio uses. Rates that have short preamble are indicated with *sp*.

Use the *set* command to enable or disable the custom rates feature. By default, the custom rates feature is disabled.

Once you enabled custom rates, use the *add* and *del* parameters to create the specific list of rates that you need. The *<rate_string>* parameter is one of rates output by the *show custom-rates* command.

If you use the *set* command without specifying a custom rate, a list of valid custom rates is displayed.

Note: Adding a rate does not mean that the radio automatically begins to use that rate. The modulation rate selected by a radio depends on several factors. The custom rates list is just one of those factors.

Example 1 - Using Custom Rates

```
/interface/wifi-1-2# set custom-rates enabled
Valid custom b rates are:
11,5.5,2,1,11(sp),5.5(sp),2(sp)

Valid custom g rates are:
48,24,12,6,54,36,18,9

Valid custom n rates are:
mcs0,mcs1,mcs2,mcs3,mcs4,mcs5,mcs6,mcs7

/interface/wifi-1-2# show custom-rates
Custom-rate is enabled and the list includes:
         A/G : 48 24 12 6 54 36 18 9
           B : 11 5.5 2 1 11(sp) 5.5(sp) 2(sp)
        HTSS : mcs0 mcs1 mcs2 mcs3 mcs4 mcs5 mcs6 mcs7
        HTDS : mcs8 mcs9 mcs10 mcs11 mcs12 mcs13 mcs14 mcs15
```

Example 2 - Using Custom Rates

```
/interface/wifi-1-2# show custom-rates
Custom-rate is enabled and the list includes:
         A/G : 48 24 12 6 54 36 18 9

/interface/wifi-1-2# set custom-rates enabled del g 18

/interface/wifi-1-2# show custom-rates
Custom-rate is enabled and the list includes:
         A/G : 48 24 12 6 54 36 9
```

Displaying Associated Wireless Clients

```
/interface/wifi-<n>-<m>/show clients [ssid <ssid_index>]
```

This command displays the list of associated wireless clients for a given SSID. If no SSID is specified, the displayed list shows all associated clients and their SSID.

The *ssid_index* parameter must be a valid SSID index.

In the resulting output:

- The *time* field displays how long the client has been associated to the BelAir Networks radio.
- The *IP* field lists the client's IP address. (s) indicates static IP addressing.
- The *identity* field lists the 802.1X client identity. It is present for dot1x or WPA SSIDs.
- The *auth* field lists the authentication state of the client. See Table 9.
- The *dhcp* field lists the client DHCP state (applicable only if client uses dynamic IP addressing). See Table 10 on page 126.

Table 9: Auth Field Value Descriptions

Value	Description
unauth	default or initial state
auth	client is authorized for Open or WEP privacy
eapAuth	client is authorized for dot1x, WPA1 or WPA2 privacy
pskErr	Possible wrong WPAPSK key configured on client
radto	For dot1x, WPA1 or WPA2. Problems connecting to radius server, possibly because of a network problem.
cltto	For dot1x, WPA1 or WPA2. Problems sending EAP packets to client.

Table 10: DHCP Field Value Descriptions

Value	Description
init	Client has just connected and has not yet started a DHCP sequence

Table 10: DHCP Field Value Descriptions (Continued)

Value	Description
disc	Client has sent a DHCP Discover message and is waiting for a DHCP Offer message to get its IP address. (Applicable only if client does not already have a valid IP address. Otherwise client sends DHCP Request message.)
offer	Server has responded to the DHCP Discover message with a DHCP Offer message. This packet tells the client its IP address. The client should then send a DHCP Request message to verify the IP address.
req	Client has sent the DHCP Request message to the server and is waiting for a DHCP Ack message to confirm the assigned IP address.
decl	Server has declined the client's DHCP request. Verify the server settings.
ack	Client has sent a DHCP Request message and the server has confirmed the assigned IP address. (a * appended to the value indicates a completed DHCP process.)
nack	Server has responded to the client's DHCP request with a DHCP Nack message. Verify the server settings.
relse	Client has sent a DHCP Release message.
inform	Client has sent a DHCP Inform message. Depending on the server, the server may respond with a DHCP Ack message. (a * appended to the value indicates a completed DHCP process.)
arpRes	Client has gone through one of the DHCP state transitions and replied to an ARP request for its IP address. (a * appended to the value indicates a completed DHCP process.)

Depending on the server configuration, if a client moves to a different subnet, it may need to timeout the current IP address (approx. 30 seconds) and then restart the DHCP sequence. During this process the client may use the standard default IP address for Microsoft Windows (169.254.X.X).

Example

```
/interface/wifi-2-1# show clients

SS-ID vlan    mac addr          time IP                 identity   rssi auth    dhcp
----- ---- ----------------- ---- ------------------ ---------- ---- ------- ------
2-4   0    00:11:24:26:24:AA 4m   10.9.9.20(s)                  -82  eapAuth static
```

Displaying Wireless Client Details

```
/interface/wifi-<n>-<m>/show client <1|2|...|2007>
                                        [throughput] [stats]
```

This command displays the details of a wireless client that is associated or was recently associated with the AP. You determine the client number *<1/2/.../2007>* with the *show clients* command. See "Displaying Associated Wireless Clients" on page 126.

The *throughput* parameter displays additional information on traffic throughput.

The *stats* parameter allows displays additional information on packet statistics.

In the resulting output, the *age* parameter shows the time since the radio last received a data frame from the client and the *state* parameter shows *authenticated (2)* if the client is no longer associated.

Example

```
/interface/wifi-1-1# show client 35
   Ssid: ........... 1
   Vlan: ........... 0
   Mac Address: .... 00:18:DE:98:28:E8
   Connected Time: . 0 yrs 0 days 00:00:42
   Aging Time: ..... 0 seconds
   Ip Address: ..... 10.1.1.60
   Identity: .......
   Rssi: ........... -48 (dBm)
   Auth State: ..... Authenticated(open/wep)
   Dhcp State: ..... Client sent ARP response (complete)
```

Disconnecting a Wireless Client

```
/interface/wifi-<n>-<m>/disconnect client <mac_address>
```

This command lets you disconnect the specified client from the AP.

You determine the client MAC address with the *show clients* command. See "Displaying Associated Wireless Clients" on page 126.

Wireless Client Load Balancing

```
/interface/wifi-<n>-<m>/set max-num-clients <max_num> [strict]
```

This command lets you set the maximum number of clients that can associate with the AP. Once the maximum is reached, new client associations are not immediately accepted.

While using this command, keep in mind the following:

- If you do not use the *strict* parameter, and a new client continues to try to associate after the client maximum is reached, the AP does accept it after three retries. (All association retries in a one minute interval is considered a single retry.)
- If you use the *strict* parameter, the AP does not accept a new client when the client maximum is reached, even if the new client to tries to associate repeatedly.
- Changing the client maximum does not take effect until two minutes later.
- Changing the client maximum does not disconnect any existing client.

The <max_num> parameter ranges from 0 to 256. The default is 256.

Configuring RTS-CTS Handshaking

```
/interface/wifi-<n>-<m>/set rts-cts {disabled|enabled <threshold>}
```

This command lets you enable or disable Request-to-Send (RTS) and Clear-to-Send (CTS) handshaking.

When enabled, handshaking occurs for packets larger than the threshold. The <threshold> parameter can range from 1 to 65536. The default value is 100.

By default, dynamic rate handshaking is *disabled*.

Specifying the Beacon Period

```
/interface/wifi-<n>-<m>/set beacon-period
                            {auto | <bp_value> [dtim <dt_value>]}
```

This command lets you specify the behavior of your beacon period for broadcast Service Set Identifiers (SSIDs). See also "AP Service Set Identifiers" on page 131.

If specified, the *<bp_value>* parameter specifies a fixed beacon period in milliseconds. It ranges from 100 to 400.

The optional *<dt_value>* parameter specifies the DTIM value. It ranges from 1 to 3.

If you select *auto*, the AP automatically adjusts the beacon period and DTIM value dynamically according to the number of MBSSIDs.

The default setting is to have a fixed beacon period of 100 ms with a DTIM value of 3.

Displaying Client Association Records

```
/interface/show client-record <num_entries> [radio <radioIf_name>]
                          [vlan {<vlan_id>| none}] [mac-addr <mac_address>]
                            [aggregation | start <start_idx>]
/interface/show client-record detail <num_entries>
```

Every 15 minutes, the AP generates wireless client association records. A client record includes the following information:

- The IP address, MAC address, VLAN, RSSI, DHCP state, and authentication state of the client.
- The radio interface and SSID index for the radio the Wi-Fi client is associated to.
- The start and end connection time, as well as the times a client has a throughput greater than 2 kBps or transmits more than 2 kB of traffic.

If a client connection crosses more than one 15-minute interval, another client record is generated for that client. A *continue* flag indicates that the client has another record in the next 15-minute interval.

The *num_entries* parameter specifies the number of entries to display.

You can filter the output based on the following optional parameters:

- Use *radio <radioIf_name>* to filter for records of clients connected to a particular Wi-FI interface, such as *wifi-2-1*.
- Use *vlan <vlan_id>* to filter for records of clients using a particular VLAN, or no VLAN.
- Use *mac-addr <mac_address>* to filter for records with a client's MAC address.
- Use *aggregation* to show combined client records when a client connection crosses multiple 15-min boundary. Use *start <start_idx>* to show client records starting from a particular record index number. The starting index number is always unique.

Use the *show client-record detail* command to display details of a particular client record.

Example - Non Aggregated Records

```
/interface# show client-record 4

          SSID Start Time Connect      IP              MAC             RSSI      Vlan   RX    TX Continue
ID    Radio  INX dd hh:mm:ss mm:ss   address          address        max avg min   Id    KB    KB  flag
 11 wifi-2-1  1 11 06:42:57 15:02      10:1:1:7 00:18:de:c2:30:46 -25 -44 -64     0    90   109  Yes
 10 wifi-2-1  1 11 06:27:55 15:02      10:1:1:7 00:18:de:c2:30:46 -25 -44 -64     0    60    72  Yes
  9 wifi-2-1  1 11 06:12:53 15:02      10:1:1:7 00:18:de:c2:30:46 -25 -44 -64     0   268   323  Yes
  8 wifi-2-1  1 11 05:57:51 15:02      10:1:1:7 00:18:de:c2:30:46 -25 -44 -64     0   219   250  Yes
```

Example - Aggregated Records

```
/interface# show client-record 20 aggregation

          SSID Start Time  End Time        IP              MAC          RSSI Vlan  RX    TX Cross Byte  Cross Rate
ID   Radio  INX dd hh:mm:ss dd hh:mm:ss    address          address        avg  Id   KB    KB dd hh:mm:ss dd hh:mm:ss
  1 wifi-2-1  1 11 04:57:41 11 04:59:40     10:1:1:7 00:18:de:c2:30:46 -42    0    5     4 11 04:58:42 not exceed
  3 wifi-2-1  1 11 05:00:11 11 05:01:25     10:1:1:7 00:18:de:c2:30:46 -45    0   11     8 11 05:00:52 not exceed
  4 wifi-2-1  1 11 05:08:02 11 06:57:59     10:1:1:7 00:18:de:c2:30:46 -44    0 1074 1255 11 05:08:21 not exceed
```

Example - Client Record Detail

Figure 14: Client Record Detail Example

```
/interface# show client-record detail 4

Client Record INX[4]:
  Radio Interface: wifi-2-1
  SSID Idx: 1
  Start Time (mon-dd hh:mm:ss): 07-11 05:08:02
  End Time (mon-dd hh:mm:ss): 07-11 05:12:45
  Vlan ID: 0
  IP Address: 10:1:1:7
  MAC Address: 00:18:de:c2:30:46
  RSSI(dbm): max -25, min -64, avg -43
  Exceed Throughput(2KB) Time: 07-11 05:08:21
  Throughput: Rx 35KB, Tx 33KB
  Authenticate State: Authenticated(open/wep)
  DHCP State: Client sent ARP response
  Is Continued: Yes
```

When the client logged in

When the record ends

Client RSSI information

Time when client crossed the 2 kbyte threshold.

Same as *show client detail* command.

If *Yes*, record continues into next 15-minute window.

Changing AP Admin State

```
/interface/wifi-<n>-<m>/set ap admin-state {enable|disable}
```

This command controls the state of the AP. When set to *enable*, the AP is in the operational state. When set to *disable*, the AP and all associated functions are disabled. The default is *enabled*.

AP Service Set Identifiers

Use the commands in this section to:

- configure AP Service Set Identifiers (SSIDs)
- map an SSID to a VLAN

- provide vendor specific information

Each AP supports up to 8 SSIDs. If associated clients use different SSIDs, then the AP can use the SSID to direct traffic to different VLANs.

Displaying the SSID Table

```
/interface/wifi-<n>-<m>/show ssid table
```

This command summarizes in table format the parameters of all configured SSIDs. In the resulting output:

- The *broadcast* setting is the default for SSID 1. A *broadcast* setting means that the access radio responds to a broadcast probe request and that SSID information element is present in the beacon dataframe. A *broadcast* SSID has a Basic Service Set (BSS), a unique identifier having the same format as a MAC address.
- A *suppressed* setting means that the access radio responds only to a unicast probe request and that SSID information element is present in the beacon dataframe, but has a length of 0 and a null value. A *suppressed* SSID has a Basic Service Set (BSS), a unique identifier having the same format as a MAC address.

Example - Typical Output

```
/interface/wifi-1-1# show ssid table
SSID Information
-------------------------------------------------------------------------------------
  id enabled vlan type       privacy        wb sp acl       bss          ssid
-------------------------------------------------------------------------------------
  1    yes    --   Broadcast  none           -- -- --  00:0D:67:0C:21:98 RickBA20E-15-2
  2    no     --   Suppressed none           -- -- --  00:0D:67:0C:21:99 DefaultSsid2-2
  3    no     --   Suppressed none           -- -- --  00:0D:67:0C:21:9A DefaultSsid2-3
  4    no     --   Suppressed none           -- -- --  00:0D:67:0C:21:9B DefaultSsid2-4
  5    no     --   Suppressed none           -- -- --  00:0D:67:0C:21:9C DefaultSsid2-5
  6    no     --   Suppressed none           -- -- --  00:0D:67:0C:21:9D DefaultSsid2-6
  7    no     --   Suppressed none           -- -- --  00:0D:67:0C:21:9E DefaultSsid2-7
  8    no     --   Suppressed none           -- -- --  00:0D:67:0C:21:9F DefaultSsid2-8
  ====================================================================================
```

In the previous example:

- *wb* is for wireless bridge; see "Disabling or Enabling AP Wireless Bridging" on page 157
- *sp* is for secure port; see "AP Secure Port Mode" on page 159
- *acl* is for access control list; see "Wireless Client Access Control List" on page 155

- *bss* is for basic service set; see "Configuring SSIDs" on page 134
- a star (*) means that the feature is enabled for that particular SSID
- a double dash (--) means that the feature is not enabled for that particular SSID

Displaying SSID Details

```
/interface/wifi-<n>-<m>/show ssid <ssid_index> config
```

This command displays details of a particular SSID. Use the *show ssid table* command to determine *<ssid_index>*.

Example

```
/interface/wifi-1-1# show ssid 3 config
Configuration for ssid 3
admin state: ..................... Enabled
SSID: ............................ DefaultSsid2-1
AP oos identifier: ............... outOfService..
mbssid state: .................... Enabled
type: ............................ Broadcast
privacy mode: .................... none
rekey: ........................... Disabled
key strict: ...................... no
traffic mapped to vlan: .......... none
passthrough vlan(s): ............. disabled
wireless bridge state: ........... Disabled
group address filter: ............ none
upstream UP marking: ............. Disabled (0)
acl state: ....................... Disabled
secure port state: ............... Disabled
arp unicast conversion state: .... Disabled
radius NAS identifier: ........... belair
radius accounting: ............... Disabled
radius station id unformatting: .. Disabled
radius account session id: ....... Disabled
secure addresses (vlan):
   No secure addresses configured
client blacklist:
  No blacklist entries
auto secure gateway: ............. enabled
  Address            Vlan
  00:0a:5e:49:1c:33  (500)
  00:0a:5e:49:1c:8b  (600)
radius servers:
  No radius servers configured for this ssid
DHCP relay servers:
  Server[1] Addr: 10.1.100.88
      sub-option: 150/151 inserted
      sub-option151: vpn-selector
Option82 Insert Enabled.
```

Default Management SSID

By default, SSID 8 of each radio is a suppressed SSID preconfigured for a management session.

The default management SSID is *BelAir-<MAC_info>*, where <MAC_info> is the last six digits of the AP's MAC address.

For example, if an AP has a MAC address of *00:0D:67:08:48:98*, the default management SSID is *BelAir-084896*.

By default, SSID 8:

- uses WPA encryption with the following pre-shared key: *DefaultKey123*. Users may wish to change the security settings to suit their needs.
- is not mapped to a VLAN. Users may wish to map SSID 8 to a separate VLAN reserved for management sessions.

Refer to the following topics for details on changing the default settings for SSID 8:

- To change the SSID and map it to a VLAN, see "Configuring SSIDs" on page 134.
- To change the security settings, see "Wi-Fi AP Security" on page 146.

Configuring SSIDs

```
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                     service-set-identifier <ssid_string>
                    {broadcast | suppressed}
                     vlan {<vlanID-list>|none}
                    [passthrough-vlan {<passvlanID-list>|none}]
```

This command allows you to configure AP SSIDs.

The *ssid_string* parameter is the SSID setting. SSIDs are case sensitive and can contain up to 32 alphanumeric characters. To specify a blank string, input two double quotes ("").

The *ssid_index* parameter is an integer from 1 to 8. Use the *show ssid table* command to determine *<ssid_index>*.

For a description of the *broadcast* and *suppressed* parameters, see "Displaying the SSID Table" on page 132.

The *vlanID-list* parameter, if present, specifies a comma separated list of VLAN IDs. Each VLAN ID must be an integer from 1 to 3015 and from 3018 to 4045. The list can contain up to eight VLAN IDs.

The *vlanID-list* parameter activates functionality to balance traffic among up to eight VLANs, based on the last three bits of the MAC address of the wireless client generating the traffic. The last three bits of the MAC address can range in value from 0 to 7. For example:

- Traffic from clients where the last three bits have a value of 0 is directed to the first VLAN on the list.
- Traffic from clients where the last three bits have a value of 1 is directed to the second VLAN on the list.
- Traffic from clients where the last three bits have a value of 6 is directed to the seventh VLAN on the list.

If the last three bits of the MAC address does not reference a VLAN on the list, then the client's traffic is directed to the first VLAN on the list.

If the *vlan* parameter is *none* and the wireless client is sending untagged traffic, then the traffic corresponding to the specified SSID is passed through the access radio without change. If the wireless client is sending tagged traffic, then you can use the *passvlanID-list* parameter.

The *passvlanID-list* parameter, if present, also specifies a comma separated list of VLAN IDs. As with the *vlanID-list* parameter, each VLAN ID must be an integer from 1 to 3015 and from 3018 to 4045, and the list can contain up to eight VLAN IDs.

The *passvlanID-list* parameter applies to pre-tagged traffic; for example, generated from Linux wireless clients. If the traffic's VLAN tag matches a VLAN on the list, then that traffic is allowed to go through unchanged. Otherwise, the tagged traffic from the client is dropped.

If *passvlanID-list* is populated, then *vlanID-list* can specify only one VLAN ID. In such cases, untagged traffic from the client is tagged with the VLAN from *vlanID-list*. If the VLAN ID list is set to *none*, then untagged traffic from the client remains untagged.

If the passthrough VLAN list is *none*, tagged packets from a wireless client are dropped. Untagged packets from the client are tagged with the VLAN ID from *vlanID-list* according to the last three bits of the client's MAC address.

CAUTION! This caution applies to the BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100. If your network contains a BelAir200, you must configure its VLAN subsystem with the specified VLAN ID before using this command on a BelAir100SN. Refer to the *BelAir200 User Guide* for instructions on configuring VLAN subsystems. All traffic from the specified client is discarded by the BelAir200 if the mapped VLAN is not previously configured.

Upstream User Priority Marking

```
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                              upstream-up-marking {enabled|disabled}
                            [ up-value <val> ]
```

This command enables or disables the ability to set the User Priority (UP) value of any packet received by the AP for a particular SSID. The UP values are then used throughout the network to separate and prioritize traffic through Quality of Service (QoS) settings. See "Quality of Service Settings" on page 225 for details.

By default, upstream UP marking is *disabled*.

The *ssid_index* parameter must be a valid SSID index. See "AP Service Set Identifiers" on page 131

Setting Traffic Limits

```
/interface/wifi-<n>-<m>/set ssid <ssid_index> traffic-limit
                                        ([upstream <bits-per-second>]
                                         [downstream <bits-per-second>])
```

This command allows you to control the amount of traffic the AP sends for a particular SSID:

- Use the *upstream* parameter to specify the amount sent to the network.
- Use the *downstream* parameter to specify the amount sent to wireless clients.
- Specify 0 to remove previously set limits.

Use the *show ssid table* command to determine *<ssid_index>*. Use the *show ssid <ssid_index> config* command to see the currently configured values.

Limiting the Number of Clients per SSID

```
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                             client-limit-priority <priority-number>
                             [min <minimum-guaranteed>]
                             [max <maximum-allowed>]
```

This command allows you to control the number of clients that a particular SSID can service. The sum of all clients for all SSIDs cannot exceed the limit set with the *set max-num-clients <max_num>* command. (See "Wireless Client Load Balancing" on page 129.)

The associated parameters are:

- Use *<priority-number>* to assign a priority number to the SSID. Priority numbers range from 1 to 8, where 8 is the highest priority. The default priority is 1.

- Use the *min* parameter to specify the minimum number of clients this SSID is guaranteed to serve. The default setting is 0.
- Use the *max* parameter to specify the maximum number of clients this SSID can have. The default setting is 256.

Use the *show ssid table* command to determine *<ssid_index>*. Use the *show ssid <ssid_index> config* command to see the currently configured values.

Providing Vendor Specific Information

```
/interface/wifi-<n>-<m>/set ssid <ssid-number>
                            option82 insertion {enabled|disabled}
/interface/wifi-<n>-<m>/set ssid <ssid-number> option82 use
                        ([circuit-id {enabled | disabled}]
                         [remote-id {enabled | disabled}]
                         [vendor-option {enabled | disabled}]
                         [scope-selector {enabled | disabled}])
/interface/wifi-<n>-<m>/set ssid <ssid-number>
                           option82-circuit-id
                           {SSID | custom-field <num_str>}
/interface/wifi-<n>-<m>/set ssid <ssid-number>
                           option82-remote-id
                           {node-mac | custom-field <num_str>}
/interface/wifi-<n>-<m>/set ssid <ssid-number>
                           option82-scope-selector <random_str>
```

For any SSID, you can add vendor specific option 82 information to DHCP packets. Typically, this is done when DHCP relay functionality is enabled with the *set ssid <ssid_index> dhcp-relay* command. (For details see "Assigning SSID Traffic to Use DHCP Relay" on page 193.) However, vendor specific information can be added even if DHCP relay is disabled. In such cases, a warning is displayed but the vendor specific information is still added to the packets.

Use the *set ssid option82 insertion* command to control whether DHCP option 82 (DHCP relay agent information) is inserted into packets or not.

Relay agent information can be packaged in the following option 82 suboption fields:

- Circuit ID; that is, suboption 1
- Remote ID; that is, suboption 2
- Vendor option; that is, suboption 9
- Scope selector; that is, suboptions 150 and 151

If option 82 insertion is enabled, use the *set ssid option82 use* command to control which fields (circuit ID, remote ID, vendor option, or scope selector) are used. You can use any or all of these fields.

Note: There are DHCP packet length limitations. If you enable all fields, then the DHCP packet may not be large enough to contain all the vendor specific information. In such cases, some vendor specific information may not be inserted into the packet properly and the packet may be marked as *Malformed Packet*. However, the packet still contains the IP address.

If you enable circuit ID (suboption 1), by default the field contains the SSID. You can also use the *set ssid option82-circuit-id* command to configure the field to use one of the five custom fields described in "Custom Fields" on page 67.

If you enable remote ID (suboption 2), by default the field contains the AP MAC address. You can also use the *set ssid option82-remote-id* command to configure the field to use one of the five custom fields described in "Custom Fields" on page 67.

If you enable vendor option (suboption 9), the relay agent information is packaged as follows:

- agent circuit ID
- Subsuboption 1, the MAC address of your AP
- Subsuboption 2, VLAN identifier
- Subsuboption 3, Radio MAC address
- Subsuboption 4, SSID: the SSID that is using the DHCP relay functionality
- Subsuboption 5, GPS coordinates

If you enable scope selector (suboption 150 and 151), the relay agent information is packaged as follows:

- Suboption 150. The VLAN info is packaged as follows:

  ```
  0x96, 0x04,0xn, 0xn, 0xn, 0xn
  ```

  Where:

  —The first field is always 0x96, identifying Suboption 150.

  —The second field is always, 0x04, specifying the length of the VLAN info.

  —The last four fields are 0xn, where each value of n is a digit specifying the VLAN number.

  For example, 0x96, 0x04, 0x1, 0x2, 0x0, 0x0 specifies VLAN 1200. VLAN 100 would be specified as 0x96, 0x04, 0x0, 0x1, 0x0, 0x0.

- Suboption 151. The VPN selection ID is packaged as follows:

  `0x97, 0x0a, 0x00, 0xnn, 0xnn, 0xnn, 0xnn, 0xnn, 0xnn, 0xnn, 0xnn, 0xnn`

  Where:

  —The first field is always 0x97, identifying Suboption 151.

  —The second field specifies the length of the VPN selection ID.

  —The remaining fields specify an ASCII string of the VPN selection ID.

If Suboption 150 and 151 are selected, use the *set ssid option82-scope-selector* command to specify the VPN selection ID. You can specify an ASCII string of up to 32 alphanumeric characters. To specify a blank string, input two double quotes (“”).

If Suboption 150 and 151 are selected and a Suboption 151 string is undefined, the SSID string is used instead.

Changing SSID Admin State

```
/interface/wifi-<n>-<m>/set ssid <ssid_index> admin-state
                                                {enable|disable}
```

This command enables or disables a particular SSID. Use the *show ssid table* command to determine *<ssid_index>*.

The default is *enabled* for SSID 1 and *disabled* for all others.

Wi-Fi SSID Performance Monitoring Statistics

```
/interface/wifi-<n>-<m>/show ssid <ssid_index> pm
                          {fifteen-min|day} [{<num_str>|all}]
```

This command displays an SSID’s performance measurements either for a specific time interval or for a series of time intervals. This command applies to all non-WCS radios.

The *ssid_index* parameter must be a valid SSID index. For details see “Configuring SSIDs” on page 134.

The valid time parameter options are:

- *fifteen-min*, *fifteen-min 0* to *fifteen-min 96*, and *fifteen-min all*
- *day*, *day 0* to *day 7*, and *day all*

Note: Depending on the type and vintage of radio, not all statistics may be available.

Specifying *fifteen-min* is equivalent to specifying *fifteen-min 0* and means the current 15-minute interval. Specifying *day* is equivalent to specifying *day 0* and means the current day, excluding data from the current 15-minute period.

When specifying a specific time interval

The output displays the following statistics for the specified SSID:

- *TxByte* and *RxBytes* are the number of bytes sent and received.
- *NumberOfMacs* is the number of unique client MAC addresses that have associated with the AP
- *NumberOfAssociations* is the number of successful client associations
- *NumberOfAuthorized* is the number of associated clients that have received at least 25,000 bytes of traffic from the AP.

When specifying *all* intervals

The output displays an SSID's performance measurements in table format for a series of day or 15-minute time intervals. Each interval is displayed as a row. Individual statistics are displayed as columns.

Example 1

```
/interface/wifi-2-1# show ssid 1 pm fifteen-min
SSID 1 Performance - Interval type: current 15 minute    Interval number: 0
    TxByte:                 1589       RxBytes:          0
    NumberOfMacss:          0          NumberOfAssociation:0          NumberOfAuthorized:0
```

Example 2

```
/interface/wifi-2-1# show ssid 1 pm fifteen-min all
int         TxBytes              RxBytes      NumberOfMacs  NumberOfAssociation  NumberOfAuthorized
0                342                2188                 0                    1                   0
1           10182662               63106                 1                    1                   1
```

Out-of-service Advertising

```
/interface/wifi-<n>-<m>/set ssid <ssid-number> ap-oos-identifier
                                                          <oos_string>
/system/set ap-oos-broadcast-delay <oos_delay>
/interface/wifi-<n>-<m>/set ap-oos-broadcast {enabled|disabled}
                                            [option {replace|prepend}]
/system/show ap-oos-broadcast-delay
```

These commands let you modify the SSIDs of a radio with an out-of-service string when an AP loses its egress connection for longer than the period specified by *<oos_delay>*. The out-of-service string can be prepended to the existing SSID or it can replace the existing SSID. The out-of-service string can contain up to 14 characters. The default string is *outOfService..* and by default it replaces the SSID.

The out-of-service delay (<oos_delay>) ranges from 30 to 300 seconds. The default is 300 seconds. The out-of-service delay is set for the entire AP. Use the */system/show ap-oos-broadcast-delay* command to display the current delay.

When an AP's egress connection is declared out-of-service, the AP also applies WPA AES encryption with a 16-character pre-shared key to all SSIDs except for the default management SSID. This is to prevent a user from accidently connecting to an open SSID which is in out-of-service. The 16-character pre-shared key consists of the first 10 characters of the out-of-service identifier followed by the last six digits of the AP's MAC address. If the out-of-service identifier is less than 10 characters, then period characters (.) are used to complete the first 10 characters of the pre-shared key.

The status of an AP's egress connection is determined as follows:

1 If a tunnel is enabled, the egress status is the tunnel's status.
2 If a tunnel is not enabled and there is a cable modem in the system, the egress status is the modem's status.
3 If a tunnel is not enabled and there is no cable modem in the system, the egress status is the Ethernet link's status.

See also:

- "Default Management SSID" on page 133
- "Security Options for Wireless Clients" on page 146

Filtering Broadcast and Multicast Packets

```
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                            group-address-filter {none | ipv4}
```

This command filters all broadcast and multicast packets to and from a wireless client except for ARP and DHCP packets, allowing you to reduce the amount of broadcast and multicast traffic in the network.

The *ssid_index* parameter must be a valid SSID index. See "AP Service Set Identifiers" on page 131

Use the *none* setting to disable this function. Use *ipv4* to enable this function.

If wireless bridging is enabled, the default is *none*. If wireless bridging is disabled, the default is *ipv4*.

See also:

- “Limiting Broadcast Packets” on page 73
- “Broadcast to Unicast Packet Conversion” on page 142

Broadcast to Unicast Packet Conversion

```
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                         dhcp-advanced {upstream-unicast | none}
```

This command lets you convert broadcast packets to unicast packets. Reducing the number of broadcast packets sent over wireless connections provides the following benefits:

- Broadcast packet are not retried in wireless transmissions, so in high interference environments wireless clients can miss their DHCP exchange.
- It reduces the bandwidth required for exchanges of DHCP messages.

The *ssid_index* parameter be a valid SSID index. See “AP Service Set Identifiers” on page 131.

The *set ssid <ssid_index> dhcp-advanced* command is set to *none* by default, meaning that it is disabled. In this case:

- All BOOTP packets, including DHCP packets, coming from the client are examined to determine if they are broadcast or unicast. This information is stored for use when the response arrives.
- All BOOTP packets, including DHCP packets, arriving from the network are examined. If needed, they are converted to match the format (broadcast or unicast) sent by the wireless client.

When the *set ssid <ssid_index> dhcp-advanced* command is set to *upstream-unicast*, it unsets the Request Broadcast bit for BOOTP packets, including DHCP packets, originating from clients before sending those packets to the network. This means that the network should respond with unicast packets instead of broadcast packets.

The *set ssid <ssid_index> dhcp-advanced* command does not affect BOOTP packets arriving from the network. All BOOTP packets, including DHCP packets, arriving from the network are examined. If needed, they are converted to match the format (broadcast or unicast) sent by the wireless client.

See also:

- “Limiting Broadcast Packets” on page 73
- “Filtering Broadcast and Multicast Packets” on page 141

ARP Filtering

```
/interface/wifi-<n>-<m>/set arp-filtering {disabled|enabled}
```

This command enables or disables ARP filtering on radio traffic from the AP to the wireless client. When enabled, the radio only forwards ARP request packets to a currently connected client. Otherwise, the downstream ARP requests are dropped.

The default setting is *disabled*.

ARP to Unicast Conversion

```
/interface/wifi-<n>-<m>/show arp-unicast-table [vlan <vlan_id> ]
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                       arp-unicast-conversion {enabled|disabled}
```

These commands control the conversion of upstream ARP packets to unicast packets.

When enabled, this feature intercepts ARP requests from wireless clients and sends them only to known gateway MAC addresses. ARP responses from the gateway are sent to the wireless client without interception and manipulation.

When the AP starts, the ARP unicast conversion table is empty. So the first ARP packet from the client is sent out as is; no conversion happens. When the ARP response arrives, the AP records its information, including the unicast MAC address, in the conversion table. For the following ARP packets, the AP replaces the broadcast MAC address in the ARP packet with the unicast MAC address from the conversion table.

When a conversion table entry is used, a 4-second response timer is started. If the ARP response arrives within 4 seconds, then the entry remains valid. Otherwise the entry is deemed invalid and removed from the table. Each entry is removed after 4 hours of inactivity.

The table holds up to 128 entries.

The default setting is *disabled*.

Example

```
/interface/wifi-1-2# show arp-unicast-table

  vlaid              ip                    mac     expire
----------------------------------------------------------------
     5          10.1.5.53    00:10:18:27:bc:07   03:57:18
     0          10.1.1.53    00:10:18:27:bc:07   03:59:32
    90         10.1.90.53    00:10:18:27:bc:07   03:59:55
```

802.11b Protection

```
/interface/wifi-<n>-<m>/set b-protection {disabled|enabled}
```

This command enables or disables 802.11b protection for the radio. Normally, an 802.11g AP uses CTS-to-self to interact with 802.11b APs. The transmitted packet is small, but in High Capacity and Interference environments the accumulated effect is a substantial performance penalty. This feature disables 802.11b protection for the radio, meaning that CTS-to-self are not sent and maximizing the throughput for wireless clients that operate in the 2.4 GHz range.

This feature improves performance if there are only a few 802.11b clients present and they are not generating large amounts of traffic. If not, the 802.11b clients may generate substantial numbers of collisions and actually impair traffic.

The default setting is *enabled*.

Wi-Fi Client Statistics

```
/interface/wifi-<n>-<m>/show client <ssidIdx-clientIdx>
                                  [throughput] [stats]
/interface/wifi-<n>-<m>/clear client {all|<ssidIdx-clientIdx>}
```

These commands display radio transmission statistics for a particular client.

Use the *show clients* command to determine the *<ssidIdx-clientIdx>* parameter. See the "Displaying Associated Wireless Clients" on page 126 for details on the *show clients* command.

In the output of the *show client <ssidIdx-clientIdx> [throughput] [stats]* command:

- The *Attempts* column contains the number of packets for which the initial transmission attempt was made at the specified rate.
- The *Success* column contains the number of packets for which transmission succeeded at the specified rate.
- The *Start Rate Change* column contains the number of times the specified rate was changed to be the initial transmission rate.
- The *Tx Retries* entry describes the number of times 0, 1 or more retries were required.
- The *Tx Failures* entry indicates the number of packets which were placed on the air at least once but never acknowledged.
- The *Tx Dropped* entry indicates the number of packets dropped without ever being transmitted (due to interference).

Example

```
/interface/wifi-2-1# show client 2-4 throughput stats

  Ssid: ........... 2
  Vlan: ........... 0
  Mac Address: .... 00:11:24:26:24:AA
  Connected Time: . 0 yrs 0 days 00:04:46
  Aging Time: ..... 1 seconds
  Ip Address: ..... 10.9.9.20 (static)
  Identity: .......
  Rssi: ........... -82 (dBm)
  Auth State: ..... Authenticated(dot1x/wpa)
  Dhcp State: ..... Static (in-progress)

Tx: Bytes     1360  Bytes/Sec      136  Avg Bytes/Sec      142  Moving Avg Bytes/Sec      571
Tx: Pkts        10  Pkts/Sec         1  Avg Pkts/Sec         1  Moving Avg Pkts/Sec         5
Rx: Bytes      980  Bytes/Sec       98  Avg Bytes/Sec      111  Moving Avg Bytes/Sec      446
Rx: Pkts        10  Pkts/Sec         1  Avg Pkts/Sec         1  Moving Avg Pkts/Sec         6

Tx Rate     Attempts    Success   Start Rate Change
   54            146          6          55
   48            193        157          58
   36              4        174           3
   24              2          8           1
   18              1          1           1
   12              1          1           0
    6              0          0           0
    2              0          0           0
    1              0          0           0
Tx Retries(0,1,2,3,4,>4): 87 198 62 0 0 0
Tx Failures:          0
Tx Dropped:           0
Tx Efficiency:       51

Rx Rate       Success  Duplicate
   54              0          0
   48              0          0
   36            441          5
   24             10          0
   18              2          0
   12              0          0
    6              0          0
    2              0          0
    1              4          0
```

Wi-Fi AP Security

This chapter describes how you can set up security to encrypt your Wi-Fi transmissions so that your data cannot be deciphered if it is intercepted, and to prevent access to the network by unauthorized clients. The following topics are covered:

See also:

- "Configuring Wi-Fi Radio Parameters" on page 103
- "Configuring Wi-Fi Access Point Parameters" on page 123
- "Wi-Fi Backhaul Link Configuration" on page 161
- "Mobile Backhaul Mesh" on page 169

Security Options for Wireless Clients

The AP has several options for wireless authentication and data encryption. The method that you use depends on your security needs and your network configuration.

If multiple SSIDs are configured, each SSID can be configured with its own security options.

The authentication options are:

- instruct the AP to connect to a Remote Authentication Dial In User Service (RADIUS) server in your network that keeps a list of accepted clients. RADIUS is a standard for user authentication. For this option, you need a RADIUS server. Multiple APs can share the information from the same RADIUS server.
- use a pre-shared key. This is a simpler authentication option, but more difficult to maintain because pre-shared keys must be distributed to all users.

You can also create a list of accepted clients; that is, an Access Control List (ACL). This option is best suited for small networks.

The encryption options are:

- Wired Equivalent Privacy (WEP). This is a basic encryption scheme.
- Temporal Key Integrity Protocol (TKIP). This is an more advanced encryption scheme.
- Advance Encryption Standard (AES). This is the strongest encryption scheme.

BelAir Networks Wi-Fi radios offer WEP, WPA, WPA2 and WPA2mixed privacy settings. With WPA2mixed, the wireless client can use WPA or WPA2, and the AP accepts them both. WPA, WPA2 and WPA2mixed privacy uses TKIP or AES encryption. Because of this, WPA, WPA2 and WPA2mixed provide much stronger security than WEP. For small networks, you can use WEP or WPA with pre-shared keys. For large networks, you can use WPA, WPA2 or WPA2mixed in combination with dot1x (a RADIUS server) authentication.

CAUTION! RADIUS authentication, WPA or WPA2 can only be used with wireless clients that support these standards (both the operating system and the network card). For clients that only support WEP, select a combination with WEP.

Note: A network is as secure as its weakest link. If WEP is enabled, the overall level of network security will be that of WEP.

RADIUS Servers for Wireless Clients

To use RADIUS authentication, you need to configure at least one RADIUS server.

Table 11 shows the attributes that are included in the *access-request* messages sent to the RADIUS server when using RADIUS (EAP) authentication.

Table 11: RADIUS Attributes

Name	ID	Description
RA_USERNAME	1	Client identity
RA_NAS_IP_ADDRESS	4	AP IP address configured with the */protocol/radius/set server* command. See "Managing RADIUS Servers" on page 150.
RA_NAS_PORT	5	For accounting packets, contains the client association ID that ranges from 1 to 256. For RADIUS packets, contains the SSID index values (from 0 to 15) + 100
RA_SERVICE_TYPE	6	Always *2*
RA_FRAMED_MTU	12	Always *1400*
RA_STATE	24	Client state from the RADIUS server
RA_CLASS	25	Always *0*
RA_VENDOR_SPECIFIC	26	Not used
RA_SESSION_TIMEOUT	27	RADIUS reauth time configured with the */protocol/radius/set server* command. See "Managing RADIUS Servers" on page 150.
RA_IDLE_TIMEOUT	28	Client timeout value, always 5 minutes
RA_TERMINATION_ACTION	29	Incoming only (*0* for terminate or *1* for reauth)
RA_CALLED_STATION_ID	30	AP MAC address If station-id-unformatting is set to enable, colons are removed.

Table 11: RADIUS Attributes (Continued)

Name	ID	Description
RA_CALLING_STATION_ID	31	Client MAC address If station-id-unformatting is set to enable, colons are removed.
RA_NAS_IDENTIFIER	32	Name configured with the */interface/wifi-<n>-<m>/set ssid <ssid_index> radius* command. See "RADIUS Accounting" on page 153.
RA_ACCT_STATUS_TYPE	40	Always *1*,*2* or *3*
RA_ACCT_INPUT_OCTET	42	Integer counter
RA_ACCT_OUTPUT_OCTET	43	Integer counter
RA_ACCT_SESSION_ID	44	Unique number generated by system.
RA_ACCT_AUTH	45	*1* for RADIUS or *2* for local
RA_ACCT_SESSION_TIME	46	RADIUS reauth time configured with the */protocol/radius/set server* command. See "Managing RADIUS Servers" on page 150.
RA_ACCT_INPUT_PACKET	47	Integer counter
RA_ACCT_OUTPUT_PACKET	48	Integer counter
RA_TERMINATE_CAUSE	49	One of: • *1* for session terminated by user request • *2* for session terminated due to lost carrier • *4* for session terminated due to idle timeout • *5* for session timeout • *9* for session terminated due to NAS error • *20* for session terminated due to reauth failure
RA_ACCT_INPUT_GIGAWORDS	52	Not used
RA_ACCT_OUTPUT_GIGAWORDS	53	Not used
RA_EVENT_TIMESTAMP	55	System time when the RADIUS packet is sent
RA_NAS_PORT_TYPE	61	Always *19* for port type of wireless

Table 11: RADIUS Attributes (Continued)

Name	ID	Description
RA_TUNNEL_TYPE	64	Refer to "RADIUS Assigned VLAN" on page 152.
RA_TUNNEL_MEDIUM_TYPE	65	Refer to "RADIUS Assigned VLAN" on page 152.
RA_TUNNEL_PRIVATE_GROUP_ID	81	Refer to "RADIUS Assigned VLAN" on page 152.
RA_CONNECT_INFO	77	Always *CONNECT 11Mbps 802.11b*
RA_EAP_MESSAGE	79	EAP packet
RA_MESSAGE_AUTHENTICATOR	80	Authentication string from RADIUS server
RA_INTERIM_INTERVAL	85	Not used

Managing RADIUS Servers

```
/protocol/radius/show servers
/protocol/radius/set server <server_idx> <server_ip_address>
                   <shared secret> [authport <server_port>]
                   [acctport <radius_acc_port>]
                   [interface <NAS IP address>] [timeout <seconds>]
                     [reauthtime <seconds>]
/protocol/radius/del server <server_idx>
```

These commands let you manage the RADIUS server list used for authenticating wireless clients. The list can contain up to 16 RADIUS servers. After the list is configured, you can then assign which AP SSID uses which server on the list. See "Assigning SSIDs to RADIUS Servers" on page 151. By default, if a RADIUS server is unavailable, then the SSID uses the next RADIUS server in the list. You cannot delete a server if it is being used by an SSID.

The *server_ip address* parameter specifies the IP address of the RADIUS server.

The *shared secret* parameter specifies the password for access to the RADIUS server.

The *server_port* parameter ranges from 0 to 65535. It specifies the UDP port number of the RADIUS server. The default is 1812.

The *radius_acc_port* parameter ranges from 0 to 65535. It specifies the UDP port number for RADIUS accounting data. The default value is 1813.

The *NAS IP address* parameter specifies the Network Access Server (NAS) IP address for the AP RADIUS client. It is used when the AP is configured with multiple IP interfaces and matches the interface used to communicate with the given RADIUS server. The default value is the IP address of the AP's management interface, which is usually the system's default IP address.

Note: The *NAS IP address* parameter is entered statically with this command. If the VLAN IP addresses are determined dynamically with a DHCP server, then an updated VLAN IP address is not automatically reflected into the *NAS IP address* parameter.

The *timeout* parameter ranges from 2 to 300. It specifies the interval (in seconds) after which the RADIUS client considers that the remote server has timed out if a reply is not received. The default value is 10 seconds.

The *reauthtime* parameter ranges from 0 to 50000000. It specifies the RADIUS re-authentication time (in seconds). This forces the AP to check all connected clients with the RADIUS server (that is, make sure they are still allowed to access the network) at the specified interval. You only need to configure this parameter if it is not specified on the RADIUS server. Setting the interval to zero disables this feature. The maximum interval time is 2147483647. If you enter a higher number, the value is set to its maximum.

Example

```
/protocol/radius# set server 3 172.16.1.20 my-secret12345 authport 1812 acctport 1813
interface 172.16.1.254 timeout 15 reauthtime 1
```

Changing RADIUS Server Admin State

```
/protocol/radius/set server-state <server_idx> {enable|disable}
```

This command enables or disables a particular RADIUS server on the server list. Use the *show servers* command to determine *<server_idx>*.

Assigning SSIDs to RADIUS Servers

```
/interface/wifi-<n>-<m>/add ssid <ssid_index>
                                      radius-server <server_idx>
/interface/wifi-<n>-<m>/del ssid <ssid_index>
                                      radius-server <server_idx>
```

The *add* command specifies which RADIUS server to use to authenticate the specified SSID. The *del* command means that the specified RADIUS server stops authenticating the specified SSID. Use the */wifi-<n>-<m>/show ssid table* command to determine *<ssid_index>*. Use the */radius/show servers* command to determine *<server_idx>*.

RADIUS Pre-authentication

```
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                               radius-pre-auth {enabled|disabled}
                               [delimiter {none|colon|dash}]
```

This feature allows you to set up a centralized access control list at the RADIUS server instead of each AP. With this feature enabled, when an AP receives a client's association request, it composes an *access-request* message and sends it to a RADIUS server. If an *access-accept* message is received from the RADIUS server, the AP continues with the client's association procedure and grants access based on other criteria such as encryption type and key matching.

To use this feature, you must configure your RADIUS server to have a list of all allowed clients. Each entry in this list includes a user name and a password. The user name and the password must be set to the client's MAC address. The *delimiter* parameter specifies whether the RADIUS packets use a colon (:), a dash (-) or nothing as a delimiter when specifying a MAC address.

To reduce the message exchanges between the AP and RADIUS server, an AP maintains two cache tables: one for all allowed clients and another for all disallowed clients. When the AP receives a client's association request, it first searches both tables. If the client's information is in the allowed table, the AP bypasses RADIUS pre- authentication. If the client is in the disallowed table, it is rejected immediately. Cache entries in either table expire in two minutes.

The feature can be enabled or disabled on each SSID. Use the */wifi-<n>-<m>/ show ssid table* command to determine *<ssid_index>*.

The default setting is *disabled*.

RADIUS Assigned VLAN

The AP can create VLANs as instructed by the RADIUS server. When this feature is activated, the RADIUS server instructs the AP to tag the authenticated packets to use the specified VLAN.

This feature has no CLI commands. To activate this feature, you must provision the following attributes on your RADIUS server:

- RA_TUNNEL_TYPE, set to *13*
- RA_TUNNEL_MEDIUM_TYPE, set to *6*
- RA_TUNNEL_PRIVATE_GROUP_ID, configure to contain the VLAN to be created.

Refer to Table 11 on page 148.

CAUTION! This caution applies to the BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100. If your network contains a BelAir200, you must configure its VLAN subsystems with the VLAN ID specified by the RADIUS server before it is created on the BelAir100SN. Refer to the *BelAir200 User Guide* for instructions on configuring VLAN subsystems. All traffic from the specified client is discarded by the BelAir200 if the RADIUS assigned VLAN is not previously configured.

RADIUS Accounting

```
/interface/wifi-<n>-<m>/set ssid <ssid_index> radius
                    ([accounting {enable|disable}]
                     [nas-id <name>]
                     [delimiter {none|colon|dash}]
                     [append {none|ssid}]
```

These commands let you manage RADIUS accounting for wireless clients.

By default RADIUS accounting is disabled.

The *nas-id <name>* parameters specify the RADIUS Network Access Server (NAS) identifier. The default value for *<name>* is *belair*.

The *delimiter* parameter specifies whether the RADIUS packets use a colon (:), a dash (-) or nothing as a delimiter when specifying a MAC address.

The *append* parameter specifies RADIUS station ID formatting. The default setting is *ssid*, meaning that the *called-station-ID* and the *calling-station-ID* fields are formatted to include SSID information to the provided MAC address.

Client Authentication and De-authentication Trap

```
/interface/wifi-<n>-<m>/set client-trap {enabled|disabled}
                                 [trap-delay {enabled|disabled}]
```

This command controls whether a trap is sent for this particular radio whenever a wireless client authenticates or de-authenticates; that is, disconnects from the radio. The trap can be used by any Network Management System to monitor client activities.

When the client trap is enabled and the trap delay is enabled, the trap is not sent out until 10 seconds after either of the following events:

- the client connects and stays connected
- the client is disconnected and stays disconnected

If the trap delay is disabled, then the trap is sent out immediately after either of the previous events.

When the client trap is disabled, the trap is not sent out.

The default is to have both the client trap and trap delay enabled.

AP Privacy

```
/interface/wifi-<n>-<m>/set ssid <ssid_index> privacy
           {none|dot1x-open|wep40|wep104|
           {wpa {tkip|aes}}|wpa2 {tkip|aes}|wpa2mixed}
           [{psk <key-str>}|dot1x]
```

```
[rekey {no|kpackets <count>|seconds <seconds>}]
[strict {yes|no}]
```

This command configures wireless privacy for a particular SSID. Use the *show ssid table* command to determine *<ssid_index>*. Use the *show ssid <ssid_index> config* command to show the current privacy settings.

The *dot1x-open* parameter specifies an open privacy setting, but uses a RADIUS server for SSID authentication. The RADIUS server authenticates a wireless client by its username and password. After accepting the client, the RADIUS server does not provide encryption keys. The data transmission is *open*.

WPA, WPA2 and WPA2mixed privacy uses TKIP or AES encryption. With WPA2mixed, the wireless client can use WPA or WPA2, and the AP accepts them both.

The *psk* parameter specifies using a pre-shared key for authentication. When specifying the pre-shared key, note the following:

- For *wep40*, the pre-shared key must be exactly 5 bytes.
- For *wep104* with *psk*, the pre-shared key must be exactly 13 bytes.
- For *wpa*, *wpa2* and *wpa2mixed*, the pre-shared key must be between 8 and 63 bytes long. The longer the key, the more secure the connection.
- The pre-shared key can be specified as a hexadecimal number or ASCII string. Hexadecimal numbers must be preceded by *0X* or *0x*. ASCII strings must not contain the following characters:

  —bar (|)

  —semicolon (;)

  —question mark (?)

  —double quotation mark (“)

The *dot1x* parameter specifies using RADIUS (EAP) authentication. You must pre-configure a list of RADIUS servers. See “RADIUS Servers for Wireless Clients” on page 148.

The *rekey* parameter allows you to specify Group Key Rekey options to improve security. These options allow you to specify that a new group key (the key that is used for communication between the access radio and a group of clients) must be generated at regular intervals.

The default *rekey* setting is *no* meaning that the group key is not changed. If *rekey* is set to *n* seconds, the group key is changed after that time period. If *rekey* is set to *n* kpackets, the group key is changed after that many thousand packets.

If *strict* is set to *yes*, the group key changes immediately when one client leaves the network. The default is *no*. The *strict* setting applies to wpa and wpa2 encryption only.

Additional Considerations

Make sure to set the AP SSID to something other than the default before enabling *wpa*, *wpa2* or *wpa2mixed*. The AP combines the password phrase with your SSID to create the key.

Note: Some configuration commands take longer than others to be applied to a radio module. For example, it can take up to 40 seconds per SSID for a WPA PSK configuration to be applied to radio. The delay varies depending on the amount of computing resources required to implement the configuration.

Wireless Client Blacklist

```
/interface/wifi-<n>-<m>/add client blacklist <mac-addr>
/interface/wifi-<n>-<m>/del client blacklist <mac-addr>
```

These commands let you add and remove a MAC address from a client blacklist. If a wireless client's MAC address matches an entry on the blacklist, the client cannot associate with the AP. The client blacklist can contain up to 16 entries. Each physical interface can have its own client blacklist.

Use the *show config access* command to display the current client blacklist entries.

Wireless Client Access Control List

```
/interface/wifi-<n>-<m>/show ssid <ssid_index> acl
                              [page <page-number> <page-size>]
/interface/wifi-<n>-<m>/add ssid <ssid_index> acl-mac-address
                                              <mac-address>
/interface/wifi-<n>-<m>/del ssid <ssid_index> acl-mac-address
                                              <mac-address>
/interface/wifi-<n>-<m>/set ssid <ssid_index> acl
                                           {enabled|disabled}
```

You can create a local list of clients (an ACL) that controls access to the network. The list can contain up to 16 clients per SSID. Clients are identified by the MAC address of their network card. If you have multiple APAP in your network, you need to create this list for every AP.

You should only use an ACL as an extra security measure if:

- you cannot or prefer not to set up a RADIUS server
- your network provides access to network clients which do not support RADIUS authentication

In both cases, it is recommended that you enable pre-shared key encryption (WEP, WPA, WPA2 or WPA2mixed).

The *enabled* setting for the *set acl* command means that only the wireless clients on the ACL can access the network. All other clients are denied access. The *disabled* setting means that all wireless clients can access the network. See also "AP Secure Port Mode" on page 159.

Typically, you enable ACL mode only after you have added all the desired MAC addresses to the control list.

CAUTION! When used with multiple SSIDs, this method affects wireless clients attempting to associate with any of the SSIDs.

Use the *show ssid table* command to determine *<ssid_index>*.

Controlling Inter-client Communication

If wireless bridging is enabled for an SSID, then by default wireless clients associated to an AP and using that SSID can communicate to one another (assuming they are able to determine the IP addresses of their peer wireless clients).

For security reasons in a public network environment, it may be desirable to block inter-client communications.

CAUTION! Provisioning inter-client communication can affect the wireless clients associated with all the SSIDs of that AP.

The goal is to prevent communications between associated wireless clients and still allow them to connect to the Internet. To do this, use one of the following methods.

Manual Provisioning of Gateway MAC Addresses

The following method offers the precise control of SSID communications:

1. Determine the MAC address of the Internet gateway(s) or router(s) in your network.
2. Disable wireless bridging for each AP in your network.

3 Disable inter-AP wireless client communications:
   a Add the previously determined gateway MAC address or addresses to the secure MAC white list. This allows wireless clients to communicate with the Internet. The secure MAC white list typically contains the MAC address of the gateway interfaces.
   b If the DHCP server for your network is on a different machine than the gateway, add the MAC address of the DHCP server machine to the secure MAC white list.
   c Enable *secure port* mode for each of the APs in your network.

Automatic Discovery of Gateway MAC Addresses

The following method automates MAC address provisioning:

1 Disable wireless bridging for each AP in your network.
2 Disable inter-AP wireless client communications:
   a Enable the *auto-secure gateway* feature for each of the APs in your network.
   b Enable *secure port* mode for each of the APs in your network.

Determining the MAC Address of the Internet gateway

This step is only required if you want to manually provision the MAC addresses of the Internet gateway(s) or router(s) in your network.

Determining the MAC address of your Internet gateway(s) depends on the type of equipment you are using. Refer to your equipment's User Manual for the specific details.

You will need the MAC address of your gateways later to provision the secure MAC white list of the APs configured in *secure port* mode.

Disabling or Enabling AP Wireless Bridging

```
/interface/wifi-<n>-<m>/set ssid <ssid_index> wireless-bridge
                                             {enabled|disabled}
```

Use the *show ssid table* command to determine *<ssid_index>*.

Disabling wireless bridging for an AP prevents wireless clients associated to that particular AP from communicating with one another.

It does not prevent a wireless client associated with one AP (AP "A") from communicating with a wireless client associated with another AP (AP "B"). The *secure port* mode prevents this. See "AP Secure Port Mode" on page 159.

By default, wireless bridging is *enabled*.

Disabling Inter-AP Wireless Client Communication

Disabling inter-AP wireless client communications involves setting up a secure MAC white list and enabling secure port mode for each AP.

Secure MAC White List

```
/interface/wifi-<n>-<m>/add secure-mac-address <mac-address-string>
                              [secure-mac-mask <mac-mask-string>]
                             [all | untagged | <vlan-id>]
/interface/wifi-<n>-<m>/del secure-mac-address <mac-address-string>
                             [all | untagged | <vlan-id>]
```

Use these commands only if you want to manually provision the MAC addresses of the Internet gateway(s) or router(s) in your network.

These commands add and remove a MAC address from the secure MAC white list. The MAC address can optionally be qualified with a mask and a traffic descriptor as follows:

- The mask is specified with the *secure-mac-mask* option. Use *ff* to indicate bits to accept. Use *00* to indicate bits to ignore. For example, a MAC address of 00:0d:67:0c:21:90 with a mask of ff:ff:ff:00:00:00 specifies all MAC addresses beginning with 00:0d:67. You can also customize the mask to exactly suit your needs by using values other than *ff* or *00*.
- The traffic descriptor can be one of *all*, *untagged* or a VLAN ID. Use a VLAN ID to specify the traffic of a particular VLAN. Use *untagged* to specify only untagged traffic. Use *all* to specify all traffic.

When configured in secure port mode, the AP forwards to the associated wireless clients only those Layer 2 (Ethernet) frames for which the source MAC address and VLAN matches an entry its white list. The white list can contain up to 32 entries. If a VLAN is not specified, it is assumed to have a value of zero.

In effect, while in this mode the AP acts as a firewall for all Layer 2 frames arriving from inside the network for the wireless clients. The secure MAC white list should only contain the MAC addresses of the gateway interfaces. Thus, wireless clients associated to other APs in the network are prevented from communicating with locally associated clients.

Note 1: The secure MAC white list is different from the list described in "Wireless Client Access Control List" on page 155. In a client ACL, only the listed MAC addresses are allowed to associate with an AP. The secure MAC white list controls data forwarding to the wireless clients from remote entities in the network.

Note 2: If the gateway and DHCP servers on your networks are on different machines, you must put the MAC addresses of both machines on the secure MAC white list.

The content of the secure MAC white list takes effect only when the AP secure port mode is enabled.

AP Secure Port Mode

```
/interface/wifi-<n>-<m>/set ssid <ssid_index> secure-port
                                              {enabled|disabled}
```

Use the *show ssid table* command to determine *<ssid_index>*.

To prevent wireless clients associated with different APs from communicating with each other, you must enable the secure port mode on each of the APs in your network.

By default, the secure port mode is *disabled*.

Note: Typically, you provision the secure MAC white list before enabling the secure port mode. This ensures that wireless clients that are already associated do not lose their connection to the Internet.

Auto-secure Gateway

```
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                          auto-secure-gateway {enabled|disabled}
```

Use this command only if you want to automatically discover the MAC addresses of the Internet gateway(s) or router(s) in your network. To use this command, you must set the ROUTER_IP option (DHCP option 3) on the DHCP server in your network.

Use the *show ssid table* command to determine *<ssid_index>*.

This command starts the process of detecting the MAC addresses of the gateway for each VLAN in the system. Once it determines the MAC address, it adds it to the secure MAC white list. This feature also continuously monitors for changes in the gateway's MAC address updates the secure MAC white list accordingly.

By default, the auto-secure gateway functionality mode is *disabled*.

Note: If you are automatically discovering the MAC addresses of your network gateways, then you typically enable auto-secure gateway before enabling the secure port mode. This ensures that wireless clients that are already associated do not lose their connection to the Internet.

Protecting against Denial of Service Attacks

The AP provides protection against the following types of Denial of Service (DoS) attacks:

- deauthentication DoS, where deauthentication packets are maliciously sent to the AP causing it to terminate wireless sessions

The AP also automatically generates alarms when it detects the following conditions:

- If the AP detects more than 600 DHCP requests within 30 seconds, it raises a *DHCP_STARVATION* alarm.
- If the AP detects a client with a MAC address that matches any of the addresses in the secure MAC white list, it raises a *SECURE_MAC_SPOOF* alarm.

You can clear these alarms with the following command:

```
/interface/wifi-<n>-<m>/clear alarm {secure-mac-spoof |
                                     dhcp-starvation |
                                     deauth-dos}
```

Deauthentication DoS

```
/interface/wifi-<n>-<m>/set deauth dos defense {enabled|disabled}
```

When a deauthentication packet arrives and this feature is enabled, the AP waits 5 to 10 seconds before it terminates the wireless session. If the wireless client sends another data packet during that interval, then the previous deauthentication packet is deemed false and ignored. If the AP does not receive any data packets during the interval, then the session is terminated.

Use the */interface/wifi-<n>-<m>/show statistics* command to display the number of potential attacks it has detected since you enabled the feature.

Wi-Fi Backhaul Link Configuration

This chapter describes how to display and configure Wi-Fi backhaul parameters, including:

- "Displaying Backhaul Link Configuration" on page 161
- "Configuring Backhaul Link Identifier, Topology and Privacy" on page 162
- "Managing MP-to-MP Meshes" on page 164
  - "Displaying the Mesh Topology" on page 164
  - "Setting a Link RSSI Threshold" on page 165
  - "Managing the Mesh Blacklist" on page 166
  - "Mesh Auto-connections" on page 166
  - "Managing Mesh Auto-connections" on page 167
- "Egress Protection" on page 168
- "Changing Backhaul Link Admin State" on page 168

See also:

- "Configuring Wi-Fi Radio Parameters" on page 103
- "Configuring Wi-Fi Access Point Parameters" on page 123
- "Wi-Fi AP Security" on page 146
- "Mobile Backhaul Mesh" on page 169

Displaying Backhaul Link Configuration

Use the *show config backhaul* command to display the current backhaul configuration. See "Displaying Wi-Fi Radio Configuration" on page 104 for details.

Example - BelAir20E

```
/interface/wifi-1-1# show config backhaul
Slot: 1, Card Type: htme, revision: 1, Port: 1, Radio: HTMv1 5GHz
802.11n
admin state: ................. Enabled
channel: ..................... 149
  mode: ...................... ht40plus
  mimo: ...................... 3x3
  tx power: .................. 18.0 (dBm per-chain), 23.0 (dBm total)
antenna location: ............ External Port
antenna index: ............... 1
antenna gain: ................ 5.0  (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:0c:21:90
```

```
Common Backhaul:
  privacy: ................... AES
  key: .......................
  mesh-min-rssi............... -100 (dbm)
Stationary Backhaul:
  link admin state: .......... Disabled
  link id: ................... BelAirNetworks
  topology: .................. mesh
Mobile Backhaul:
  mobile admin state: ........ Disabled
  mobile link id: ............
  mobile link role: .......... ss
Blacklist:
  No blacklist entries
Link Failure Detection: ...... Disabled
Backhaul T1 Bandwidth limit:.. Disabled
```

Configuring Backhaul Link Identifier, Topology and Privacy

```
/interface/wifi-<n>-<m>/set backhaul link ([identifier <link-id>]
    [topology {p2p|mesh|{star role {bs|ss} index <lnk_idx>}}]
    [privacy {{enabled key <pre_shared_key>}|disabled}])
```

This command configures the backhaul link identifier, the backhaul topology and backhaul privacy.

The backhaul link identifier identifies all members of a particular topology. The *<link_id>* parameter is case sensitive and can be up to 32 alphanumeric characters:

- For Point-to-Point (P-to-P) links, BelAir Networks recommends that the link identifier describes the link; that is, the APs it connects.
- For Point-to-Multipoint (P-to-MP) or Multipoint-to-Multipoint (MP-to-MP) links, the link identifier is also known as a mesh identifier. It is the same for all members of a particular mesh. A suitable link identifier is short phrase unique to the MP-to-MP mesh, for instance Company x Mesh A or Mesh Number 23.

When configuring a particular topology, you must configure all members to have:

- the same channel. Refer to “Operating Channel” on page 105 for the appropriate command
- the same link identifier
- the same privacy settings

As well, you must meet the requirements listed in Table 12 on page 163.

Table 12: Wi-Fi Backhaul Configuration Requirements

Topology	Requirements
P-to-P	1 Set the *topology* parameter to *p2p*.
P-to-MP (Star topology with one base station in the middle connecting up to eight subscriber stations)	1 Set the *topology* parameter to *star*. 2 Set the AP's role. The AP can be a base station (*bs*) or a subscriber station (*ss*). A base station is located at the center of the star and can support up to eight subscriber stations. 3 Set the *<lnk_idx>* parameter. The link index identifies individual links in the star topology. It ranges from 1 to 8. For a subscriber station, you specify a single link index. For a base station, you specify all the link indexes that are used to connect to subscriber stations. Use a comma to separate multiple link indexes. To configure P-to-MP links configure the subscriber stations first followed by the base station.
MP-to-MP (Full mesh topology with each BelAir Networks radio having up to eight links)	1 Set the *topology* parameter to *mesh*.

The *privacy* setting determines whether AES privacy is used or not.

The pre-shared key must be exactly 32 bytes long (16 characters). The pre-shared key can be specified as a hexadecimal or ASCII string and must not contain the following characters:

- bar (|)
- semicolon (;)
- question mark (?)
- double quotation mark (“)

Managing MP-to-MP Meshes

This section describe additional commands to help you configure and manage an MP-to-MP mesh clusters, including:

- “Displaying the Mesh Topology” on page 164
- “Setting a Link RSSI Threshold” on page 165
- “Managing the Mesh Blacklist” on page 166
- “Mesh Auto-connections” on page 166
- “Managing Mesh Auto-connections” on page 167

Displaying the Mesh Topology

```
/interface/wifi-<n>-<m>/show backhaul status
```

This command displays the operating parameters of the MP-to-MP links you are connected to.

Example 1 and Example 2 that follow illustrate the output describing a mesh between three radios: RadioA, RadioB and RadioC.

Example 1: RadioA

```
/interface/wifi-4-1# show backhaul status

Backhaul Links:
  Link      Radio MAC      State(L,R) RSSI Radio    Node IP       Node Name
  ---- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:0b:55:17 fwd  fwd   -49  wifi-3-1 180.1.5.120
 [S] 2 00:0d:67:0b:51:ed fwd  fwd   -54  wifi-3-1 180.1.4.150
```

In the previous output, link 1 goes to RadioC and link 2 goes to RadioB.

RadioA is measuring a signal strength of -49 dBm from RadioC. RadioC has a MAC address of 00:0d:67:0b:55:17 and is physical interface wifi-3-1 on an AP with IP address 180.1.5.120.

RadioA is measuring a signal strength of -54 dBm from RadioB. RadioB has a MAC address of 00:0d:67:0b:51:ed and is physical interface wifi-3-1 on an AP with IP address 180.1.5.150.

Example 2: RadioB

```
/interface/wifi-3-1# show backhaul status

Backhaul Links:
  Link      Radio MAC      State(L,R) RSSI Radio    Node IP       Node Name
  ---- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:0b:55:17 fwd  fwd   -68  wifi-3-1 180.1.5.120
 [S] 2 00:0d:67:08:63:31 fwd  fwd   -54  wifi-4-1 180.1.5.180
```

In the previous output, link 1 goes to RadioC and link 2 goes to RadioA.

RadioB is measuring a signal strength of -68 dBm from RadioC. As in example 1, RadioC has a MAC address of 00:0d:67:0b:55:17 and is physical interface wifi-3-1 on an AP with IP address 180.1.5.120.

As in example 1, RadioB is measuring a signal strength of -54 dBm from RadioA. RadioA has a MAC address of 00:0d:67:08:63:31 and is physical interface wifi-4-1 on an AP with IP address 180.1.5.180.

Example 3: Mobile Backhaul Mesh

```
/interface/wifi-1-1# show backhaul status

Backhaul Links:
 Link  Radio Mac          State(L,R) RSSI Radio     Node IP       Node Name
 ----- ----------------- ---------- ---- -----     --------      ----------
 [M] 1 00:0d:67:09:23:6a fwd  fwd     -68 wifi-3-1 10.1.1.123    NYC_WALLST
 [M] 1 00:0d:67:00:08:06 fwd  UP      -71 wifi-3-1 10.1.1.122    NYC_BROADWAY
```

In the previous output, there are two mobile backhaul mesh links. One is forwarding while the other is listening.

Setting a Link RSSI Threshold

```
/interface/wifi-<n>-<m>/set backhaul mesh-min-rssi <rssi_value>
```

This command lets you set a signal strength threshold for creating mesh links. If a radio signal from another AP is weaker than the specified threshold, then no link is created to that other AP, except if there is no other link to either AP at each end of the link. In that case, the link is still created even if the radio signal is weaker than the specified threshold.

This command applies only when an AP is forming MP-to-MP links with other APs. Existing links are not affected by this command.

The *rssi_value* parameter is specified in as a negative number in dBm. The default value is -100 dBm. Use the *show config backhaul* command to display the current value.

Example

```
/interface/wifi-1-1# set backhaul mesh-min-rssi -70
```

The previous command sets the link RSSI threshold to -70 dBm. If the signal from another radio is stronger than -70 dBm, then a backhaul link to that radio is created. If it is weaker than -70 dBm, then a link is not created.

Managing the Mesh Blacklist

```
/interface/wifi-<n>-<m>/add backhaul blacklist <mesh_pt_MAC_addr>
/interface/wifi-<n>-<m>/del backhaul blacklist <mesh_pt_MAC_addr>
```

These commands allow you to control whether or not a link is used between two mesh points in an MP-to-MP mesh. To blacklist a link, you need to log in to both ends of the link and put the radio of other AP on the local blacklist. For example, to prevent the use of a link between AP A and B, you need to:

1 Log in to AP A and add to its blacklist the MAC address of AP B radio.
2 Log in to AP B and add to its blacklist the MAC address of AP A radio.

The MAC addresses of the AP radios can be determined with the *show backhaul status* command.

Typically, these commands are used to disable an unstable link. This behavior may occur when either radio at each end of the link is operating at the limit of its sensitivity.

As well, these commands can be used to disable a particular link if the RF plan predicts low RSSI values for it.

Mesh Auto-connections

Mesh auto-connection applies to the BelAir20, BelAir100i WCS, BelAir20E, BelAir20EO, BelAir100N and BelAir2100.

BelAir Networks MP-to-MP meshes have the ability to detect when their egress AP loses the ability to route traffic out of the mesh. When such a situation exists, each radio that is part of the affected mesh begins trying to find an alternate way of routing its traffic out of the mesh.

If the affected radio is part of a multi-radio AP, such as the BelAir100N, and the other radios are also part of a mesh, then it attempts to route its traffic through the other radios of its own AP.

If it cannot do so, then it begins scanning other channels to see if it can establish a link to another radio that is part of a neighboring mesh with an active egress AP.

The affected radios stagger their attempts to “hunt” for a neighboring mesh to avoid overloading the neighboring radios and to allow time for their own egress AP to re-establishing itself.

A link to a neighboring mesh only occurs when:

- The neighboring mesh has an active egress AP.
- The first six bytes of the neighboring mesh identifier matches the local mesh identifier.

If there are several candidate meshes to connect to, then the link is made to the mesh that:

- matches the longest possible mesh identifier string
- has the better signal level
- has the minimum hop count to the egress AP

Once a new link is established, the radio does not automatically revert back to the old mesh, even if the old mesh's egress AP regains its ability to route traffic outside of the mesh. To do so, you must manually use one of the provided CLI commands.

Mesh auto-connect uses RSTP to establish the new mesh topology. Disabling RSTP disables this functionality.

See also:

- "Managing Mesh Auto-connections" on page 167
- "Setting the Network Egress Point" on page 72
- "Mesh Auto-connection Example" on page 299

Managing Mesh Auto-connections

```
/services/auto-conn/set admin-state {enabled|disabled}
/services/auto-conn/revert alternate-mesh
/services/auto-conn/show alternate-mesh
/services/auto-conn/show egress-node-list
/services/auto-conn/show config
/services/auto-conn/show status
```

These commands allow you to control mesh auto-connection capabilities.

Mesh auto-connection applies to the BelAir20, BelAir100i WCS, BelAir20E, BelAir20EO, BelAir100N and BelAir2100.

Use the *set admin-state* command to enable or disable this capability. By default mesh auto-connections are enabled.

Use the *revert alternate-mesh* command to manually force a link to a neighboring mesh back to the original mesh.

Use the *show alternate-mesh* command to display the AP's links to a neighboring mesh when the AP's egress is lost.

Use the *show egress-node-list* command to display the list of egress APs for the current mesh.

Use the *show config* command to display the current auto-connection configuration.

Use the *show status* command to display whether the auto-connection capability is enabled or disabled.

Refer to "Mesh Auto-connection Example" on page 299.

Egress Protection

```
/interface/wifi-<n>-<m>/set backhaul protection-admin-state {enable|disable}
```

This command controls egress protection. The default setting is *disable*.

Egress protection provides extra redundancy for the AP's egress point. The egress point is the point where the AP's access traffic leaves the BelAir Networks wireless network. This may be through an Ethernet connection, L2TP tunnel end-point, or a cable modem.

If the egress point fails and egress protection is enabled, the AP uses a Wi-Fi backhaul link to connect to another AP so that traffic can leave the BelAir Networks wireless network through that AP's egress point. The AP selects the best AP to use based on several factors including signal strength and the number of hops to the egress point.

Egress protection is revertive. If the original egress point becomes operational again, the access data is redirected back to original egress point.

To use egress protection, make sure of the following:

- The AP and it surrounding APs are equipped with appropriate hardware to provide the Wi-Fi backhaul link.
- The channel number, privacy settings and link identifier are the same for all surrounding APs.
- The *backhaul protection-admin-state* option for the radios has been enabled.
- The tunnel engine for the AP is enabled, if the egress point is an L2TP tunnel end point. See "Setting Tunnel Engine Parameters" on page 214.

Changing Backhaul Link Admin State

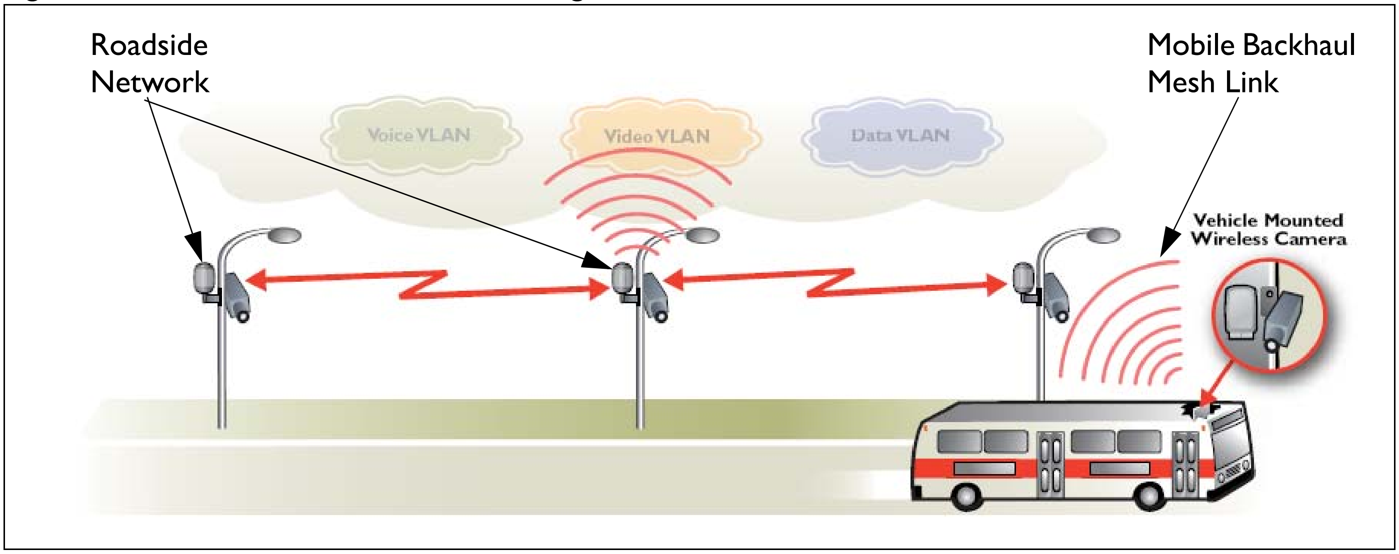
```
/interface/wifi-<n>-<m>/set backhaul admin-state {enable|disable}
```

This command lets you enable or disable backhaul functionality regardless of the topology (MP-to-MP, P-to-MP or P-to-P). The default setting is *disable*.

Mobile Backhaul Mesh

This feature extends the BelAir Networks fixed wireless infrastructure onto high-speed vehicles such as trains, buses, police and fire vehicles, and ambulances. Refer to Figure 15.

Figure 15: Mobile Backhaul Links Connecting Vehicle Cameras to Roadside Network



An AP with mobile backhaul mesh links can support uninterrupted high-performance broadband connectivity for critical applications, including voice and video, as the vehicle moves throughout the wireless mesh at speeds up to 150 mph (240 kph).

In such a deployment, the mobile AP, mounted on a vehicle, acts as a subscriber station to a stationary base station AP. All mobile subscriber stations and their stationary base stations use the same wireless channel, mobile link identifier and privacy settings.

Each mobile subscriber station can have up to three mobile links with three different stationary base station APs. Mobile links can be either listening or forwarding. Only one of the three mobile links from the subscriber station can be forwarding at a particular moment to a particular stationary base station AP. Traffic from the forwarding link is propagated to the rest of the network. The mobile subscriber station constantly determines the relative link quality of all its links based on several factors, including signal strength, aging and failure rates.

When the mobile subscriber station determines that a listening link has a better link quality than the current forwarding link, it changes the link state so that the listening link with the higher quality becomes forwarding.

These *look ahead* and *make before break* handover schemes allow the AP with mobile backhaul mesh links to provide uninterrupted support for a wide variety of applications, including voice and video.

Each base station AP can support up to eight links. These can be mobile links or links to other stationary base stations. Mobile links can be either forwarding or listening. If a mobile subscriber station arrives within range of the base station, its forwarding link has precedence over the listening links of the other mobile subscriber stations.

Configuring Mobile Backhaul Mesh Links

The following tasks can be done:

- "Displaying Mobility Configuration and Status" on page 170
- "Configuring MIMO Operation for Mobile Applications" on page 171
- "Configuring and Enabling Mobile Backhaul Mesh Links" on page 171

Displaying Mobility Configuration and Status

```
/interface/wifi-<n>-<m>/show backhaul mobility-path-select-history
```

This command displays the history of a radio's mobile path switches for debugging purposes. The displayed information includes an event ID, local RSSI, peer RSSI, failure rate, age time, mobile credit score, peer MAC, peer IP address, and the peer system name. Each radio stores up to 500 entries. The data is not persistent.

Example

```
                        /# interface/wifi-1-1/show backhaul mobility-path-select-history
1    1970-01-01 10:46:30 new [-64 -58 0  0  -64  00:0d:67:09:7d:fa 10.1.1.110 BA100T_110]
2    1970-01-01 11:54:44 chg [-57 -63 0  0  -63  00:0d:67:0c:6e:f4 10.1.1.120 BA100tt_120]
3    1970-01-01 12:01:14 chg [-54 -57 0  0  -57  00:0d:67:09:7d:fa 10.1.1.110 BA100T_110]
4    1970-01-01 12:22:30 chg [-55 -63 0  0  -63  00:0d:67:0c:6e:f4 10.1.1.120 BA100tt_120]
5    1970-01-01 12:33:13 chg [-53 -53 0  0  -53  00:0d:67:09:7d:fa 10.1.1.110 BA100T_110]
```

Additional Configuration Display Commands

Refer to the following sections and command descriptions:

- "Displaying Backhaul Link Configuration" on page 161
- "Displaying the Mesh Topology" on page 164
- `show rf-survey backhaul`, described in "Backhaul RF Survey" on page 115

Configuring MIMO Operation for Mobile Applications

```
/interface/wifi-<n>-<m>/set mimo-mode {1x1|1x2|2x2|2x3|3x3}
```

This command configures the Multiple-Input and Multiple-Output (MIMO) antenna settings for mobility applications using 802.11n radios, such as those for the BelAir20M. In such applications. the 5.8 GHz radio must operate with a MIMO setting of 1x1 while the 2.4 GHz access radio must operate with a MIMO setting of 2x2.

Use this command to adjust the MIMO setting of each radio interface as required. The supported modes vary depending on the type of radios in your AP, as follows:

- HTM and DRUE radios support only 1x1, 2x2 and 3x3 modes
- HTME radios support only 1x1 and 2x2 modes
- DRU radios support only 1x1, 1x2, 2x2 and 2x3 modes

Example

```
/interface/wifi-1-1# set mimo-mode 1x1
/interface/wifi-1-2# set mimo-mode 2x2
```

The previous commands apply to a BelAir20M where interface wifi-1-1 is for a 5.8 GHz radio while interface wifi-1-2 is for a 2.4 GHz access radio.

Configuring and Enabling Mobile Backhaul Mesh Links

```
/interface/wifi-<n>-<m>/set backhaul mobile
    ([identifier <link-id>] [role {bs|ss}]
     [privacy {{enabled key <pre_shared_key>}|disabled}]
     [admin-state {enable|disable}])
```

This command configures the mobile backhaul link identifier, the role of the AP and backhaul privacy. It also lets you enable or disable mobile backhaul mesh functionality. The default setting is *disable*.

The mobile backhaul link identifier identifies all members of a particular mobile backhaul mesh. The *<link_id>* parameter is case sensitive and can be up to 32 alphanumeric characters. A suitable link identifier is short phrase unique to the mobile backhaul mesh.

When configuring a particular mobile backhaul mesh, you must configure all members to have:

- the same channel. Refer to “Operating Channel” on page 105 for the appropriate command
- the same mobile link identifier
- the same privacy settings

As well, you must meet the requirements for the P-to-MP topology listed in Table 12 on page 163.

The *privacy* setting determines whether AES privacy is used or not.

The pre-shared key must be exactly 32 bytes long (16 characters). The pre-shared key can be specified as a hexadecimal or ASCII string and must not contain the following characters:

- bar (|)
- semicolon (;)
- question mark (?)
- double quotation mark (“)

Example 1 - Mobile AP

```
/interface/wifi-1-1# set backhaul mobile identifier test100m role ss
/interface/wifi-1-1# set backhaul mobile admin-state enable
```

Example 2 - Stationary AP

```
/interface/wifi-1-1# set backhaul mobile identifier test100m role bs
/interface/wifi-1-1# set backhaul mobile admin-state enable
```

Mobile Backhaul Point-to-point Links

This feature extends the BelAir Networks fixed wireless infrastructure onto low-speed vehicles such as ships travelling near a sea port. An AP with mobile backhaul point-to-point links provides redundant high-performance broadband connectivity.

In such a deployment, the mobile AP mounted on a ship acts as a subscriber station to a stationary base station AP mounted on shore.

A subscriber station searches for base station links on a pre-defined set of channels. It creates up to two links, a primary link and a secondary link, when it finds a base station advertising available links with an appropriate mobile link identifier and privacy settings. Once a primary link and a secondary link are created, one is used for active communications while the other acts as a standby.

If the signal strength of the active link falls below a threshold, then the standby becomes the primary link and the subscriber station searches for a new secondary link.

If performance degrades on the active and standby links, the subscriber station searches for new base station links with better signal strength.

In addition to providing mobile links, a base station AP can also provide links to other stationary base stations. Mobile link pairs can only be used by one subscriber station. The links of a base station are configured to operate on one channel only.

The user defines a channel list that determines the channels that the subscriber station uses to scan for base station APs.

Subscriber stations support partial matches to the mobile link identifier. For example, a subscriber station scanning for a mobile identifier of *mobilityTest* accepts a base station link advertising a mobile link identifier of *mobilityTestBsLink28*.

The *set home-check* CLI command forces a subscriber station to connect to specific base station links. When home check is enabled, the subscriber station accepts only base station links that advertise a mobile link identifier that is exactly the same as the subscriber station's home-check identifier.

If the mobile backhaul APs (subscriber stations and their stationary base stations) are part of a larger network of BelAir Networks equipment, make sure the mobile link identifiers and mobile channels are not used elsewhere in the network. If a neighboring stationary subscriber station uses a link identifier and channel similar to a mobile subscriber station, then it can interfere with the creation of links between the mobile backhaul APs.

With mobile backhaul point-to-point links, the base station is passive. The subscriber station determines whether or not to connect or disconnect from a base station. If a connection is lost, then the subscriber station starts its scanning process.

Scanning Process

If a subscriber station scans for available links when either member of its mobile link pair is disconnected from a base station. It scans all configured channels looking for available base station links. The subscriber station selects the link with a matching mobile link identifier and the best signal strength.

If another link in the subscriber station is using a channel in the configured channel list, then this channel is skipped by the scanning process. Once connected, the subscriber station does not scan again until the connection is lost.

Sample Subscriber Station Configuration

1 Configure the topology and privacy settings, and enable each Wi-Fi interface.

```
/interface/wifi-2-1# set backhaul link topology p2p privacy
disabled
/interface/wifi-2-1# set backhaul admin-state enabled
```

2 Disable RSTP dynamic cost for each backhaul link. The mobility service manages link cost.

```
/protocol/rstp# set interface wifi-2-1 dynamic-cost disable
```

3 Configure the mobile backhaul point-to-point links.

a Specify the mobile link identifier with the *set network-identifier* command.

```
/services/mobility# set network-identifier mobilityTest
```

b Specify the topology and role.

```
/services/mobility# set topology p2p-mobile role SS
```

c Define the channels expected from the shore links. Up to eight lists can be defined.

```
/services/mobility# add scan-list 2 148,61,151
```

d Set release 7 compatibility to *yes* if this AP is connecting to a shore AP running Release 7.1.0 software.

```
/services/mobility# set release-7-compatibility no
```

e Optionally set the RSSI threshold.

The *minimum* parameter specifies the minimum signal strength required to connect.

The *switch* parameter defines the signal strength level at which a link switch occurs, provided the secondary link is better by at least the specified *margin* set and has an signal strength better than *secondary*.

If the secondary link falls below the secondary threshold, the subscriber station begins scanning with its third or fourth radio if they exist.

```
/services/mobility# set RSSI minimum -85 margin 5 switch -70
secondary -75
```

f Enable scanning by connecting the Wi-Fi interfaces to the appropriate scan-list.

```
/services/mobility# connect scan-list 1 wifi-2-1
```

4 Display the configuration and correct any settings as required. Use following commands as required.

a Display the mobility configuration.

```
/services/mobility# show config

Topology   : point-to-point
Role       : SS
Rel 7      : False
Network Id : mobilityTest
Home Check : Disable    Link Id: AutoconfSSID

RSSI       : minimum  margin  switch  secondary
---------- : -------  ------  ------  ---------
(dbm)      :     -85       5     -70        -75
```

b Display the scan lists.

```
/services/mobility# show scan-list 2

Scan list [2] channels:
   61  148  151
Scan list [2] used by:
     wifi-2-1 (5GHz 802.11a)
     wifi-3-1 (5GHz 802.11a)
```

c Display the links detected by scanning.

```
/services/mobility# show available-infra
```

```
wifi-2-1 (MRMv1 4.4GHz 802.11n) scan list
Mac Address         CH    ANT    RSSI(dBm) AVL-BS  ENBL-BS  NET-ID-MATCH  Age  MESH ID
---------------     --    ---    --------- ------  -------  ------------  ---  -------
  00:0d:67:09:c4:79 91    1     -58        Yes     Yes      Yes           0    mobilityTest
current time: 01:06:30  last scan time: 21:01:38

wifi-3-1 (MRMv1 4.4GHz 802.11n) scan list
Mac Address         CH    ANT    RSSI(dBm) AVL-BS  ENBL-BS  NET-ID-MATCH  Age  MESH ID
---------------     --    ---    --------- ------  -------  ------------  ---  -------
  00:0d:67:09:c6:b9 107   1     -67        Yes     Yes      Yes           0    mobilityTest
current time: 01:06:30  last scan time: 20:59:03
```

The *show available-infra* command displays detected channel links and base station MAC addresses. Use *AVL-BS* (link not in use by another AP), *ENBL-BS* (base station mode enabled) and *NET-ID-MATCH* (match with shore AP) to determine why some links may not connect.

d Perform a backhaul survey.

```
/interface/wifi-2-1# show rf-survey backhaul
```

```
mac addr          ch  RSSI age priv topo   role linkIdx  identifier
                      (dbm) (s)                 12345678
----------------- --- ---- --- ---- ------ ---- -------- ----------
00:0D:67:00:B2:47 151 -42  0   none P-to-P --   -------- mobilityTest

noise floor: ................ -91 (dbm)
```

e Display the status of the primary and secondary links.

```
/services/mobility# show link-state
```

```
LINK ROLE  INTERFACE  CH  RSSI  MESH ID                         NODE IP          NODE NAME
---------  ---------  --  ----  ------------------------------  ---------------  -------------------
Primary    wifi-3-1   148 -44   mobilityTest                    10.1.1.13        ba100tBSmode
Secondary  wifi-2-1   151 -40   mobilityTest                    10.1.1.209       BA200CEM209
```

Sample Base Station Configuration

1 Configure the topology and privacy settings, and enable each Wi-Fi interface. Make sure to specify the mobile link identifier, specified with the *set network-identifier* command on the subscriber station.

```
/interface/wifi-3-1# set backhaul link identifier mobilityTest
topology p2p privacy disabled
/interface/wifi-3-1# set backhaul admin-state enabled
```

2 Disable RSTP dynamic cost for each backhaul link. The mobility service manages link cost.

```
/protocol/rstp# set interface wifi-3-1 dynamic-cost disable
```

3 Configure the mobile backhaul point-to-point links.

a Specify the topology and role.

```
/services/mobility# set topology p2p-mobile role bs
```

b Add links needed to support service

```
/services/mobility# add interface wifi-3-1
```

Note: The *scan-list*, *release-7-compatibility* and *RSSI thresholds* parameters and apply only to subscriber stations. The *show available-infra* command applies only to subscriber stations.

4 Display the configuration and correct any settings as required. Use following commands as required.

a Display the mobility configuration.

```
/services/mobility# show config

Topology    : point-to-point
Role        : BS
Rel 7       : False
Network Id : .....
BS OOS broadcast : Enabled
BS OOS timeout   : 180 (s)
Home Check : Disable    Link Id: AutoconfSSID

RSSI       : minimum  margin  switch  secondary
---------- : -------  ------  ------  ---------
(dbm)      :     -85       5     -70        -75
```

b Display the interface list.

```
/services/mobility# show interface-list

Mobility BS Interfaces:
    wifi-2-1
    wifi-3-1
```

c Display the backhaul status.

```
/interface/wifi-2-1# show backhaul status

Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:09:c4:79 up   fwd   -59  wifi-2-1 10.1.1.208    ba200-ShoreA
```

d Perform a backhaul survey.

```
/interface/wifi-2-1# show rf-survey backhaul

mac addr          ch  RSSI age priv topo   role linkIdx  identifier
                     (dbm) (s)                  12345678
----------------- --- ---- --- ---- ------ ---- -------- ----------
00:0D:67:00:44:49 151 -27  0   none P-to-P --   -------- mobilityTest

noise floor: ................. -96 (dbm)
```

Mobile Backhaul Point-to-point Commands

Commands are available to do the following tasks:

Displaying Mobile Backhaul Point-to-point Configuration

```
/services/mobility/show config
```

This command displays the current mobile backhaul point-to-point configuration.

Example

```
/services/mobility# show config

Topology    : point-to-point
Role        : SS
Rel 7       : False
Network Id : mobilityTest
BS OOS broadcast : Enabled
BS OOS timeout   : 180 (s)
Home Check : Disable    Link Id: AutoconfSSID

RSSI       : minimum  margin  switch  secondary
---------- : -------  ------  ------  ---------
(dbm)      :     -85       5     -70        -75
```

Displaying Link Status

```
/services/mobility/show link-state
```

This command displays the status of the primary and secondary links.

Example

```
/services/mobility# show link-state

LINK ROLE  INTERFACE  CH  RSSI  MESH ID                          NODE IP          NODE NAME
---------  ---------  --  ----  -------------------------------  ---------------  -------------------
Primary    wifi-3-1   148 -44   mobilityTest                     10.1.1.13        ba100tBSmode
Secondary  wifi-2-1   151 -40   mobilityTest                     10.1.1.209       BA200CEM209
```

Displaying Scan Results

```
/services/mobility/show available-infra
```

This command displays detected channel links and base station MAC addresses. Use *AVL-BS* (link not in use by another AP), *ENBL-BS* (base station mode enabled) and *NET-ID-MATCH* (match with shore AP) to determine why some links may not connect.

Example

```
/services/mobility# show available-infra

wifi-2-1 (MRMv1 4.4GHz 802.11n) scan list
Mac Address          CH    ANT    RSSI(dBm) AVL-BS  ENBL-BS  NET-ID-MATCH  Age  MESH ID
---------------      --    ---    --------- ------  -------  ------------  ---  -------
  00:0d:67:09:c4:79 91    1    -58        Yes     Yes      Yes           0    mobilityTest
current time: 01:06:30  last scan time: 21:01:38

wifi-3-1 (MRMv1 4.4GHz 802.11n) scan list
Mac Address          CH    ANT    RSSI(dBm) AVL-BS  ENBL-BS  NET-ID-MATCH  Age  MESH ID
---------------      --    ---    --------- ------  -------  ------------  ---  -------
  00:0d:67:09:c6:b9 107   1    -67        Yes     Yes      Yes           0    mobilityTest
current time: 01:06:30  last scan time: 20:59:03
```

Managing Interfaces

```
/services/mobility/add interface <interface-name>
/services/mobility/del interface <interface-name>
/services/mobility/show interface-list
```

These commands let you manage which interfaces are in the mobile backhaul point-to-point configuration.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

Example

```
/services/mobility# show interface-list

Mobility BS Interfaces:
    wifi-2-1
    wifi-3-1
```

Managing the Scan List

```
/services/mobility/add scan-list <1-8> <chan_nums>
/services/mobility/add scan-list <1-8> <chan_nums>
/services/mobility/show scan-list {<1-8>|all}
```

These commands let you manage the contents of up to eight scan lists.

Example

```
/services/mobility# show scan-list 2

Scan list [2] channels:
   61  148  151
Scan list [2] used by:
     wifi-2-1 (5GHz 802.11a)
     wifi-3-1 (5GHz 802.11a)
```

Associating a Scan List to an Interface

```
/services/mobility/connect scan-list <1-8> <interface-name>
/services/mobility/disconnect scan-list <1-8> <interface-name>
```

These commands let you manage which interface uses which scan list.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

Configuring RSSI Threshold

```
/services/mobility/set rssi [minimum <-100 - 0>]
                            [margin <5 - 20>]
                            [switch <-100 - 0>]
                            [secondary <-100 - 0>]
```

This command lets you configure the RSSI parameters that the AP uses to determine the viability of creating primary and secondary links.

The *minimum* parameter specifies the minimum signal strength required to connect.

The *switch* parameter defines the signal strength level at which a link switch occurs, provided the secondary link is better by at least the specified *margin* set and has an signal strength better than *secondary.*

If the secondary link falls below the secondary threshold, the subscriber station begins scanning with its third or fourth radio if they exist.

Example

```
/services/mobility# set RSSI minimum -85 margin 5 switch -70
secondary -75
```

Primary Link Drop

```
/services/mobility/set p2p-mobile drop-primary-at-min-rssi
                                                  {true|false}
```

Once a link has been established based on the RSSI threshold parameters, the AP can maintain the link, even if the signal strength drops below the minimum threshold setting.

This commands let you configure this feature. If set to *false*, the AP maintains the link even when the signal strength drops below the minimum threshold setting. If set to *true*, the AP drops the link.

Mobile Link Identifier

```
/services/mobility/set network-identifier <net_id>
```

This command lets you configure a mobile link identifier, consisting of up to 20 characters.

Example

```
/services/mobility# set network-identifier mobilityTest
```

Home Check

```
/services/mobility/set home-check {enabled|disabled} <home_id>
```

This command lets you configure and activate the home check feature which forces a subscriber station to connect to specific base station links. When home check is enabled, the subscriber station accepts only base station links that advertise a mobile link identifier that is exactly the same as the subscriber station's home-check identifier.

The specified home-check identifier can of up to 20 characters.

Base Station Out-of-service Check

```
/services/mobility/set bs-oos-timeout <time-out>
/services/mobility/set bs-oos-broadcast {enabled | disabled}
```

These commands apply to base stations only. They let you configure and activate the behavior when the base station can no longer egress traffic to an outside network. The <time-out> parameter is a timer in seconds. Values range from 60 to 86400. The default value is 300 seconds.

These commands work in conjunction with the *set system-egress-point* command described in "Setting the Network Egress Point" on page 72:

- If the system egress point is set to *direct*, then the base station out-of-service timer starts when the Ethernet link becomes unavailable. If the timer expires and the Ethernet link is still unavailable, then the base station is taken out of service by prepending *bsOutOfService* to the mobile link identifier.

- If the system egress point is set to *indirect* with a gateway IP address, then the base station pings the gateway IP address and starts the out-of-service timer if it does not receive a reply. If the timer expires and the gateway still does not reply, then the base station is taken out of service by prepending *bsOutOfService* to the mobile link identifier.

Release 7 Compatibility

```
/services/mobility/set release-7-compatibility {true|false}
```

This command lets you connect a subscriber station to a base station running Release 7.1.0 software.

Single Channel Mesh

```
/services/mobility/set single-channel-mesh ([channel <chan_no>]
                 [link-id <link_id>]
                 [privacy {{enabled key <random_str>}|disabled}]
                 [allow-multi-links {yes|no}])
```

Normally, APs create a wireless mesh between themselves using multiple radio channels to avoid radio interference. However, in some mobile applications, in may be desirable to have all radios use a single channel. Such an application requires that all radios use directional antennas and are correctly positioned to avoid radio interference.

This command allows you to configure such an application, where all radios use a single channel. This command must be invoked on each AP in the mesh.

The *<chan_no>* parameter allows you to specify which channel to use.

The *<link_id>* parameter is case sensitive and can be up to 32 alphanumeric characters. BelAir Networks recommends that the link identifier describes the link; that is, the APs it connects.

The *privacy* setting determines whether AES privacy is used or not.

The pre-shared key must be exactly 32 bytes long (16 characters). The pre-shared key can be specified as a hexadecimal or ASCII string and must not contain the following characters:

- bar (|)
- semicolon (;)
- question mark (?)
- double quotation mark (")

The *allow-multi-link* setting determines whether both a primary and secondary links are created between each AP in the mesh or just a primary. Multiple links increase redundancy, but in a single channel mesh application may limit the number of inter-connected APs. The default is *no*.

When a single channel mesh is created, the resulting links are simple point-to-point backhaul links, as described in "Wi-Fi Backhaul Link Configuration" on page 161. Typical mobile backhaul point-to-point notions, such as scan-lists, RSSI thresholds, and primary and secondary links, do not apply to them.

Operating in High Capacity and Interference Environments

High Capacity and Interference (HCI) environments usually have the following characteristics:

- high number of wireless clients in a relatively small geographic area
- wireless traffic is restricted to relatively few wireless APs
- sudden surges of demand for connectivity
- building structure or geometry may restrict connectivity

Stadiums and other sports venues are typical examples. In such locations when a sports event occurs, several thousand wireless clients can suddenly request connectivity to a network of Wi-Fi Access Points.

The AP provides several features that you can adjust to optimize performance in such an environment. These include:

- Modulation Rate Control, described on page 185
- VLAN based QOS, described on page 185
- Traffic Priority Based on Modulation Rate, described on page 186
- No SSID on Egress Down, described on page 186
- Ethernet Port Statistics, described on page 186
- Access Receive and Transmit Error Statistics with SNMP Support, described on page 187
- Noise Floor Support, described on page 187
- Access Packet RSSI Filter, described on page 187
- Effective Mesh Path Selection, described on page 187
- Blacklist SNMP Support, described on page 188
- Client Association Records, described on page 188
- CTS-to-Self Control, described on page 188
- DHCP to Attached Clients Only, described on page 188
- ARP to Attached Clients Only, described on page 188
- Upstream Broadcast Filter, described on page 188

- Secure Port Mode, described on page 189
- Wireless Bridging, described on page 189
- Client Load Balancing, described on page 189
- Client Authentication History, described on page 190
- Automatic Mesh Connect, described on page 190
- Traffic Test Tool, described on page 190

Modulation Rate Control

This feature allows the operator to directly control the allowed modulation rates (and select the basic rates). This increases network efficiency in HCI environments through the following effects:

- Collisions cause retransmissions that usually occur at a reduced modulation rate. Ongoing collisions reduce the starting modulation rate for packets. Use this feature to eliminate lower modulation rates and put a lower bound on this effect.
- Eliminating lower modulation rates also eliminates distant clients (low RSSI) and clients in high noise areas (low SNR).

For details, see “AP Custom Rates” on page 124.

VLAN based QOS

This feature allows the operator to control the relative priority of traffic on a per-VLAN basis.

By mapping certain VLANs onto higher priorities in HCI environments, the traffic on those VLANs can obtain preferential access to the airwaves at the expense of other traffic which is forced to wait.

The usefulness of this feature is limited if the overlap of the APs is significant. It is most effective when overlap is small and the interference comes from third-party APs.

The relevant commands are:

- `/interface/wifi-<n>-<m>/set ssid <ssid> service-set-identifier <ssid-name> broadcast vlan <vlan-id>`, described in detail in “Configuring SSIDs” on page 134.
- `/qos/set vlan-to-queue-mapping <vlan-id> <queue-id>`, described in detail in “Prioritizing Traffic using VLAN IDs” on page 226.

Traffic Priority Based on Modulation Rate

A Wi-Fi AP sorts traffic according to priority and transmits it by priority in order of arrival. Different QOS schedulers (EDCA, LSPQ, SPQ) result in different performance for the various priorities.

This feature applies a priority based on modulation rate on top of the QOS priority. It tries to give clients equal amounts of air-time instead of equal numbers of packets. The result in HCI environments is that more packets are sent to clients who are using higher modulation rates, increasing the effective bandwidth.

For details, see "Rate Aware Fairness" on page 112.

No SSID on Egress Down

When this feature is enabled, all SSIDs on a radio can be modified with a text string, such as *outOfService*, when an AP loses its egress connection. In HCI environments, this feature prevents traffic from being uselessly directed to an AP which can not successfully forward it.

This feature can be enabled or disabled on per radio basis. The text string can be configured on a per-SSID basis.

The relevant commands are:

- `/interface/wifi-<n>-<m>/set ap-oos-broadcast {enabled|disabled} [option {replace|prepend}]` and `/interface/wifi-<n>-<m>/set ssid <ssid-number> ap-oos-identifier <oos_string>` described in detail in "Out-of-service Advertising" on page 140.
- `/system/set system-egress-point {yes {direct|indirect gateway-ip <ip_addr>}|no}` described in detail in "Setting the Network Egress Point" on page 72.

Ethernet Port Statistics

Ethernet port statistics are available for the BelAir200, BelAir100, BelAir100C and BelAir100T. In HCI environments, these statistics measure the traffic passing through the AP if its Ethernet port is connected to an external network.

The relevant command is `/interface/eth-1-1/show statistics`, described in detail in the *Troubleshooting Guide*.

The output includes:

- received octets, unicast packets, multicast packets, broadcast packets and discarded packets
- transmitted octets, unicast packets, multicast packets and broadcast packets

Access Receive and Transmit Error Statistics with SNMP Support

BelAir Networks radios provide extensive statistics for insight into network behavior and to guide network optimization.

The relevant commands are:

- `/interface/wifi-<n>-<m>/show statistics`
- `/interface/wifi-<n>-<m>/show pm`
- `/interface/wifi-<n>-<m>/show client`

These commands are described in detail in the *Troubleshooting Guide*.

Noise Floor Support

In HCI environments, accurate noise floor data is critical for channel planning and to interpret performance statistics. Noise floor reporting is available through SNMP for all radios:

- For newer radios, such as the ERMv5, instantaneous and average noise floors are reported.
- For older radios, such as the ARMv3, instantaneous and average noise floors are reported but the value is the same for both.
- SNMP reports the average noise floor value.

You can also use the command `/interface/wifi-<n>-<m>/show rf-survey`, described in detail in the *Troubleshooting Guide*, to show the instantaneous noise floor.

Access Packet RSSI Filter

This feature blocks clients from associating if their RSSI is below a threshold value. This prevents clients that would be forced to use a low modulation rate from associating. In an HCI environment, contention is already high so it is preferable to exclude clients that make inefficient use of air-time.

For details, see "Minimum Association Thresholds" on page 113.

Effective Mesh Path Selection

Higher modulation rates are strongly preferred in HCI environments. BelAir Networks' mesh path selection software favors paths with good RSSI, and therefore higher modulation rates, even at the cost of a few more hops. Field testing has shown increasing the number of hops may increase airtime slightly, but using a path with poor RSSI can increase the airtime significantly as the modulation rate decreases with poor RSSI.

Blacklist SNMP Support

BelAir Networks APs support adding and deleting backhaul blacklist members through SNMP. This allows operators using BelView Network Management System (NMS) Release 6 or later to override the mesh paths selected by particular APs to optimize performance.

Client Association Records

In HCI environments, client associations are often of short duration and the connection data is discarded rapidly to support newer clients. This causes some associations to be missed by the polling cycle of the NMS.

To increase the measurability of the network, APs maintain a circular buffer containing information, such as client MAC and IP address, RSSI, and connection duration, about current and recently associated clients. These client records can be used to assist the NMS.

CTS-to-Self Control

Normally, an 802.11g AP uses CTS-to-self to interact with 802.11b APs. The transmitted packet is small, but in HCI environments the accumulated effect is a substantial performance penalty. This feature disables 802.11b protection for the radio, maximizing the throughput for wireless clients that operate in the 2.4 GHz range.

This feature improves performance if there are only a few 802.11b clients present and they are not generating large amounts of traffic. If not, the 802.11b clients may generate substantial numbers of collisions and actually impair traffic.

For details, see “802.11b Protection” on page 144.

DHCP to Attached Clients Only

This feature prevents the radio from forwarding DHCP responses for MAC addresses that are not used by an associated client, thus reducing the number of transmitted packets and improving bandwidth use. This feature is always enabled.

ARP to Attached Clients Only

This feature prevents the radio from forwarding ARP requests for IP addresses that are not used by an associated client, thus reducing the number of transmitted packets and improving bandwidth use.

For details, see “ARP Filtering” on page 143.

Upstream Broadcast Filter

When enabled, this feature limits the types of multicast and broadcast packets passed through the AP:

- In the upstream direction (from the client), only ARP requests, DHCP requests and DHCP discover messages are allowed.

- In the downstream direction (to the client), only ARP response, DHCP offer, DHCP ACK, and DHCP NAK are allowed.

In HCI environments, this feature reduces the overall traffic load by reducing broadcast flooding throughout the network.

For details, see "Filtering Broadcast and Multicast Packets" on page 141.

Secure Port Mode

Secure port mode forces all client communications to be directed toward a specified MAC address or group of MAC addresses. It also prevents a client claiming to be one of these MAC addresses from associating.

In HCI environments, this feature forces all traffic to flow to or from the network gateway. This can be used to allow traffic policy enforcement. It prevents direct inter-client communication that could load down the network.

For details, see "Controlling Inter-client Communication" on page 156,

Wireless Bridging

The wireless bridging feature allows traffic to be forwarded directly from one client to another within the AP. In HCI environments, it should be disabled.

As with secure port mode, this feature controls whether all traffic flows to the network gateway and can be used to allow traffic policy enforcement. It prevents client-to-client direct communication that could load down the network.

For details, see "Controlling Inter-client Communication" on page 156,

Client Load Balancing

BelAir Networks APs allow you to configure the maximum number of associated clients per radio. If the number of associated clients exceeds the configured value, new clients are not allowed to connect.

In HCI environments, limiting the number of associated clients:

- reduces the number of collisions. (Each client attempts to transmit after a random back-off. With many clients the probability of collision is greatly increased.)
- limits the total traffic offered
- forces traffic to be distributed over different APs operating on different channels

For details, see "Wireless Client Load Balancing" on page 129.

Client Authentication History

This feature lets the operator display the details of the association and authentication process of the clients connected to the AP. In HCI environments, it can be used to troubleshoot client issues and determine how much success clients are having when attempting to access and use the network.

The relevant command is `/interface/wifi-<m>-<n>/show authentication history [mac <mac-address>]`, described in detail in the *Troubleshooting Guide*.

Automatic Mesh Connect

This feature allows APs to automatically reconnect to a network if they lose their egress connection. A cluster of meshed APs may lose their egress connection if the ethernet connection to the exterior network fails or if an AP fails. In this case, a member of the cluster looks for an alternate mesh to join and reconnect the isolated cluster.

In HCI environments, this feature can be used for rapid deployment of a network. The APs in a network can be grouped by shared backhaul link identifier into a cluster. Multiple clusters can be deployed to control traffic flows and optimize backhaul performance.

As soon as one AP in each cluster has an egress path, the whole cluster has egress. In the event that an egress fails, a cluster can self-repair by reconnecting to one of the other mesh clusters.

Traffic Test Tool

This tool provides an internal mechanism to measure the available traffic capacity of the network. The tool reports the throughput on a hop-by-hop basis from the AP under test to the destination IP address (another AP in the network).

In HCI environments, this tool can be used to test the network deployment during the commissioning phase. It can be used to determine the theoretical capacity of the network and identify poorly performing links.

The relevant command is:

```
/diagnostics/test link IP <end point IP address>
                          rate <traffic rate>
                         [update_interval <report interval>]
                         [duration <test duration>]
                        [dir {tx|rx|both}]
```

The command is described in detail in the *Troubleshooting Guide*.

DHCP Relay Settings

This chapter describes how to configure your AP's DHCP Relay agent settings.

You can configure up to five profiles for the DHCP Relay agent on your AP. Each profile specifies a subnet interface, which can be either the AP's system interface or a VLAN. The DHCP server assigns an IP address to the client according to the subnet of this interface.

Each profile also contains the IP addresses for up to three DHCP servers. When a profile is activated, the DHCP agent forwards a DHCP request to all the listed servers. The DHCP client receives packets from the first server to respond to the request.

Profiles offer an easy way of configuring different DHCP servers for each subnet interface.

Your AP can also add BelAir Networks specific information to the DHCP packets sent to the wireless client.

Finally, you can create a list of valid IP address subnets to filter out unwanted directed and broadcast DHCP packets from your wireless network.

The following topics are covered in this chapter:

See also "Providing Vendor Specific Information" on page 137.

Displaying the DHCP Relay Configuration

```
/protocol/dhcp/show config [{relay {all|<relay-idx>}} |
                        {dhcp-allowed-subnet {all|<index 1-32>}}]
```

The *show config* command displays DHCP Relay configuration:

- Use *show config* to display information for all DHCP Relay profiles and all configured DHCP allowed subnet entries.

- Use *show config relay all* to display information for all DHCP Relay profiles only.
- Use *show config relay <relay-idx>* to display information on the specified DHCP Relay profile.
- Use *show config dhcp-allowed-subnet all* to display all configured DHCP allowed subnet entries.
- Use *show config dhcp-allowed-subnet <index 1-32>* to display information on the specified DHCP allowed subnet entry.

Example

```
/protocol/dhcp# show config

Idx En     DHCP Relay Info
-----------------------------------------------------
1    *   Server[1] IP: 10.1.1.88
         Interface: System
2    *   Server[1] IP: 10.1.100.88
         Interface: Vlan-100
3    *   Server[1] IP: 10.1.200.88
         Interface: Vlan-200
4        No server configured

5        No server configured
```

Modifying DHCP Relay Parameters

```
/protocol/dhcp/set relay <relay-idx> server-addr-1 <ip-addr>
                                    [server-addr-2 <ip-addr>]
                                    [server-addr-3 <ip-addr>]
                             interface {system | vlan <vlan-id>}
/protocol/dhcp/del relay <relay-idx> server <server-idx>
```

The *set relay* command creates a DHCP Relay profile or modifies an existing one. It configures the IP addresses of the DHCP servers to which the Relay Agent needs to forward the packets from the client. You must specify at least one DHCP server IP address and the type of interface; either system or a VLAN. The VLAN must be a valid VLAN management interface.

The *vlan_id* parameter specifies that traffic be directed to the specified Virtual LAN (VLAN). The VLAN ID is an integer from 1 to 3015 and from 3018 to 4045.

The *del relay* command removes only one IP address from each profile. To completely clear a profile, you must use the *del relay* command up to three times.

Before clearing the profile, you must first make sure that no SSID is using that profile.

Interface Administrative State

```
/protocol/dhcp/set relay <relay-idx> admin-state {enabled|disabled}
```

This command allows you to activate individual DHCP relay profiles. When enabled, the Relay Agent forwards the packets from the client to the DHCP servers specified in the profile.

Assigning SSID Traffic to Use DHCP Relay

```
/interface/wifi-<n>-<m>/set ssid <ssid_index> dhcp-relay
                                    {disabled | enable <relay-idx>}
```

This command assigns which SSID traffic uses the AP's DHCP relay functionality. Perform this step after the DHCP Relay profile is added and enabled.

Once DHCP relay functionality is enabled for the SSID, your AP automatically adds DHCP Option 82 information (that is, relay agent information) to the DHCP packets for that SSID sent to the wireless client and DHCP server. For details, see "Providing Vendor Specific Information" on page 137.

The *ssid_index* parameter is an integer from 1 to 8. Use the *show ssid table* command to determine *<ssid_index>*.

DHCP Address Filtering

```
/protocol/dhcp/set dhcp-allowed-subnet <index 1-32)>
                                 ip_addr <ip_addr> netmask <random_str>

/interface/wifi-<n>-<m>/add ssid <ssid_index>
                                   dhcp-allowed-subnet <index 1-32>
/interface/wifi-<n>-<m>/del ssid <ssid_index>
                                dhcp-allowed-subnet {<index 1-32> | all}
/interface/wifi-<n>-<m>/set ssid <ssid_index>
                                   dhcp-addr-filter {enabled | disabled}
/interface/wifi-<n>-<m>/show dhcp-allowed-subnet {all | <index 1-32>}
```

This feature reduces unnecessary or unwanted directed and broadcast DHCP packets from your wireless network.

First, use the */protocol/dhcp/set* command to generate a list of valid IP subnets and masks for this AP. Your list can contain up to 32 members. To remove an entry from the list, set the IP address and the mask to 0.0.0.0.

Then, use the */interface/wifi-<n>-<m>/add* command to assign a member of that list to an SSID. The *ssid_index* parameter must be a valid SSID index. Use the */interface/wifi-<n>-<m>/add* command repeatedly to add more than one entry to an SSID. Each SSID can have up to 32 entries. Entries for different SSIDs can overlap.

When a Wi-Fi client sends DHCP Request packets and the requested IP addresses are not within the allowed subnet entries for the SSID, the AP intercepts the Request and sends a DHCP NAK response.

Use the equivalent */interface/wifi-<n>-<m>/del* command to remove a subnet entry from an SSID. The */interface/wifi-<n>-<m>/set* command allows you to enable or disable DHCP address filtering on individual SSIDs.

Use the */interface/wifi-<n>-<m>/show ssid (ssid_index> config* command to display whether DHCP address filtering is enabled for the SSID and the allowed subnets for the SSID.

DHCP Relay Performance Monitoring Statistics

```
/protocol/dhcp/show relay {aggregate|<relay-idx>} pm {fifteen-min|day}
                                                  [{<0-96>|<0-7>|all}]
```

This command displays DHCP Relay performance measurements for either a specific subnet interface as specified by the DHCP Relay profile index, or for an aggregate of all the subnet interfaces. The relay profile index ranges from one to five. For details on DHCP Relay settings, refer to "DHCP Relay Settings" on page 191.

The displayed performance measurements are either for a specific time interval or for a series of time intervals. The valid parameter options are:

- *fifteen-min*, *fifteen-min 0* to *fifteen-min 96*
- *day*, *day 0* to *day 7*
- *all*, all performance measurements.

Specifying *fifteen-min* is equivalent to specifying *fifteen-min 0* and means the current 15-minute interval. Specifying *day* is equivalent to specifying *day 0* and means the current day, excluding data from the current 15-minute period.

When *aggregate* is specified, the output displays the total number of dropped DHCP Relay packets for all subnet interfaces. When a specific relay profile index is specified, the output displays the number of DHCP packets that are relayed, both received and sent.

Example 1

```
/protocol/dhcp# show relay 1 pm fifteen-min 0

DHCP relay 1 message PMs: Interval type: current 15 minute    Interval number: 0

DHCP relay messages received:
BOOTREQUEST:                      3
DHCP Decline:                     0
DHCP Discover:                    0
DHCP Inform:                      0
DHCP Release:                     3
DHCP Request:                     0
```

```
DHCP relay messages sent:
BOOTREPLY:                        3
DHCP Offer:                       0
DHCP ACK:                         3
DHCP NAK:                         0
```

Example 2

```
/protocol/dhcp# show relay 1 pm fifteen-min all
```

```
int Request: Discover    Decline     Inform     Release    Request  Reply:  NAK       ACK       Offer
00                  0          0          0          0          3          0         3           0
01                  0          0          0          0          0          0         0           0
```

Example 3

```
/protocol/dhcp# show relay aggregate pm fifteen-min 0
```

```
DHCP relay aggregate PMs: Interval type: current 15 minute    Interval number: 0

DHCP relay total dropped Pkt:          0
Invalid DHCP Pkt:                      0
Invalid DHCP Relay:                    0
```

Example 4

```
/protocol/dhcp# show relay aggregate pm fifteen-min all
```

```
int  Invalid Pkt   Invalid Relay
00             0            0
01             0            0
```

Network Address Translation

Network Address Translation (NAT) allows the AP to modify network address information in packet headers to remap a given address space into another. This technique can hide several private network IP addresses behind a single IP address in another public address space.

The AP implements NAT IP masquerading, where the AP acts as a DHCP server to assign IP addresses in the private network starting from a specified base IP address. NAT applies only to traffic entering and leaving the AP through its Ethernet interface or its cable modem interface.

The AP lets you configure up to eight NAT address scopes. For each scope, you can associate different VLAN traffic, a different base IP address and different DHCP lease settings.

You can use NAT with or without Universal Access Method (UAM) to provide user authentication, client authentication and accounting information. For details on configuring and enabling UAM, see "Universal Access Method" on page 201. If you use NAT with UAM, ensure that the same VLANs are configured in both NAT scopes and UAM scopes.

The AP can provide both NAT and Layer 2 tunnels. User traffic separation is based on VLANs. If you use both NAT and Layer 2 tunnels, make sure that your VLANs are mapped to either an NAT scope or a Layer 2 tunnel, but not both. Refer to "Using Layer 2 Tunnels" on page 210 for a description of Layer 2 tunnels.

The following tasks can be done:

Displaying the Operational Status

`/protocol/nat/show status`

This command displays NAT operational status and settings.

Example

```
/protocol/nat# show status

NAT admin state is DISABLED, oper state is NOT RUNNING

Egress interface - eth-1-1

 Dns1: undefined
 Dns2: undefined

DHCP scopes:

 Num   Status  VLAN   IP subnet    Lease(min)  Mgmt
===== ======== ==== ============= ============ ====
    1  enabled untg   192.168.5.0           60   no
    2 disabled    0       0.0.0.0            0   no
    3 disabled    0       0.0.0.0            0   no
    4 disabled    0       0.0.0.0            0   no
    5 disabled    0       0.0.0.0            0   no
    6 disabled    0       0.0.0.0            0   no
    7 disabled    0       0.0.0.0            0   no
    8 disabled    0       0.0.0.0            0   no
```

Displaying the Current DHCP Lease Status

`/protocol/nat/show dhcp-leases`

This command displays DHCP lease status and settings.

Example

```
/protocol/nat# show dhcp-leases

  IP address       MAC address         State
=============== ================= ===============
Scope 1
  192.168.5.254 00:0d:67:10:e8:1a

Scope 2
--- no entries ---
```

Displaying the DHCP Lease History

`/protocol/nat/show leases history`

This command displays DHCP lease history.

Example

```
/protocol/nat# show leases history

  IP address       MAC address                    Lease & State
=============== ================= ==================================
  192.168.5.254 00:0d:67:10:e8:1a starts 2 2009/08/04 12:04:24 - State active
  192.168.5.254 00:0d:67:10:e8:1a starts 2 2009/08/04 12:34:24 - State active
```

Configuring Network Address Translation

```
/protocol/nat/set scope <index (1-8)>
                        dhcp-server {untagged | vlan <vlan_id>}
                        based-ip <IP_addr>
                        lease-time <minutes>
                        [num-entries <number>]
```

This command lets you configure the NAT settings for each address scope.

The *dhcp-server* setting lets you specify which VLAN traffic to associate to the scope. The *untagged* setting specifies that the scope applies only to untagged traffic. The *vlan <VLAN ID>* settings specifies that the scope applies only to traffic with that VLAN ID. VLAN IDs cannot be shared across different scopes. The default setting is *untagged*. Refer to "Layer 2 Network Configuration" on page 231 for more information on VLAN configuration.

The *based-ip* setting lets you specify the base IP address for the scope. Use xx.xx.xx.0 as the format. Once specified, the AP IP address becomes xx.xx.xx.1 and it begins to allocate addressed from xx.xx.xx.2 to xx.xx.xx.254.

The *lease-time* setting lets you specify the maximum DHCP lease time in minutes for IP addresses supplied by NAT. The default is 60 minutes. Other DHCP server settings are based on those specified in "Configuring Dynamic IP Addressing" on page 62.

The optional *num-entries* setting lets you specify the maximum number of IP addresses that can be allocated to clients in this scope. Values range from 1 to 253. The default value is 253.

By default, scope 1 is preconfigured for untagged VLAN traffic with a base IP address of 192.168.5.0.

Choosing an Egress Interface

```
/protocol/nat/set egress {eth-1-1|cm-9-1}
```

This command applies to the BelAir100SN and BelAir100SNE.

The BelAir100SN and BelAir100SNE have two interfaces that can act as an egress point for NAT: the ethernet interface and the cable modem interface. This command lets you define which interface to use.

Preventing AP Management from within the Scope

```
/protocol/nat/set scope <index (1-8)>
                        management {enabled | disabled}
```

This command lets you control whether clients within a particular scope can access the AP's management interface. The default setting is *disabled*, meaning that the APs within that scope cannot access the management interface of the AP providing NAT.

Enabling or Disabling Individual Scopes

```
/protocol/nat/set scope <index (1-8)>
                        status {enabled | disabled}
```

This command lets you enable or disable individual NAT scopes. The default setting is *disabled*.

Changing NAT Admin State

```
/protocol/nat/set admin-state {enabled | disabled}
```

This command lets you enable or disable NAT functionality. The default setting is *disabled*.

When you enable or disable NAT functionality, you must:

1 Issue the *config-save* command. See "Saving your Changes" on page 37 for details.

2 Reboot the AP. See "Activating a Software Load" on page 250 for details.

Managing APs in a NAT Cluster

This section describes functions that you can use to manage APs that are part of a NAT cluster.

In a NAT cluster, one AP serves as an egress point to several other APs. The egress AP uses NAT to provide IP addresses to the APs that are cluster members.

In such a configuration, the cluster members are normally hidden from network management behind the egress AP. To help manage the cluster members, you can use the egress AP functions described in the following sections:

- "Mac Address to IP Address Mapping" on page 199
- "Port Forwarding" on page 200

Mac Address to IP Address Mapping

```
/protocol/nat/add scope <index (1-8)>
                              mac-static <MAC_addr> ip <IP_addr)
/protocol/nat/del scope <index (1-8)>
                              mac-static <MAC_addr> ip <IP_addr)
```

These commands let you specify which IP address to provide to specific cluster members based on their MAC address.

Port Forwarding

```
/protocol/nat/add port-fwd protocol {tcp | udp} port <number>
                          dest-ip <IP_addr> dest-port <number>
/protocol/nat/del port-fwd protocol {tcp | udp} port <number>
                          dest-ip <IP_addr> dest-port <number>
```

These commands let you create a port forwarding table for TCP or UDP traffic. If a station managing APs in a NAT cluster needs to send TCP or UDP traffic addressed to a particular application (for example, Telnet, web, or SNMP) on particular AP within the cluster, it can specify:

- the IP address of the egress AP as the destination address
- the port as defined for the application in question for the egress AP as the destination port

The egress AP can then use the port forwarding table to translate the destination port to the correct port and IP address for the intended target AP in the cluster.

For example, if AP 2 in a cluster has an IP address 182.168.5.2, then to send Telnet (TCP port 23) traffic to AP 2, you must:

1 Define the following port forwarding entry on the egress AP:

```
add port-fwd protocol tcp port XXXX dest-ip 192.168.5.2
dest-port 23
```

2 Execute the following command on your management station:

```
telnet Y.Y.Y.Y XXXX
```

where *Y.Y.Y.Y* is the public IP address of egress AP.

The port forwarding table can contain up to 32 entries.

Universal Access Method

The Universal Access Method (UAM) is key element of BelAir Networks' Policy Enforcement Point (PEP) module. UAM is a simple authentication method where a user needs only a Web browser. When a user requests a URL, the request is checked against a series of white lists containing hosts, MAC addresses and protocols.

The user's request is granted if any of the following conditions are met:

- The requested URL or its equivalent IP address is on the host white list.
- The MAC address of the user's client is on the MAC white list.
- The user's request uses DHCP, DNS, ARP or any protocol you put on the protocol white list with the *add scope <n> protocol-white-list* command.

Otherwise, the user is redirected to a Web server that displays a page requesting credentials. The supplied credentials are then sent to a RADIUS authentication server. Once authenticated, the user is redirected to the URL they originally requested. The user can terminate their authenticated session by using functions provided by the Web server (such as a logout button) or by entering the *http://1.1.1.1* URL.

Note: UAM requires the use of a DNS server to resolve supplied URLs to IP addresses.

Finally, through correct provisioning of the RADIUS server, the AP's implementation of UAM also allows you to enforce client access policies:

- It can perform client MAC address authentication when a client associates to the AP, even before the user supplies a URL.
- It can enforce policies based on the attributes listed in Table 13.

Table 13: Attributes for UAM Client Access Policy Enforcement

RADIUS Attribute	Value used if unspecified by RADIUS
Session idle timeout	5 minutes
Client session timeout	Unlimited
Total client traffic	Unlimited
Maximum downstream client traffic	Unlimited

Table 13: Attributes for UAM Client Access Policy Enforcement (Continued)

RADIUS Attribute	Value used if unspecified by RADIUS
Maximum upstream client traffic	Unlimited
Termination time	Unlimited

As well, UAM can also provide accounting information, again depending on correct provisioning of the RADIUS server.

The AP lets you configure up to eight UAM scopes. For each scope, you can:

- create different UAM white lists
- associate different VLAN traffic
- gather different session accounting records
- enforce different client access policies

The following tasks can be done:

- "Displaying the Current Configuration" on page 203
- "Displaying the Operational Status" on page 203
- "Displaying the Client Session Information" on page 204
- "Specifying the Web Server" on page 205
- "Specifying Redirection Variable Pairs" on page 206
- "Specifying the RADIUS Server" on page 206
- "Managing White List Entries" on page 206
- "Associating VLAN Traffic to a Scope" on page 207
- "Performing MAC Address Authentication" on page 207
- "Collecting Accounting Information" on page 208
- "Operating in WAN Mode" on page 209
- "Changing UAM Admin State" on page 209

Displaying the Current Configuration

```
/services/uam/show config [scope <index (1-8)>]
```

This command displays the current UAM configuration. Specifying a scope displays just that scope.

Note: This command displays only the host, mac and protocol white list entries that you control through the *add* and *del* commands. (See "Managing White List Entries" on page 206.) This commands does not display the white list entries that the AP automatically tracks internally.

Example

```
/services/uam# show config scope 2

Scope 2 Configuration:
----------------------
admin state: ....................   Enabled
mac authentication state:........   Enabled
mac authentication password:.....
mac authentication success redirect:Enabled
mac authentication reject suspend:  Enabled
accounting state:................   Enabled
authentication web server url:...   http://
secure2.worldspot.net/wk/Uam
authentication shared secret:....   Mm94XVjzug
splash web server url:...........
uam local interface:.............   System
wan-mode admin state: ...........   Disabled
wan-mode web server key:.........
radius servers:..................   2
radius nasid:....................   BelAirHotspot
host-white-list:
   www.paypal.com
   www.paypalobjects.com
   paypal.112.2o7.net
   www.belairnetworks.com
mac-white-list:
protocol-white-list:
vlan-list:
     10
added redirect variable pairs:
   ssid mySsid
   locationId   myLocation
```

Displaying the Operational Status

```
/services/uam/show status [scope <index (1-8)>]
```

This command displays UAM operational status and settings.

Example

```
/services/uam# show status scope 2

Scope 2 Status:
```

```
----------------------
admin state: .................... Enabled
mac authentication state:........ Enabled
accounting state:................ Enabled
authentication web server ip:.... secure2.worldspot.net
        resolved IP addresses:
                69.64.50.37
authentication shared secret:.... Mm94XVjzug
splash web server ip:............
        resolved IP addresses:
radius servers:.................. 2
radius nasid:.................... BelAirHotspot
host-white-list:
        www.paypal.com:
                resolved IP addresses:
                        66.211.169.2
                        66.211.169.65
                        64.4.241.33
                        64.4.241.49
        www.paypalobjects.com:
                resolved IP addresses:
                        184.29.112.146
        paypal.112.2o7.net:
                resolved IP addresses:
                        66.235.139.118
                        66.235.138.18
                        66.235.139.121
                        66.235.138.19
        www.belairnetworks.com:
                resolved IP addresses:
                        206.191.51.223
        optimumwifi.optimum.net:
                resolved IP addresses:
                        167.206.247.50
mac-white-list:
protocol-white-list:
vlan-list:
     10  800
local info:
    uamPort:..................... 3991
    radius-server-index:......... 2
    radius-local-ip:............. 10.100.1.9
    uam-local-ip:................ 10.100.1.9
    uam-logout-ip:............... 1.1.1.1
```

Displaying the Client Session Information

```
/services/uam/show client-session
                   [{ip <ip_str>|mac <mac_str>|scope <num_str>}]
```

This command displays UAM client session information.

Example

```
/services/uam# show client-session

Client-Session:
```

```
----------------------
ip address: .................... 10.100.1.210
Mac address: ................... 00:1E:E5:DE:DD:C5
Scope: ......................... 1
Vlan: .......................... untag
Authenticated: ................. yes
User Name: ..................... BAunlim
Redirect url: ..................
User url: ...................... http://fxfeeds.mozilla.com/
en-US/firefox/headlines.xml
Bandwidth MaxUp: ............... 0
Bandwidth MaxDown: ............. 0
Max Input Octets: .............. 0
Max Output Octets: ............. 0
Max Total Octets: .............. 0
Timeout: ....................... 14526
Idle Timeout: .................. 300
Accounting interim Interval: ... 600
Terminate Time: ................ 0
Start Time: .................... 1280150841
Last Active Time: .............. 1280150841
Last Accounting Update Time: ... 1280150841
Last Radius Request Time: ...... 1280150841
Input Packets: ................. 0
Output Packets: ................ 0
Input Octets: .................. 0
Output Octets: ................. 0
Input Gigawords: ............... 0
Output Gigawords: .............. 0
Internal Usage Info:
Radius Session Id: ............. 547999736
Radius Uam Port: ............... 41
Radius Act State: .............. 4
Uam Challenge Start Time: ...... 1280150841
Suspend Time: .................. 60
Suspend Start Time: ............ 0
Current Time: .................. 1280150905
```

Specifying the Web Server

```
/services/uam/set scope <index (1-8)> auth-url <url-string>
                                      shared-secret <string>
                                      [splash-url <url-string>]
                     [uam-interface {system | {vlan <vlan-str>}}]
```

This command lets you specify the URL of the Web server for individual UAM scopes.

The splash URL specifies a special usage web page (for example, advertisement). If it is configured, the AP redirects the user to the splash page instead of authentication page. The splash page then redirects the user to authentication server. The AP does not control the behavior of the splash page.

If the *splash-url* parameter is not specified, then the user is sent directly to the authentication server.

Both the *splash-url* and the *auth-url* (if specified) are automatically tracked internally as UAM host white list entries.

The *uam-interface* parameter is used for communications between the wireless client and AP. You can set the uam-interface to be the AP's system IP address, or a particular VLAN interface. The default is the system interface.

Specifying Redirection Variable Pairs

```
/services/uam/add scope <index (1-8)> redir-var
                     name <variable-name> value <variable-value>
/services/uam/del scope <index (1-8)> redir-var
                     name <variable-name>
```

This command lets you specify up to five pairs of redirection variables for individual UAM scopes. Each pair consists of a variable name and value.

Variable names and values can contain up to 49 characters.

Refer to "Specifying the Web Server" on page 205. The AP appends all of the redirection variable pairs to the *splash-url* string before sending it to the wireless client. The redirection variable pairs are appended in the order they appear in the *show config* command.

Specifying the RADIUS Server

```
/services/uam/add scope <index (1-8)> radius-server <server_idx>
/services/uam/del scope <index (1-8)> radius-server <server_idx>
/services/uam/set scope <index (1-8)> uam-nasid <name>
```

The *add* and *del* commands let you associate different RADIUS servers with different UAM scopes. See "Managing RADIUS Servers" on page 150 for a description on how to set up RADIUS servers. Each UAM scope can have up to four RADIUS servers.

The *set* command lets you specify the RADIUS Network Access Server (NAS) identifier. The default value for *<name>* is *BelAirNetworks*.

Managing White List Entries

```
/services/uam/add scope <index (1-8)> host-white-list <host name>
/services/uam/del scope <index (1-8)> host-white-list <host name>
/services/uam/add scope <index (1-8)> mac-white-list <mac addr>
/services/uam/del scope <index (1-8)> mac-white-list <mac addr>
/services/uam/add scope <index (1-8)> protocol-white-list {icmp}
/services/uam/del scope <index (1-8)> protocol-white-list {icmp}
```

These commands let you add or remove entries from the host, MAC address and protocol white lists.

Host entries can contain URLs or IP addresses. The host white list and the MAC address white list can have up to 10 entries. The protocol white list can be empty or contain *ICMP* only.

In addition to the entries you control with these *add* and *del* commands, the AP has an internal white list that contains the DHCP, DNS and ARP protocols, and the URLs for the authentication server and the splash page (if specified).

Example

```
/services/uam# add scope 1 host-white-list www.mysite.com
```

Associating VLAN Traffic to a Scope

```
/services/uam/add scope <index (1-8)> vlan {<vlan-list>|untagged}
/services/uam/del scope <index (1-8)> vlan {<vlan-list>|untagged}
```

These commands let you associate different VLAN traffic with different UAM scopes. If you specify *untag*, then untagged traffic is associated with the specified UAM scope.

See “Configuring IP Parameters” on page 62 for a description on how to set up VLANs for dynamic and static IP addressing.

Performing MAC Address Authentication

```
/services/uam/set scope <index (1-8)>
                         mac-auth-state {enabled|disabled}
                        [passwd <string>]
                        [success-redir {enabled|disabled}]
                        [reject-suspend {enabled|disabled}]
```

This command lets you control whether or not client MAC address authentication is performed when a client attempts to associate to the AP.

When this feature is enabled, the AP determines the client’s MAC address when the client attempts to associate with AP. The AP then sends the MAC address to the RADIUS server for authentication. If the server authenticates the MAC address, then the user has full access to the Internet when the association completes. If the RADIUS server does not authenticate the MAC address, then the user must provide credentials through the typical UAM mechanism (Web server, RADIUS server, white lists) before they can access the Internet. The default setting is *enabled*.

The *passwd* parameter provides an alternate password to log into the RADIUS server.

The *success-redir* parameter allows you to control the behavior of the AP if the RADIUS server authenticates the user and responds with a Redirection-URL as part of the WISPr Vendor Specific Attribute:

- If *success-redir* is enabled and the RADIUS server provides a Redirection-URL, the client is redirected to the URL the first time it associates to the AP. Afterwards, the user has full access to the Internet.
- If *success-redir* is disabled and the RADIUS server provides a Redirection-URL, then the AP ignores the provided URL.

By default, the *success-redir* parameter is disabled.

The *reject-suspend* parameter allows you to control the behavior of the AP if the RADIUS server does not authenticate the user. The RADIUS server response message can include a Redirect-Suspend-Time parameter as part of the WISPr Vendor Specific Attribute:

- If *reject-suspend* is enabled and the RADIUS server does not authenticate the user, then the user's session is suspended for the time period specified by the Redirect-Suspend-Time parameter from the RADIUS server.
- If *reject-suspend* is disabled and the RADIUS server provides a Redirect-Suspend-Time parameter, then the AP ignores the provided RADIUS parameter.

By default, the *reject-suspend* parameter is enabled with a default suspend time of 1 minute.

Collecting Accounting Information

```
/services/uam/set scope <index (1-8)>
                               accounting-state {enabled|disabled}
```

This command lets you enable or disable the collection of accounting information for individual UAM scopes. The default setting is *enabled*.

The accounting request packet is sent to the RADIUS server using the *Acct-Interim-Interval* attribute obtained from the client authentication response. If the RADIUS server does not provide an accounting interval, the default value of 10 minutes is used.

Operating in WAN Mode

```
/services/uam/set scope <index (1-8)> wan-mode
                    admin-state {enabled|disabled}
                   [web-server-key <key-str>]
```

UAM WAN mode is for special applications that use alternate communications between the AP, the Web server and the RADIUS authentication server.

For additional details, contact your BelAir Networks representative.

Changing UAM Admin State

```
/services/uam/set scope <index (1-8)>
                                  admin-state {enabled|disabled}
```

This command lets you enable or disable UAM functionality for individual UAM scopes. The default setting is *disabled*.

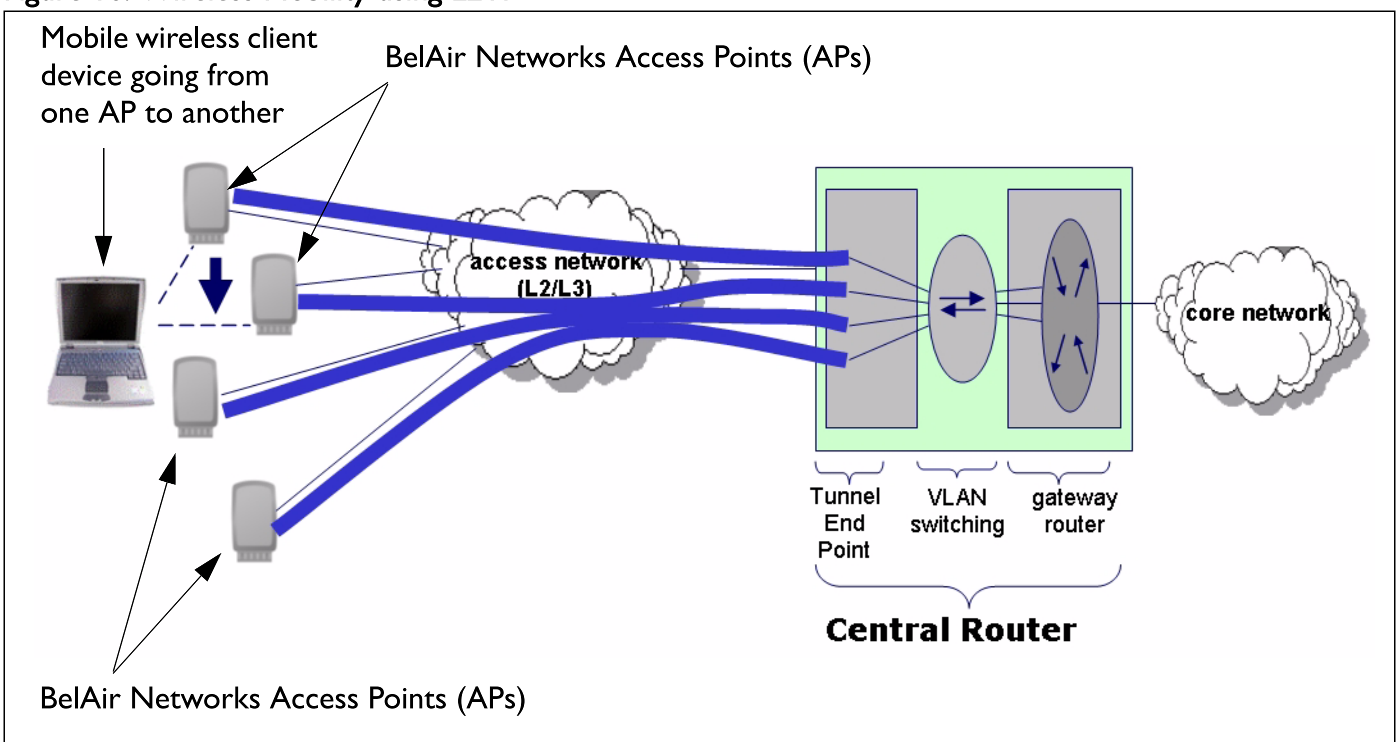
Using Layer 2 Tunnels

Layer 2 tunnels use the Layer 2 Tunneling Protocol (L2TP), version 2, to provide the following benefits:

- provide a bi-directional communication path between the AP and a central router. The path is unaffected by the size, topology and complexity of the Layer 2 and Layer 3 access network between them.
- ensure efficient handling of mobile client MAC addresses, especially for customers using DOCSIS technology in their access network

Figure 16 shows how wireless mobility is implemented with L2TP. When a wireless client transmits an 802.11 frame, the AP converts it to an Ethernet frame with VLAN information, encapsulates it within an IP packet and then sends the packet to a Tunnel End Point (TEP). The TEP is usually part of a network central router. The BelAir Networks implementation of Layer 2 tunnels currently operates with a Cisco 7200 router or equivalent, with a RedBack SmartEdge router or equivalent., with other routers that use Generic Router Encapsulation (GRE), or with Proxy Mobile IPv4 (PMIP) implementations.

Figure 16: Wireless Mobility using L2TP



The TEP strips off the encapsulation data to reveal the original Ethernet frame exactly as sent by the AP. The TEP delivers the Ethernet frame to a VLAN-aware Ethernet switch. The switch applies normal Ethernet forwarding rules to send it to a gateway router with one router port per subnet. The gateway router switches the Ethernet frame to the appropriate outgoing router port.

For packets moving in the other direction to the wireless client, the gateway router applies to IP traffic an Ethernet header with the client's MAC address as the destination. The VLAN switch forwards this packet to the interface on which it last saw the client's MAC address, which is the interface connected to the tunnel. The TEP receives the frame and encapsulates it in an IP packet. When the AP receives the packet, it strips off the encapsulation data, converts the resulting Ethernet frame to an 802.11frame, and then transmits it to the wireless client.

When a mobile wireless client moves to a new AP, its traffic travels through a different Layer 2 tunnel. The traffic is encapsulated and sent to TEP as before. The VLAN-aware Ethernet switch then updates its MAC address table as required with the information for the wireless client's new AP. Any subsequent frames sent to the wireless client are then forwarded to the new AP.

Tunneling is performed by a software module called a *tunnel engine*. APs can have only one tunnel engine. Each tunnel engine can create up to 10 tunnels to one or more TEPs. The end points of a Layer 2 tunnel are identified by their IP addresses. The IP address of the BelAir Networks tunnel end point can be the IP address of the AP's management interface, or any IP address associated with a VLAN. The BelAir Networks IP addresses can be set manually or through the Dynamic Host Configuration Protocol (DHCP).

Each tunnel can carry traffic belonging to any group of configured VLANs.

By assigning a group name to tunnels, you can also use BelView NMS to do dynamic load balancing of APs between different LNSs.

Configuring the AP for Layer 2 Tunneling

The following tasks can be done:

- "Displaying Tunnel Configuration and Status" on page 212
- "Starting and Stopping Layer 2 Tunneling" on page 213
- "Configuring Layer 2 Tunnels" on page 214
- "Setting Tunnel Engine Parameters" on page 214

Layer 2 tunnel CLI commands are available in */protocol/te-syst* mode.

Displaying Tunnel Configuration and Status

```
/protocol/te-<eng>/show config
/protocol/te-<eng>/show status
```

These commands display the current tunnel configuration and status.

Example 1

```
/protocol/te-syst# show config

Tunnel server is running, mode egress, IP address 192.168.219.25 (system), Protection-backhaul:
Disabled

 N      Type         Remote IP        Name/Label     QoS map State
== ============== =============== ================== ======= =====
 1          L2TP  167.206.58.160            tsacm0c    none UP
      Authentication disabled: Secret N/C, PPP name N/C, PPP pass N/C
      L2TP hello: interval 60 sec, retrans count 5, retrans interval 8 sec
      PPP echo: interval 10 sec, retrans count 10; DSCP value 0x0
      VLAN map:   800
 2                                                              N/C
 3                                                              N/C
 4                                                              N/C
 5                                                              N/C
 6                                                              N/C
 7                                                              N/C
 8                                                              N/C
 9                                                              N/C
```

```
10                                                       N/C
```

Example 2

```
/protocol/te-syst# show status
```

```
                           Upstream  Downstream  Upstream  Downstream
 N Active     Uptime        Packets    Packets     Bytes      Bytes    Fragmented Reassembled
== ======= ============= ========== ========== ========== ========== ========== ===========

 1 Primary   0d 01:02:24          0       1023          0     229497          0           0
                  Brdcst          0        388
                  Mltcst          0         12
           Up_Exc/Dn_Inv          0      10980
 2
 3
 4
 5
 6
 7
 8
 9
10
```

The output of the *show status* command shows:

- which LNS is active at the moment – primary or backup
- tunnel uptime
- number of transmitted and received packets and bytes:
  —first line shows total number of packets,
  —second line shows the number of MAC broadcasts
  —third line shows number of MAC multicasts
- number of packets fragmented/reassembled (due to MTU size)

Starting and Stopping Layer 2 Tunneling

```
/protocol/te-<eng>/set engine admin-state {enabled|disabled}
```

This command starts and stops tunneling operation. Use *enabled* to begin tunneling operation. Use *disabled* to stop all tunnel forwarding.

Configuring Layer 2 Tunnels

```
/protocol/te-<eng>/set tunnel <index> ip <peer_IP_addr>
         name <stn_name>
        [backup-ip <backup_IP_addr> [backup-name <backup_name>]]
         [switch {non-revertive | revertive}]
/protocol/te-<eng>/delete tunnel {all|<index>}
```

The *set tunnel* command creates a new tunnel to be terminated at the specified peer IP address, which is usually the network central router. You can create up to 10 tunnels to the same peer or to different peers. Each tunnel carries just one L2TP session.

The <index> parameter is used for easy reference when using other commands. It can be displayed with the */protocol/te-<eng>/show config* command.

The <stn_name> parameter can be any series of 18 alphanumeric ASCII characters. L2TP protocol provides the <stn_name> parameter to the other end point so it can identify different tunnels coming from the same IP address or create logical group of APs with the same name and different IP addresses.

You can optionally specify the IP address and name of a backup server. If a tunnel cannot be created to the main router or if a tunnel fails, the backup parameters become active.

The *switch* parameter controls whether the use of a backup router is revertive or not. Once the AP starts to use a tunnel to a backup router:

- If *switch* is set to *non-revertive*, then the AP uses the tunnel to the backup router until it fails. Only then does the AP switches back to the tunnel using the main router. This is the default setting.
- If *switch* is set to *revertive*, then the AP uses the tunnel to the backup router only while the main tunnel is unavailable. The AP switches back to the tunnel using the main router as soon as it becomes available again.

The *delete tunnel* command removes all tunnels or the specified tunnel. After using this command, user data mapped to this tunnel is dropped instead of forwarded.

Setting Tunnel Engine Parameters

```
/protocol/te-<eng>/set mode {local|egress}
                            [interface-vlan <VLAN_ID>]
```

The *set mode* command is used when the AP is connected to other APs through backhaul links. In this case, you may want the AP to act as an egress point and put access traffic from itself and the other APs into the tunnel. Use *local* mode when the AP puts only its own access traffic into the tunnel. Use *egress* mode when the AP puts its own access traffic and that of many other APs into the tunnel.

If the VLAN interface is not specified, the AP's management IP address is used to identify the local tunnel end point. IP addresses may be manually configured or obtained by DHCP.

If a VLAN interface is specified, it must be previously configured. Refer to "Layer 2 Network Configuration" on page 231.

Configuring Tunnel Advanced Parameters

```
/protocol/te-<eng>/set tunnel <index> advanced
                              [l2tp-hello-interval <seconds>]
                              [l2tp-hello-retrans <number>]
                              [l2tp-hello-timeout <seconds>]
                              [ppp-echo-interval <seconds>]
                              [ppp-echo-retrans <number>]
                              [dscp-control <hex value>]
```

The *set tunnel advanced* command lets you specify for particular tunnel timers and other parameters associated with the L2TP protocol.

The <index> parameter is used for easy reference when using other commands. It can be displayed with the */protocol/te-<eng>/show config* command.

The following parameters can be set with this command:

- L2TP Hello transmission interval. Values range from 10 to 300 seconds. The default setting is 60 seconds.
- L2TP Hello retransmission count. Values range from 1 to 10. The default setting is 5.
- L2TP Hello retransmission maximum interval. Values range from 1 second to 32 seconds. The default setting is 8 seconds.
- PPP echo transmission interval. Values range from 0 seconds to 300 seconds. 0 seconds means PPP echo is disabled. The default setting is 10 seconds.
- PPP echo retransmission count. Values range from 1 to 50. The default setting is 10.
- DSCP value for control (L2TP/PPP) packets. The default setting is 0.

The AP uses the L2TP Hello parameters to determine if the tunnel is available. If the AP does not receive a Hello packet during the *L2TP Hello transmission interval*, it begins to send its own Hello packets at exponential intervals starting at 1 second (that is, at 1, 2, 4, 8, ... seconds) until the *L2TP Hello retransmission* *count* and *L2TP Hello retransmission maximum interval* are reached. If none of the retransmitted Hello packets are answered, then the tunnel is considered unavailable. For additional details, refer to the L2TP specification.

The PPP echo parameters are also used to determine tunnel availability. PPP echo packets are sent periodically with the interval specified by the *PPP echo transmission interval*. The tunnel is considered unavailable if the AP does not receive consecutive responses for the number of packets specified by the *PPP echo retransmission count*.

If you specify a DSCP value, then it appears in the DSCP/TOS bits of any L2TP or PPP control packets.

Enabling Backhaul Protection for Tunnels

```
/protocol/te-<eng>/set protection-backhaul {enabled|disabled}
                                            [egress <interface>]
```

Use this command to inform the tunnel engine that the AP uses egress protection as described in "Egress Protection" on page 168.

The *egress* parameter applies to BelAir100SN only. It species whether egress is through the cable modem (cm-9-1) or the Ethernet interface (eth-1-1).

The default setting is *disabled*. Before using this command, make sure all requirements described in "Egress Protection" on page 168 are met.

When you enable or disable backhaul protection for tunnels, you must:

1 Issue the *config-save* command. See "Saving your Changes" on page 37 for details.
2 Reboot the AP. See "Activating a Software Load" on page 250 for details.

Bandwidth Limits

```
/protocol/te-<eng>/show limits
/protocol/te-<eng>/set tunnel <index> bandwidth-limit
                                   upstream <bits-per-second>
                                 downstream <bits-per-second>
```

The *set tunnel bandwidth-limit* command lets you specify for a particular tunnel the maximum upstream and downstream transmission rates.

The <index> parameter is used for easy reference when using other commands. It can be displayed with the */protocol/te-<eng>/show config* command.

The *show limit* command displays the upstream and downstream settings for the current tunnel.

Example

```
/protocol/te-syst# show limits

 N  Us limit   Ds limit
== ========== ==========

 1          0          0
 2
 3
 4
 5
 6
 7
 8
 9
10
```

Configuring Tunnels for the RedBack SmartEdge Router

```
/protocol/te-<eng>/set tunnel-l2vpn <index (1-10)>
                   oam {enabled | disabled}
                  {auto | ip <ip_addr> label <number>
                  [backup-ip <ip_addr>] [backup-label <number>]}
                  [switch {non-revertive | revertive}]
/protocol/te-<eng>/set l2vpn autoconfig
                  {ip <ip_addr> | hostname <host_name>}
                   username <string> password <string>
                   [retry-min <sec>] [retry-max <sec>]
                   [wait-time <min>]
/protocol/te-<eng>/l2vpn autoconfig renew
/protocol/te-<eng>/set tunnel-l2vpn <index (1-10)>
                            advanced inactivity-timer <seconds>
```

These commands are used to create a tunnel to the central router using Ethernet-over-MPLS-over-GRE encapsulation instead of L2TP.

Use the *set tunnel-l2vpn* command to create L2VPN tunnels to the specific destination. L2VPN tunnels may co-exist with regular L2TP tunnels and GRE tunnels on the same AP.

The *oam* parameter defines if the tunnel uses a failure detection mechanism based on 802.1ag CCM packets. If *oam* is disabled, the AP considers the tunnel to always be up. If *oam* is enabled, the AP relies on receiving 802.1ag CCM packets to detect tunnel state. These packets should be generated by outside equipment in the head end and should be forwarded to all APs. Set *oam* to *enabled* if you are using backup.

The *auto* parameter tells the AP that it should obtain L2VPN parameters (IP address and label) from the NetOp NSM server. This is a preferred setting for large deployments.

The *ip* and *backup-ip* parameters specify IP addresses of the head end tunnel endpoint. It is usually the IP address of a SmartEdge device terminating L2VPN tunnels. Use these parameters to manually configure a test environment or small deployments.

The *label* and *backup-label* parameters specify the MPLS labels of the head end tunnel endpoint virtual circuit. Use these parameters to manually configure a test environment or small deployments.

The *switch* parameter controls whether the use of a backup router is revertive or not. Once the AP starts to use a tunnel to a backup router:

- If *switch* is set to *non-revertive*, then the AP uses the tunnel to the backup router until it fails. Only then does the AP switches back to the tunnel using the main router. This is the default setting.
- If *switch* is set to *revertive*, then the AP uses the tunnel to the backup router only while the main tunnel is unavailable. The AP switches back to the tunnel using the main router as soon as it becomes available again.

Use the *set l2vpn autoconfig* command to define parameters to communicate to the NetOp NSM configuration server:

- To specify the NetOp NSM server, supply either the *ip* parameter with an IP address or the *hostname* parameter with a valid DNS host name.
- The *username* parameter and the *password* parameter are used together to authenticate the AP with NetOp NSM server.
- The optional *wait-time* parameter lets you specify in minutes how long to wait for a response from NetOp NSM configuration server before declaring a failure condition. The default setting is 15 minutes, with a valid range of 1 to 60 minutes.
- The optional *retry-min* and *retry-max* parameters let you specify in seconds a minimum and maximum value for the retry timer. The value of the retry timer is chosen randomly within the boundaries defined by the *retry-min* and *retry-max* parameters. The timer is triggered by any failure while trying to communicate with the NetOp NSM configuration server (for example, the server not responding in time or the server not recognizing the *username* parameter and the *password* parameters). When timer expires, the AP attempts to establish communications with the NetOp NSM configuration server again. The default settings are 60 seconds for *retry-min* and 180 seconds for *retry-max*, with a valid range of 10 to 1800 seconds.

To disable *l2vpn autoconfig*, enter an IP address of 0.0.0.0.

Use the *l2vpn autoconfig renew* command to trigger getting a new set of configuration parameters from the NetOp NSM configuration server.

Use the *set l2vpn advanced inactivity-timer* command to specify how long to wait until declaring the L2VPN tunnel down. The *<seconds>* parameter ranges from 10 to 1000 seconds. The default value is 60 seconds.

Configuring Tunnels for a Router using GRE

```
/protocol/te-<eng>/set tunnel-gre <index (1-10)>
                   ip <ip_addr> [proxy-arp {all | list | dhcp}]
/protocol/te-<eng>/set tunnel-gre <index (1-10)>
                            arp-list <IP_addr> [<IP_addr>]
                                    [<IP_addr>] [<IP_addr>]
                                    [<IP_addr>]
/protocol/te-<eng>/set gre autoconfig ip <IP_addr>
                   interval <seconds> [port <TCP_port>]
```

These commands are used to create tunnel to the central router using IP-over-GRE encapsulation instead of L2TP.

Use the *set tunnel-gre ip* command to create GRE tunnels to the specific destination. GRE tunnels may co-exist with regular L2TP tunnels and L2VPN tunnels on the same AP. The *ip* parameter specifies the IP address of the head end tunnel endpoint. It is usually the IP address of the router terminating GRE tunnels.

This type of configuration uses proxy ARP because it cannot act as a router to terminate IP traffic. The *proxy-arp* parameter defines the scope of the proxy ARP functionality:

- Use *all* if you want to answer ARP requests for any destination IP address.
- Use *dhcp* if you want to answer ARP requests for the default gateway IP address only. In this case, the gateway IP address is learned from the DHCP relay communication to the client.
- Use *list* to apply proxy ARP only to traffic destined to a particular set of IP address. Use the *set tunnel-gre arp-list* command to specify the set of IP addresses.

The default value of the *proxy-arp* parameter is *all*.

Use the *set gre autoconfig* command to define parameters to communicate to the third-party heartbeat server using a proprietary protocol. The *ip* parameter defines the IP address of heartbeat server. To disable this feature, configure the GRE heartbeat server with ad IP address of 0.0.0.0.

In this configuration, the AP sends a pseudo heartbeat packet at the interval specified by the *interval* parameter. The *<seconds>* parameter should be at least 60 seconds. The default value is 60 seconds. The heartbeat server uses the pseudo heartbeat packet to determine whether the tunnel's operational state is up or down. The heartbeat server also uses the pseudo heartbeat packet to determine the AP's tunnel configuration and corrects it if required.

The optional *port* parameter specifies the TCP port to communicate with the heartbeat server. The default value is 4040.

Configuring Tunnels for PMIP Implementations

```
/protocol/te-<eng>/set tunnel-pmip <index (1-10)> ha-ip <ip_addr>
                                                  secret <string>
                                                 spi <number>
                                          [lease-time <seconds>]
/protocol/te-<eng>/set tunnel-pmip <index (1-10)>
                         advanced dns1 <ip_addr> [dns2 <ip_addr>]
```

These commands are used to create a Proxy Mobile IPv4 (PMIP) tunnel. A PMIP tunnel allows a mobile client to change its point-of-attachment to the Internet without changing its IP address. In this implementation, the network tracks the movements of the mobile client and initiates the required mobility signalling on its behalf. In PMIP mode, the AP acts as MIP Foreign Agent.

Use the *set tunnel-pmip ha-ip* command to create a tunnel to a PMIP home agent. PMIP tunnels may co-exist with regular L2TP tunnels and L2VPN tunnels on the same AP.

The *ha-ip* parameter specifies the IP address of PMIP Home Agent (HA).

The *secret* parameter specifies the authentication password for access to the PMIP HA.

The *spi* parameter specifies the index identifying a security context between the AP and home agent. It is an integer value that should be greater than 255. The *spi* parameter and the *secret* parameter are used together to authenticate the AP with the HA.

The optional *lease-time* parameter specifies the maximum lease-time in seconds for the client session. If the client does not send packets for more than the specified lease-time, its session is dropped. The default value is 300 seconds.

When client traffic is forwarded through the PMIP tunnel, the AP acts as a DHCP server and provides all corresponding parameters (such as client's IP address, subnet mask, gateway, and DNS addresses). The AP proxies all these parameters from the HA. If the HA is unable to provide some of these parameters (it must provide at least the client's IP address), the following logic is used by the AP:

- The subnet mask is determined as corresponding to the IP class by IP address. For example, for IP address 67.100.125.10 subnet mask is 255.0.0.0.
- The gateway is taken as first address within a specified subnet. For the previous example, the gateway address is 67.0.0.1. This gateway address is provided by the AP itself and may not correspond to any real IP address in the network.
- The DNS IP address(es) are determined by the *set tunnel-pmip advanced dns* command.

Use the *set tunnel-pmip advanced dns1* command to define the DNS server IP addresses to be provided to the client by the AP through DHCP in case the AP can not obtain corresponding settings from the HA. The optional *dns2* parameter specifies the backup DNS server in case the primary one is unreachable.

Mapping User Traffic

```
/protocol/te-<eng>/map vlan {untagged|<VLAN ID>} to <index>
                                                 [domain <string>]
/protocol/te-<eng>/unmap vlan {all|untagged|<VLAN ID>}
```

The *map vlan* command instructs the tunnel engine to forward traffic to the specified tunnel. You can specify either traffic associated with a specific VLAN or traffic that is not tagged for any VLAN. All packets that meet this criteria received by any of the AP's radios are forwarded through the tunnel. If the tunnel is not configured or not active, all corresponding packets are dropped.

If you specify untagged traffic, then the tunnel interface itself must be associated with a VLAN. Refer to "Setting Tunnel Engine Parameters" on page 214.

The optional *domain* parameter is for PMIP tunnels. Some PMIP implementations require an additional identification string to communicate with the PMIP Home Agent (HA). The *domain* parameter allows you to specify the required string.

The *unmap vlan* command removes all tunnel mapping entries or a specified tunnel mapping entry. After this command, the specified packets are then forwarded as if the tunnel does not exist.

Configuring Authentication

```
/protocol/te-<eng>/set tunnel <index (1-10)>
       [secret <shared_secret>]
       [ppp-name <id>] [ppp-password <pw>]
       [backup-secret <backup_shared_secret>]
       [backup-ppp-name <backup_id>] [backup-ppp-password <backup_pw>]
/protocol/te-<eng>/set tunnel <index (1-10)>
                              authentication {enabled|disabled}
```

The *set secret* command configures the parameters for L2TP authentication for a specified tunnel. The *secret* parameter sets the shared secret for tunnel authentication. The *ppp-name* and *ppp-password* parameters set the data for session authentication. The settings for each of these three parameters must match the equivalent settings on the main router.

The *backup-secret*, *backup-ppp-name* and *backup-ppp-password* parameters are equivalent settings for a backup router.

Once the authentication parameters are configured, you use the *set authentication* command to enable authentication for a specified tunnel.

Configuring a Tunnel Group Name

```
/protocol/te-<eng>/set tunnel <index (1-10)>
                              group-name <group_name>
```

The <group_name> parameter indicates that an LNS belongs to a particular group.

The BelView NMS tunnel manager looks at the tunnel usage of all LNSs within the same group and spread the tunnel traffic among the LNSs within the same group. BelView also configures tunnels for newly introduced APs to the least used LNS within the same group.

For details, refer to the *BelView NMS User Guide*.

Relaying Traffic QOS Settings

```
/protocol/te-<eng>/set tunnel <index (1-10)>
                              qos-map {none|up-bits|dscp)
```

Because the AP converts the client data packet into an Ethernet frame and then encapsulates it within an IP packet, any QOS information that was part of the original client data packet is not visible to upstream equipment.

This command allows you to put the QOS information into the encapsulating IP packet header so that it becomes visible to the upstream equipment:

- The *dscp* setting means that Differentiated Services Code Point (DSCP) information from the client data packet is included in the IP packet header.
- The *up-bits* settings means that the IP packet header contains QOS settings based on User Priority bits (0 to 7) from the client data packet.

- The *none* setting means that QOS information from the client data packet is not sent to upstream equipment.

The default setting is *none*.

Setting the Tunnel Down Alarm Threshold

```
/protocol/te-<eng>/set alarm-threshold
                              {disabled | enabled <num_of_alarms>}
```

Typically, a *Tunnel Down* alarm is generated when a tunnel fails to respond. However, if there are intermittent issues with the tunnel, it may take time to identify and correct the root cause. During this period, multiple *Tunnel Down* alarms would be generated.

Enabling the alarm threshold reduces the number of *Tunnel Down* alarms generated per calendar day. If the threshold is reached, the system generates instead a single *Excess Tunnel Down Events* alarm and stops generating additional *Tunnel Down* alarms. The *Tunnel Down* events are still tracked through the tunnel's performance monitoring statistics, allowing you to analyze the behavior.

The *<num_of_alarms>* parameter ranges from 2 to 50. By default, the alarm threshold is enabled with a setting of *5*, meaning that the *Excess Tunnel Down Events* alarm is generated once 5 *Tunnel Down* events occur in a day.

Alarms generated during a maintenance window do not count against the alarm threshold. For details see, "Defining a Maintenance Window" on page 75.

Layer 2 Tunnel Performance Monitoring Statistics

```
/protocol/te-<eng>/show tunnel <index (1-5)> pm {fifteen-min|day}
                                               [{{<0-96>|<0-7>} |
                                            all {total|average|ppp}}]
```

This command displays a Layer 2 tunnel's performance measurements either for a specific time interval or for a series of time intervals. The valid parameter options are:

- *fifteen-min*, *fifteen-min 0* to *fifteen-min 96*
- *day*, *day 0* to *day 7*
- *all*, all performance measurements. If you specify *all* you need to specify whether you want the total of all measurements, the average of all measurements or all PPP measurements.

Specifying *fifteen-min* is equivalent to specifying *fifteen-min 0* and means the current 15-minute interval. Specifying *day* is equivalent to specifying *day 0* and means the current day, excluding data from the current 15-minute period.

The output displays Unavailable Seconds statistics for that interval. The counter does not start incrementing until the tunnel has been unavailable for 60 seconds.

Example

```
/protocol/te-syst# show tunnel 1 pm fifteen-min

Interval type       : current 15 minute
Interval number     : 0 (193)
Unavailable Seconds :    0
Tunnel Down Events  :    0

     --- User Data Stats ---
  Up   :       Total     Sec    Down    :       Total     Sec
Pkts   :          34 (     0)   Pkts    :        1056 (     5)
Bytes  :        9095 (    47)   Bytes   :       74713 (   387)
Brdcst :           0 (     0)   Brdcst  :        1015 (     5)
Mltcst :           0 (     0)   Mltcst  :           0 (     0)
Excess :           0 (     0)   Invalid :         272 (     1)
Frag   :           0 (     0)   Reass   :           0 (     0)

     --- PPP Echo Stats ---
     ReqRecvd:         20
      ReqSend:         20     RespRecvd:         20        % Lost:   0
Lost - 1 to 5:        0       6 to 10:        0         > 10:         0
```

Configuring the Network Central Router for Layer 2 Tunneling

The specific configuration tasks and commands for the network central router vary, depending on the type of router that is installed.

Refer to the *Tunnel Mobility Technical Bulletin*, available at www.support.belairnetworks.com for guidance on configuring the router portion of the tunnels.

Quality of Service Settings

The AP includes Quality of Service (QoS) settings for the following functional areas:

- traffic switching. See “System QoS” on page 225.
- client to access point radio communications. See “Radio QoS” on page 228.

System QoS

BelAir Networks APs work in conjunction with one another to allow you to separate and prioritize traffic. Each AP can inspect incoming traffic and prioritize traffic into four priority queues.

Prioritization

Each AP supports four traffic priority queues, numbered 0 to 3. Queue 3 has the highest priority while queue 0 has the lowest priority. Table 14 describes each queue.

Table 14: Traffic Priority Queues

Queue Number	Description
0	Background traffic
1	Best effort traffic Use this queue for traffic that does not require QoS features, such as most data traffic
2	Video traffic, T1 circuit emulation Use this queue for high priority traffic such as T1 circuit emulation, video or “gold service” customer traffic
3	Voice over IP (VoIP) traffic Use this queue for SVP or other VoIP applications

All traffic that is not associated to a VLAN has priority 1. This means that until you create VLANs, all traffic has priority 1.

Once VLANs have been created, you configure the AP traffic to have different priorities based on User Priority bits (0 to 7) or VLAN IDs.

The prioritization commands (*map* and *no map)* described in this chapter apply strictly to the AP that you are currently logged on to. You must repeat them on each related AP. For example, when specifying that particular VLAN traffic has a particular priority, you must execute the associated commands on each possible AP in the path of that VLAN.

Prioritizing Traffic Based on User Priority Bits

```
/qos/set up-to-queue-mapping <priority> <queue_id>
```

This command instructs the AP to process packets with the specified User Priority value to the specified priority queue. The *priority* parameter ranges from 0 to 7. The *queue_id* parameter ranges from 0 to 3, as described in Table 14 on page 225.

Note: Settings made with the *set vlan-to-queue-mapping* command have precedence over settings made with this command.

Table 15 shows how User Priority values are processed to priority queues by default.

Table 15: User Priority Value to Priority Queue Processing

User Priority Value	Priority Queue to which it is processed
0	1
1	0
2	0
3	1
4	2
5	2
6	3
7	3

To unmap a previously set priority, use the *set up-to-queue-mapping* command to map that priority back to the default priority queue as shown in Table 15.

Prioritizing Traffic using VLAN IDs

```
/qos/set vlan-to-queue-mapping <vlan_id> {none|<queue_id>}
/qos/show vlan {all|id <vlan_id>}
```

The *set* command instructs the AP to process packets from the specified VLAN to the specified priority queue. The *vlan_id* parameter ranges from 1 to 3015 and from 3018 to 4045. The *queue_id* parameter ranges from 0 to 3, as described in Table 14 on page 225. The *none* parameter removes the mapping of a VLAN ID to priority queue.

Note: Settings made with this command have precedence over settings made with the *set up-to-queue-mapping* command.

The *show* command displays a summary of the QoS settings that are based on VLAN IDs.

Example

```
/qos# show vlan id 100

Qos Vlan Id Configuration
------------------------

Vlan Id         : 100
------------------------
Vlan Qos Status : Enabled
Queue Map       : 3
```

Resetting the QoS Configuration

```
/qos/set defaults
```

This command returns the system QoS configuration to factory default settings.

Note: This command does not affect radio QoS configuration.

Displaying a Summary of System QoS Settings

```
/qos/show config
```

This command displays a summary of all current QOS settings, including how User Priority bits are currently mapped to the priority queues.

Example

```
/qos# show config

Qos Global Configuration
------------------------
Qos Status              : Enabled

 Qos Global UP to Queue Mapping
--------------------------------
UP Value  : 0 -- Queue :   1
UP Value  : 1 -- Queue :   0
UP Value  : 2 -- Queue :   0
UP Value  : 3 -- Queue :   1
UP Value  : 4 -- Queue :   2
UP Value  : 5 -- Queue :   2
UP Value  : 6 -- Queue :   3
UP Value  : 7 -- Queue :   3
```

```
No Vlan based Qos Configured!
----------------------------
```

Displaying the Prioritization Settings

```
/qos/show user-priority-map
```

The *show user-priority-map* command displays how User Priority bits are currently mapped to the priority queues.

Example

```
/qos# show user-priority-map

 Qos Global UP to Queue Mapping
---------------------------------
UP Value  : 0 -- Queue :   1
UP Value  : 1 -- Queue :   0
UP Value  : 2 -- Queue :   0
UP Value  : 3 -- Queue :   1
UP Value  : 4 -- Queue :   2
UP Value  : 5 -- Queue :   2
UP Value  : 6 -- Queue :   3
UP Value  : 7 -- Queue :   3
```

Radio QoS

BelAir Networks radios offer Wireless Multi-Media (WMM) support for multiple priority packets and transmit opportunities. This allows over-the-air QoS for WMM client devices with faster burst transfer. (Use the */mode* command to see the version number of your radio modules.)

Some WMM features, such as selecting the priority scheme and the mapping scheme, are also available for BelAir Networks backhaul radios to provide end-to-end QoS functionality.

Displaying a Summary of Radio QoS Settings

Use the */interface/wifi-<n>-<m>/show config qos* command to display the current radio QoS settings. See "Displaying Wi-Fi Radio Configuration" on page 104 for details.

Example - BelAir20E

```
/interface/wifi-1-1# show config qos
Slot: 1, Card Type: htme, revision: 1, Port: 1, Radio: HTMv1 5GHz
802.11n
admin state: ................. Enabled
channel: ..................... 149
  mode: ...................... ht40plus
  mimo: ...................... 3x3
  tx power: .................. 18.0 (dBm per-chain), 23.0 (dBm total)
antenna location: ............ External Port
antenna index: ............... 1
antenna gain: ................ 5.0  (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:0c:21:90
```

```
QOS:
  wmm: ....................... Enabled
  uapsd: ..................... Enabled
  mapping: ................... UP/DSCP
  voice acm: ................. Disabled
  video acm: ................. Disabled
```

Enabling or Disabling Wireless Multi-media

```
/interface/wifi-<n>-<m>/set qos wmm {enable|disable}
```

Wireless Multi-media is normally enabled. It allows the access point to communicate with a WMM enabled wireless client using WMM features.

When disabled, the access point ignores requests for WMM communications from wireless clients and instead uses traditional non-WMM features to communicate with them. To disable WMM, you must first disable Unscheduled Automatic Power-save Delivery (UAPSD). See “Unscheduled Automatic Power-save Delivery” on page 230.

QoS Mapping Scheme

```
/interface/wifi-<n>-<m>/set qos mapping {up|dscp|both}
```

The *set* command lets you decide how traffic is processed to the four priority queues depending on the values of the User Priority (UP) field or the Differentiated Services Code Point (DSCP) subfield in the client traffic fields.

Selecting *up* means that traffic is sent to the four priority queues based on the UP field value. Selecting *dscp* means that traffic is sent to the four priority queues based on the DSCP subfield value. Selecting *both* means that traffic is sent to the four priority queues based on the highest priority value of either the UP field or the DSCP subfield. By default, QoS mapping is set to *both*. Table 16 shows the mapping of the UP value and the DSCP value to the priority queue.

Table 16: UP and DSCP Value to Priority Queue Processing

UP Value	DSCP Value	Target Priority Queue
0	0 (0x0)	1
1	32 (0x20)	0
2	64 (0x40)	0
3	96 (0x60)	1
4	128 (0x80)	2
5	160 (0xA0)	2

Table 16: UP and DSCP Value to Priority Queue Processing

UP Value	DSCP Value	Target Priority Queue
6	192 (0xC0)	3
7	224 (0xE0)	3

Unscheduled Automatic Power-save Delivery

```
/interface/wifi-<n>-<m>/set qos uapsd {enable|disable}
```

Unscheduled Automatic Power-save Delivery (UAPSD) extends the battery life of wireless clients and reduces radio transmission traffic. To enable UAPSD, you must first enable Wireless Multi-media (WMM) for the radio. Refer to "Enabling or Disabling Wireless Multi-media" on page 229.

This command lets you enable or disable UAPSD. By default, UAPSD is enabled.

Layer 2 Network Configuration

The AP acts as a transparent bridge and layer 2 switch without the need to configure any software features. However, to control and manage the traffic inherent in a bridge (for example, broadcast and flooding) and to handle loop situations where multiple paths exist between APs, you can invoke layer 2 features such as:

- Virtual LANs (VLANs), that divide traffic among several sets of users and restrict broadcast to the respective VLANs. See "Configuring IP Parameters" on page 62.
- Spanning Tree Protocol (STP), where the optimum path is selected and ports of alternate paths are shutdown

If there are no loops in the network, the AP can operate in bridge mode or with VLANs. If a loop exists, STP must be invoked to manage the different paths.

This chapter contains the following sections:

See also "Managing Egress AP Traffic" on page 92.

Spanning Tree Protocol Overview

It is important to configure the Spanning Tree Protocol (STP) when multiple paths between APs are created. As networks become more complex, multiple paths between APs, either intentional or unintentional, become more likely.

Although loops benefit the network by providing path redundancy, loops must be dynamically eliminated to prevent proliferation of broadcast traffic and confusion in the MAC learning tables of the bridge. This is accomplished by a spanning tree protocol, which generates a loop-free subset of the network's topology by placing those bridge or switch ports that, if active, would create loops into a standby (blocking) condition. Blocked bridge or switch ports can be activated in the event of primary link failure, providing a new path through the network.

Loops can also occur accidentally or maliciously. For example, a technician may connect their laptop to the Ethernet port of an AP and also have a wireless link to an AP in the same network. If the laptop is configured to act as a bridge then it creates a loop in the network, and broadcast traffic quickly proliferates until the slowest link in the loop is saturated. This broadcast storm renders part—or all—of the network unusable.

Note: To prevent issues as described previously, clients that associate with the AP are not allowed to operate as a bridge. The AP will automatically disassociate without warning from any client that is detected as behaving as a bridge; that is, sending spanning-tree BPDUs. However, clients are allowed to operate as router to allow features such as sharing a wireless Internet connection. For this type of operation, BelAir Networks recommends that the computer with the wireless connection to the AP have its operating system configured to act as a router. For example, Microsoft Windows XP offers the *Internet Sharing* function.

The original spanning tree protocol is STP. When STP detects a topology change in the network, STP blocks all user traffic, creates a new loop-free configuration, and then re-enables user traffic. STP reconfigurations create outages that are typically 30 to 60 seconds in length.

A newer protocol, Rapid STP (RSTP), greatly reduces the length of outages caused by topology reconfigurations. RSTP is backwards compatible with STP so it can be used in networks where some equipment only supports STP.

APs are shipped from the factory with RSTP enabled and default settings that are a suitable starting point for most deployments. The default AP priority is 36864 (or 0x9000). The default port settings vary depending on the hardware in use, the topology and whether dynamic path cost is used or not.

You should adjust the STP AP priority and path cost settings for each AP to match the topology of your network. Refer to your network plan for details.

Configuring Spanning Tree Priority

If all APs are enabled with default settings, the switch with the lowest MAC address in the network becomes the root switch. However, due to traffic patterns, number of forwarding ports, or line types, the AP with the lowest MAC address might not be the ideal root switch. By increasing the priority (lowering the numerical priority number) of the ideal switch so that it becomes the root switch, an STP recalculation will be done to form a new topology. BelAir Networks recommends that the root AP is the Ethernet switch that is used to connect to the LIM(s).

Refer to your network plan for details.

Use the command described in “RSTP Priority” on page 240 and “RSTP Version” on page 240 to specify the STP priority and the version of STP used by the AP.

Configuring Other Spanning Tree Parameters

Table 17 describes spanning tree parameters that you can configure in addition to the STP AP priority and path cost.

Table 17: Configurable Spanning Tree Timers and Associated Parameters

Parameter	Default Value	Description	Possible Range
Hello Timer	2 s	Determines how often the bridge broadcasts hello messages to other bridges	1 s to 10 s Must be less than or equal to: (1/2Max_Age - 1)
Forward Delay Timer	15 s	Determines how long each of the listening and learning states last before the interface begins forwarding	4 s to 30 s Must not be less than: (1/2Max_Age + 1)
Maximum Age Timer	20 s	Determines the amount of time the bridge stores protocol information received on an interface	6 s to 40 s Must not be less than: 2(Hello_timer + 1) Must not exceed: 2(Forward_Delay - 1)
Transmit Hold Count	6	Transmit hold count (packet queue length)	1 to 10
Path Cost Type	32 bit	Represents the media speed (or bit rate)	16 bit or 32 bit

Table 17: Configurable Spanning Tree Timers and Associated Parameters

Parameter	Default Value	Description	Possible Range
Link Detection Count	3	Represents the number Hello timer periods to wait before declaring the link is down	3 to the ratio of the Maximum Age timer to the Hello timer

Note: BelAir Networks recommends that you do not change the RSTP parameter values in Table 17 from their default values. Experience has shown that these default values work well in a variety of networks.

To change the spanning tree transmit hold count and the path cost, refer to "Transmit Hold Count" on page 240.

To change the values of the spanning-tree timers, refer to "Max Age, Hello Time and Forward Delay" on page 241.

Note: The STP or RSTP parameter values that are actually used are inherited from the root bridge. When you configure STP or RSTP parameters on an AP, you are setting the values that are used if that AP is the root bridge.

RSTP Commands

This section describes commands that you can execute while in *rstp* mode.

Some RSTP commands apply to specific physical interfaces or to specific radio links. The *Name* column of the */protocol/rstp/show config port all* command displays available interfaces and radio links. For example, if the *Name* column displays *wifi-3-1-1*, then *wifi-3-1* identifies the interface and the *-1* suffix identifies radio link 1 of that interface.

The AP layer 2 switch forwards layer 2 frames to the output of one or more physical interfaces or radio links based on the information contained in the frame header (tags).

Displaying the RSTP Configuration Settings

```
/protocol/rstp/show config [port {all|active|<interface-name>}]
```

This command displays the currently configured RSTP settings. To see the currently active RSTP parameters, as inherited from the root bridge, use the */protocol/rstp/show config port active* command.

Specifying the *port* keyword displays RSTP configuration settings for each physical interface and radio link. Use the *<interface-name>* parameter to specify a particular interface and radio link, as shown under the *Name* column of the */protocol/rstp/show config port all* command.

Example 1

```
/protocol/rstp# show config

RSTP Configurations
--------------------

Rstp Status                    : Enabled
Stp priority                   : 36864
Stp Version                    : Rstp Mode
Bridge Max Age                 : 20 seconds
Bridge Hello Time              : 2 seconds
Bridge Forward Delay Time      : 15 seconds
Tx Hold Count                  : 3
Link Detection Count           : 3
Bridge Address                 : 00:0d:67:00:69:d4
Bridge Aging Time              : 300
---------------------------------------
```

Example 2

```
/protocol/rstp# show config port all

RSTP Port Configurations
--------------------

Port      Name       Prio  Pathcost  Migration    Edge         P2P       Protocol   Dynamic-Cost
     Interface-link                             Conf/Oper    Conf/Oper    Version  Status   Default
---- -------------- ---- ---------- --------- ------------ ------------- -------- -----------------

  1    wifi-1-1-1    128    830768    False   False/False  True/True     RSTP     Enabled    830769
  2    wifi-1-1-2    128   2000000    False   False/False  True/False    RSTP     Enabled    830769
  3    wifi-1-1-3    128   2000000    False   False/False  True/False    RSTP     Enabled    830769
  4    wifi-1-1-4    128   2000000    False   False/False  True/False    RSTP     Enabled    830769
  5    wifi-1-1-5    128   2000000    False   False/False  True/False    RSTP     Enabled    830769
  6    wifi-1-1-6    128   2000000    False   False/False  True/False    RSTP     Enabled    830769
  7    wifi-1-1-7    128   2000000    False   False/False  True/False    RSTP     Enabled    830769
  8    wifi-1-1-8    128   2000000    False   False/False  True/False    RSTP     Enabled    830769
  9    wifi-2-1-1    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 10    wifi-2-1-2    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 11    wifi-2-1-3    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 12    wifi-2-1-4    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 13    wifi-2-1-5    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 14    wifi-2-1-6    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 15    wifi-2-1-7    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 16    wifi-2-1-8    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 17    wifi-3-1-1    128   3187500    False   False/False  True/True     RSTP     Enabled   3000000
 18    wifi-3-1-2    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 19    wifi-3-1-3    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 20    wifi-3-1-4    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
 21    wifi-3-1-5    128   2000000    False   False/False  True/False    RSTP     Enabled   3000000
```

```
 22   wifi-3-1-6    128    2000000   False   False/False   True/False   RSTP    Enabled   3000000
 23   wifi-3-1-7    128    2000000   False   False/False   True/False   RSTP    Enabled   3000000
 24   wifi-3-1-8    128    2000000   False   False/False   True/False   RSTP    Enabled   3000000
 25   wifi-4-1-1    128    2000000   False   False/False   True/True    RSTP    Enabled   2000000
 26   wifi-4-1-2    128    2000000   False   False/False   True/False   RSTP    Enabled   2000000
 27   wifi-4-1-3    128    2000000   False   False/False   True/False   RSTP    Enabled   2000000
 28   wifi-4-1-4    128    2000000   False   False/False   True/False   RSTP    Enabled   2000000
 29   wifi-4-1-5    128    2000000   False   False/False   True/False   RSTP    Enabled   2000000
 30   wifi-4-1-6    128    2000000   False   False/False   True/False   RSTP    Enabled   2000000
 31   wifi-4-1-7    128    2000000   False   False/False   True/False   RSTP    Enabled   2000000
 32   wifi-4-1-8    128    2000000   False   False/False   True/False   RSTP    Enabled   2000000
 33   eth-5-1       128     200000   False   False/False   True/True    RSTP    Disabled   200000
```

Example 3

```
/protocol/rstp# show config port wifi-2-1-1


RSTP Port Configurations
--------------------

Port       Name      Prio  Pathcost  Migration     Edge          P2P       Protocol   Dynamic-Cost
     Interface-link                              Conf/Oper     Conf/Oper   Version  Status   Default
---- -------------- ---- ---------- --------- ------------ ------------- -------- -----------------

  9   wifi-2-1-1    128    2000000   False   False/False   True/False   RSTP    Enabled   3000000
```

Example 4

```
/protocol/rstp# show config port active


RSTP Port Configurations
--------------------

Port       Name      Prio  Pathcost  Migration     Edge          P2P       Protocol   Dynamic-Cost
     Interface-link                              Conf/Oper     Conf/Oper   Version  Status   Default
---- -------------- ---- ---------- --------- ------------ ------------- -------- -----------------

  1   wifi-1-1-1    128     830768   False   False/False   True/True    RSTP    Enabled    830769
 17   wifi-3-1-1    128    3187500   False   False/False   True/True    RSTP    Enabled   3000000
 25   wifi-4-1-1    128    2000000   False   False/False   True/True    RSTP    Enabled   2000000
 33   eth-5-1       128     200000   False   False/False   True/True    RSTP    Disabled   200000
```

Displaying the RSTP Topology Information

```
/protocol/rstp/show topology [port {all|active|<interface-name>}]
```

This command displays the currently active RSTP parameters as inherited from the root bridge, including the MAC address of the designated root bridge in a network, the cost of the path to the root, the port used to message to the root bridge, as well as the current values of the spanning tree timers.

To see the currently configured RSTP parameters, use the */protocol/rstp/show config* command.

In the resulting output when the *port* keyword is omitted, *Root Cost* reflects the AP's cost to root that it would advertise in its BPDUs sent out to designated or alternate ports.

Specifying the *port* keyword displays per port RSTP topology information for each physical interface and radio link. Use the *<interface-name>* parameter to specify a particular interface and radio link, as shown under the *Name* column of the */protocol/rstp/show config port all* command.

In the resulting output when the *port* keyword is used, *Designated Cost* is the minimum port cost seen in BPDUs on that link (either from the AP itself or from another AP on that same link).

Example 1

```
/protocol/rstp# show topology

RSTP Topology Information
--------------------

Designated Root                : 00:00:00:12:00:32:9d:80
Stp Root Cost                  : 4000000
Stp Root Port                  : 33
Stp Max Age                    : 31 seconds
Stp Hello Time                 : 1 seconds
Stp Forward Delay Time         : 21 seconds
---------------------------------------
```

Example 2

```
/protocol/rstp# show topology port all
```

```
RSTP Port Topology Information
------------------------------

Port       Name         Designated-root       Designated     Designated-bridge      Designated
     Interface-link                           Cost                                   Port
---- -------------- ----------------------- ---------- ----------------------- ----------

  1  wifi-1-1-1     60:00:00:23:34:b0:3e:80     200000  90:00:00:0d:67:00:69:5e  80:01
  2  wifi-1-1-2     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
  3  wifi-1-1-3     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
  4  wifi-1-1-4     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
  5  wifi-1-1-5     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
  6  wifi-1-1-6     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
  7  wifi-1-1-7     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
  8  wifi-1-1-8     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
  9  wifi-2-1-1     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 10  wifi-2-1-2     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 11  wifi-2-1-3     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 12  wifi-2-1-4     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
```

```
 13  wifi-2-1-5     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 14  wifi-2-1-6     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 15  wifi-2-1-7     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 16  wifi-2-1-8     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 17  wifi-3-1-1     60:00:00:23:34:b0:3e:80     200000  90:00:00:0d:67:00:69:5e  80:11
 18  wifi-3-1-2     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 19  wifi-3-1-3     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 20  wifi-3-1-4     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 21  wifi-3-1-5     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 22  wifi-3-1-6     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 23  wifi-3-1-7     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 24  wifi-3-1-8     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 25  wifi-4-1-1     60:00:00:23:34:b0:3e:80     200000  90:00:00:0d:67:00:69:5e  80:19
 26  wifi-4-1-2     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 27  wifi-4-1-3     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 28  wifi-4-1-4     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 29  wifi-4-1-5     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 30  wifi-4-1-6     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 31  wifi-4-1-7     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 32  wifi-4-1-8     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
 33  eth-5-1        60:00:00:23:34:b0:3e:80          0  60:00:00:23:34:b0:3e:80  80:0f
```

Example 3

```
/protocol/rstp# show topology port wifi-2-1-1
```

```
RSTP Port Topology Information
-------------------------------

Port       Name          Designated-root       Designated     Designated-bridge     Designated
     Interface-link                            Cost                                 Port
---- -------------- ----------------------- ---------- ----------------------- ----------

  9  wifi-2-1-1     00:00:00:00:00:00:00:00          0  00:00:00:00:00:00:00:00  00:00
```

Example 4

```
/protocol/rstp# show topology port active
```

```
RSTP Port Topology Information
-------------------------------

Port       Name          Designated-root       Designated     Designated-bridge     Designated
     Interface-link                            Cost                                 Port
---- -------------- ----------------------- ---------- ----------------------- ----------

  1  wifi-1-1-1     60:00:00:23:34:b0:3e:80     200000  90:00:00:0d:67:00:69:5e  80:01
 17  wifi-3-1-1     60:00:00:23:34:b0:3e:80     200000  90:00:00:0d:67:00:69:5e  80:11
 25  wifi-4-1-1     60:00:00:23:34:b0:3e:80     200000  90:00:00:0d:67:00:69:5e  80:19
 33  eth-5-1        60:00:00:23:34:b0:3e:80          0  60:00:00:23:34:b0:3e:80  80:0f
```

Displaying RSTP Port Roles and States

```
/protocol/rstp/show port roles [all]
```

This command displays the roles and states of the RSTP ports.

Specifying the *all* option displays all possible links for a specific interface. If the *all* option is omitted, then the command outputs data only for links with a status of *UP*.

Example 1

```
/protocol/rstp# show port roles

RSTP Port Roles and States
---------------------------
Port#     Name         Remote-id       Port-Role   Port-State  Port-Status
-----  -----------  ---------------  ----------  ----------   ---------
   9   wifi-2-1-1   10.5.1.22        Designated  Forwarding  Enabled
  11   wifi-2-1-3   10.5.1.10        Designated  Forwarding  Enabled
  17   wifi-3-1-1   10.5.1.13        Designated  Forwarding  Enabled
  18   wifi-3-1-2   10.5.1.14        Designated  Forwarding  Enabled
  25   wifi-4-1-1   10.5.1.25        Designated  Forwarding  Enabled
  33   eth-1-1                       Root        Forwarding  Enabled
  34   eth-1-2                       Designated  Forwarding  Enabled
```

Example 2

```
/protocol/rstp# show port roles all

RSTP Port Roles and States
---------------------------
Port#     Name         Remote-id       Port-Role   Port-State  Port-Status  Link-status
-----  -----------  ---------------  ----------  ----------   ---------   ------------
   1   wifi-1-1-1                    Disabled    Discarding  Enabled      Down
   2   wifi-1-1-2                    Disabled    Discarding  Enabled      Down
   3   wifi-1-1-3                    Disabled    Discarding  Enabled      Down
   4   wifi-1-1-4                    Disabled    Discarding  Enabled      Down
   5   wifi-1-1-5                    Disabled    Discarding  Enabled      Down
   6   wifi-1-1-6                    Disabled    Discarding  Enabled      Down
   7   wifi-1-1-7                    Disabled    Discarding  Disabled     Down
   8   wifi-1-1-8                    Disabled    Discarding  Disabled     Down
   9   wifi-2-1-1   10.5.1.22        Designated  Forwarding  Enabled      UP
  10   wifi-2-1-2                    Disabled    Discarding  Enabled      Down
  11   wifi-2-1-3   10.5.1.10        Designated  Forwarding  Enabled      UP
  12   wifi-2-1-4                    Disabled    Discarding  Enabled      Down
  13   wifi-2-1-5                    Disabled    Discarding  Enabled      Down
  14   wifi-2-1-6                    Disabled    Discarding  Enabled      Down
  15   wifi-2-1-7                    Disabled    Discarding  Enabled      Down
  16   wifi-2-1-8                    Disabled    Discarding  Enabled      Down
  17   wifi-3-1-1   10.5.1.13        Designated  Forwarding  Enabled      UP
```

```
18   wifi-3-1-2   10.5.1.14         Designated  Forwarding  Enabled      UP
19   wifi-3-1-3                     Disabled    Discarding  Enabled      Down
20   wifi-3-1-4                     Disabled    Discarding  Enabled      Down
21   wifi-3-1-5                     Disabled    Discarding  Enabled      Down
22   wifi-3-1-6                     Disabled    Discarding  Enabled      Down
23   wifi-3-1-7                     Disabled    Discarding  Enabled      Down
24   wifi-3-1-8                     Disabled    Discarding  Enabled      Down
25   wifi-4-1-1   10.5.1.25         Designated  Forwarding  Enabled      UP
26   wifi-4-1-2                     Disabled    Discarding  Enabled      Down
27   wifi-4-1-3                     Disabled    Discarding  Enabled      Down
28   wifi-4-1-4                     Disabled    Discarding  Enabled      Down
29   wifi-4-1-5                     Disabled    Discarding  Enabled      Down
30   wifi-4-1-6                     Disabled    Discarding  Enabled      Down
31   wifi-4-1-7                     Disabled    Discarding  Enabled      Down
32   wifi-4-1-8                     Disabled    Discarding  Enabled      Down
33   eth-1-1                        Root        Forwarding  Enabled      UP
34   eth-1-2                        Designated  Forwarding  Enabled      UP
```

Configuring the Bridge Aging Time

```
/protocol/rstp/set bridge aging-time <10 - 630>
```

This command specifies the aging time, in seconds, for the dynamically learned forwarding information.

RSTP Priority

```
/protocol/rstp/set priority <Decimal (0 - 61440) or
                            Hexadecimal (0x0000 -0xf000)>
```

This command specifies the STP priority.

The default AP priority is 36864 (or 0x9000). The priority values must be set in steps of 4096 (or 0x1000).

RSTP Version

```
/protocol/rstp/set version {stpCompatible|rstp}
```

This command specifies the type of STP used by the AP.

Setting the value to *rstp* mode forces it to transmit RST BPDUs while setting it to *stpCompatible* mode forces it to transmit configuration and TCN BPDUs. The default setting is *rstp*.

Transmit Hold Count

```
/protocol/rstp/set [tx-holdcount (1 - 10)]
```

This command configures the values of *transmit hold count*. The *transmit hold count* value indicates the number of BPDUs that need to be transmitted in any Hello Time interval. The default value is 6.

Note: BelAir Networks recommends that you do not change the RSTP parameter values from their default values. Experience has shown that the default values work well in a variety of networks.

Example

```
/protocol/rstp# set tx-holdcount 5
```

Max Age, Hello Time and Forward Delay

```
/protocol/rstp/set ([max-age <6 - 40>] [hello-time <1 - 10>]
    [forward-delay <4 - 30>])
```

The *max-age* field represents the time in seconds that all bridges use for MaxAge when this bridge is acting as the root. The default value is 20. The value must not exceed: 2(ForwardDelay -1).

The *hello-time* field represents the time in seconds that all bridges use for HelloTime when this bridge is acting as the root. The default value is 2.

The *forward-delay* field represents the time in seconds that all bridges use for ForwardDelay when this bridge is acting as the root. The default value is 15. The value must not be less than: 1 + 1/2 MaxAge.

Note: BelAir Networks recommends that you do not change the RSTP parameter values from their default values. Experience has shown that the default values work well in a variety of networks.

Example

```
/protocol/rstp# set max-age 20 hello-time 2 forward-delay 15
```

RSTP Link Priority

```
/protocol/rstp/set interface <interface-name>
                         priority <Decimal (0-240)
                                   or Hexadecimal (0x00 -0xF0)>
```

This command configures the link priority. This command is available only if dynamic path costs are disabled. Refer to "Dynamic Path Cost" on page 242.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

The link priority value forms the first component or the portion of the Port ID that can be written. The values for the link priority must only be in steps of 16 (only the first 4 bits can be set for the link priority).

Example

```
/protocol/rstp# set interface wifi-2-1 priority 64
```

RSTP Static Path Cost

```
/protocol/rstp/set interface <interface-name>
                                    defaultcost <1 - 200000000>
```

This command sets the static path cost in the *pathcost* field. This command is available only if dynamic path costs are disabled. Refer to "Dynamic Path Cost" on page 242.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

The static path cost determines the preferred data paths between bridges throughout the network and the root bridge. The default path cost settings vary, depending on the hardware in use, the topology and whether dynamic path cost is used or not.

Example

```
/protocol/rstp# set interface wifi-2-1 pathcost 65535
```

Dynamic Path Cost

```
/protocol/rstp/set interface <interface-name>
                   [dynamic-cost {enabled|disabled}]
```

This command lets you manage how path costs are determined for each radio link on your AP.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

Dynamic path costs are a useful way to adjust the topology of a network to isolate a link as a result of unplanned or seasonal effects. For example, there may be an unplanned source of radio interference with a particular link. Or, vegetation may affect a link during summer.

When dynamic cost is disabled, each link is assigned a fixed cost. The default value depends on the hardware and topology in use.

When dynamic cost is enabled, the AP adjusts the link's cost based on several link quality factors. For example, a link with a low RSSI, such as -80, implies poor link quality causing it to have an increased cost. Similarly, a link with a high RSSI, such as -40, implies good link quality causing it's cost to be reduced.

Enabling dynamic path costs disables the command to configure a static path cost. Refer to "RSTP Static Path Cost" on page 242.

To prevent unnecessary topology changes based on transient behaviour, a new link cost may not automatically cause a topology change. If the new link cost is very different from the current link cost, then the topology is changed.

However, if the new link cost is only slightly different from the current link cost, then the current topology is maintained. As further protection against transient behaviour, the RSTP verifies that the new link cost is maintained for 30 minutes before it implements any potential topology changes.

In all cases when a link is enabled or disabled, RSTP takes into account the new link costs as it creates a new topology.

By default, dynamic cost is enabled for most combinations of platforms and topologies. Use the */protocol/rstp/show config port* command to determine if it is enabled or disabled in your case.

Note: Dynamic path cost should be disabled for mobile backhaul mesh applications because in such application path costs are determined by the mobility application.

RSTP Protocol Migration on an Interface

```
/protocol/rstp/set interface <interface-name>
                             protocol-migration {true|false}
```

While operating in RSTP mode, setting of this value to *true* forces the interface to transmit RSTP BPDUs.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

RSTP Edge Port Status

```
/protocol/rstp/set interface <interface-name>
                             edge-port {true|false}
```

This command indicates whether the interface is an edge port or not. An edge port cannot communicate to another RSTP enabled device. This setting is typically *false*, but can be *true* for situations such as being connected to a laptop, or to a simple switch. RSTP uses edge port status to optimize performance during topology changes. If the edge port status is true, RSTP does not block it during a topology change.

This command sets the administrative value of the edge port status. The operational value of the edge port status is initially its administrative value; however, it can be updated later by the AP bridge software.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

The default settings vary, depending on the hardware in use, the topology and whether dynamic path cost is used or not.

RSTP Point-To-Point Status of an Interface

```
/protocol/rstp/set interface <interface-name>
                             p2p {forcetrue|forcefalse}
```

This command indicates whether the interface can do RSTP point-to-point communications or not. RSTP point-to-point communications is special case where the interface can communicate with only one other RSTP enabled device, such as when only two APs are connected through a simple switch. RSTP uses RSTP point-to-point status to optimize performance during topology changes.

This command sets the administrative value of the RSTP point-to-point status. The operational value of the RSTP point-to-point status is initially its administrative value; however, it can be updated later by the AP bridge software.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

Setting a value of *forcetrue* forces it to function as a point-to-point link. Setting a value of *forcefalse* forces it not to function as a point-to-point link.

The default settings vary, depending on the hardware in use, the topology and whether dynamic path cost is used or not.

Interface RSTP Configuration

```
/protocol/rstp/set interface <interface-name>
                             admin-state {enable|disable}
```

This command allows or prevents RSTP from affecting the specified interface.

The *<interface-name>* parameter specifies a particular interface, such as *wifi-2-1*.

By default, RSTP affects all enabled interfaces. Setting admin-state to *disable* prevents RSTP from affecting this interface. Setting admin-state to *enable* allows RSTP to affect this interface.

Changing RSTP Admin State

```
/protocol/rstp/set admin-state {enabled|disabled}
```

This command lets you enable or disable RSTP functionality. The default setting is *enabled*.

RSTP Statistics

```
/protocol/rstp/show stats [port {all|active|<interface-name>}]
```

This command displays RSTP-related bridge statistics.

Specifying the *port* keyword displays per port RSTP statistics. The *<interface-name>* parameter specifies a particular interface and link.

Example 1

```
/protocol/rstp# show stats

RSTP Statistics
--------------------

Rstp UP Count                   : 1
Rstp DOWN Count                 : 0
Buffer Failure Count            : 0
Memory Alloc Failure Count      : 0
Count of Root Bridge Changes    : 1
Stp Time since Topology change: 39 seconds
Total No. of topology changes : 5
---------------------------------------
```

Example 2

```
/protocol/rstp# show stats port all

RSTP Port Statistics
--------------------

Port#      Name          Fwd              RX BPDU                    TX BPDU          Protocol
     Interface-link Transitions  Total/Config/TC/TCN/Invalid    Total/Config/TC/TCN    Migration
----- ------------- ----------- --------------------------- --------------------- ---------

   1  wifi-1-1-1             2                    9/0/9/0/0             32/0/16/0  1
   2  wifi-1-1-2             2                   10/0/8/0/0             32/0/17/0  1
   9  wifi-2-1-1             1                   27/0/5/0/0             10/0/21/0  1
  17  wifi-3-1-1             0                   20/0/0/0/0               2/0/0/0  1
  33  eth-1-1                1                    0/0/0/0/0              51/0/0/0  1
```

Example 3

```
/protocol/rstp# show stats port wifi-1-1-1

RSTP Port Statistics
--------------------

Port#      Name          Fwd              RX BPDU                    TX BPDU          Protocol
     Interface-link Transitions  Total/Config/TC/TCN/Invalid    Total/Config/TC/TCN    Migration
----- ------------- ----------- --------------------------- --------------------- ---------

   1  wifi-1-1-1             2                    9/0/9/0/0             55/0/16/0  1
```

Performing a Software Upgrade

This section instructs you how to upgrade an AP by downloading a new software load from a remote server. The procedures in this section assume the following:

- You have connected to the AP.
- You have started a Command Line Interface (CLI) session and you have logged in as *root*. When you need to login again, such as after a reboot, use the *root* user account so you have access to all the required commands.
- You are familiar with the operation of the CLI.
- You are familiar with the operation of the *config-save* command. Refer to "Saving your Changes" on page 37 for details.

CAUTION! Make sure to read and understand the entire upgrade procedure described in this section before attempting to upgrade an AP. An improper upgrade could result in an AP becoming inoperable and isolated from the network.

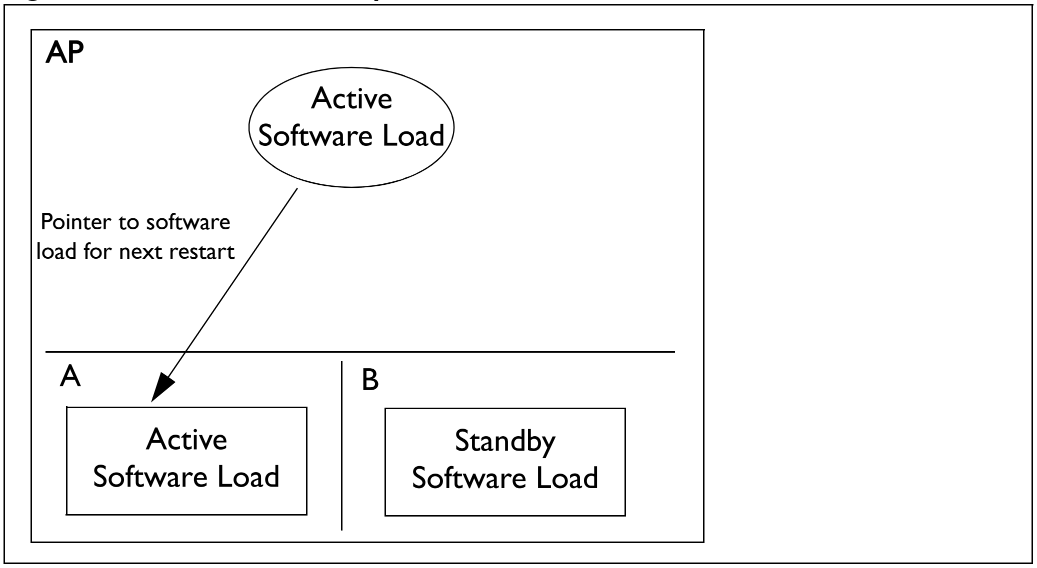
CAUTION! An AP's configuration database in one release can be structurally different than in other releases. For example, the configuration database in Release 12.2 is structurally different than in previous releases. Because of this, downgrading a software load from Release 12.2 to the previous release requires much effort. BelAir Networks strongly recommends that you fully verify the configuration and operation of an upgraded AP before you commit the new load to replace the old load and configuration. The upgrade process in this document contains guidelines to help you verify an AP.

For instructions on how to downgrade an AP, contact BelAir Networks.

Upgrade Process Overview

An operator logged in as *root* can upgrade an AP by downloading a new software load from a remote server. You can use either TFTP or FTP to communicate with the remote server. You must ensure that the server is running at an accessible IP address. For redundancy purposes, APs store two copies of the software load in two application banks: banks A and B. The active software load is the software load that is currently running. The standby software load is the software load in the alternate application bank. Either bank A or bank B may be active at a given time. See Figure 17 on page 247.

Figure 17: Active and Standby Software Loads



Under normal operating conditions, the contents of the two software load banks are identical. During a software upgrade, the new software load is copied into the standby bank at the time of the upgrade.

A software upgrade consists of the following steps:

1 Ensure the current configuration is saved. Refer to "Saving your Changes" on page 37.
2 Determine what software load is active (A or B). The new software load will overwrite the standby bank.
3 Download the new software load. The new software load is downloaded to the standby software load bank. If A is active, then the new software load is downloaded to bank B. If B is active, then the new software load is downloaded to bank A.
4 Verify the new software downloaded successfully.
5 Activate the new software load from the standby software load bank (containing the new load) by rebooting the AP. The new load is promoted to active and the formerly active software load bank becomes standby.
6 Verify the configuration and operation of the AP operating with the new software load
7 Commit the load (copy the newly activated load to the standby software load bank).

Note: Any configuration changes that you make before you commit the new software load are lost if you back out of the upgrade.

You can also use BelView NMS to manage how APs are upgraded. For details, refer to the *BelView NMS User Guide* and "Auto-upgrade" on page 253.

CAUTION! Do not change or save the AP configuration while upgrading the system.

CAUTION! It is always possible to downgrade a committed software load to an older release. However, while the existing configuration data is saved (upgraded) during a software upgrade, the existing configuration data could be lost (erased) during a software downgrade. BelAir Networks recommends that you save and remotely store the current existing configuration database in case you choose to downgrade a software load. For instructions on how to downgrade an AP, contact BelAir Networks.

Displaying the Active and Next Software Loads

Display the active software load and the load that is activated at the next reboot with the following command:

```
/system/show loads
```

Downloading a New Software Load

```
/system/upgrade load remoteip <serverIPaddress>
             remotepath <serverSubDir>
              [{tftp|ftp [user <usrname> password <pword>]}]]
```

This command downloads a new software image from a remote server. It copies the new software load into the standby software load bank and sets the new load as the next active load. See Figure 18 on page 249.

You can use either TFTP or FTP to communicate with the remote server. By default, the *upgrade load* command uses TFTP. If you specify FTP, you can also specify the user name and password. The default FTP user name is *anonymous* and the default FTP password is *root@<nodeip>*, where <nodeip> is the IP address of AP making the request. If you do not use the default FTP username, the FTP server must be configured to accept your username and password.

CAUTION! Once it begins, the upgrade process cannot be interrupted or terminated by the user with the current CLI session. See "Canceling a Software Upgrade" on page 248.

Canceling a Software Upgrade

```
/system/cancel upgrade
```

This command stops the transfer of the new software load into the standby software load bank. If you reboot the AP, the software in the active software load bank is used. See Figure 18.

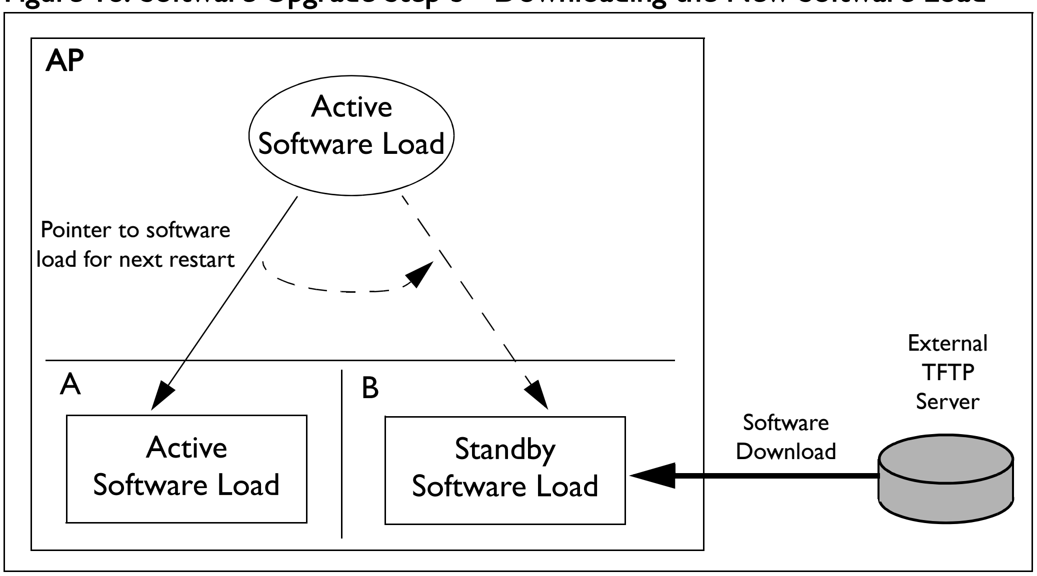
To cancel the upgrade process:

1 Start another CLI session to the AP being upgraded and log in as in as *root*.
2 Issue the following command:
```
/system/cancel upgrade
```
3 When requested, confirm your intent.

If you confirm that you want to cancel the software upgrade, a message appears in the other CLI session informing it's user that the upgrade has been cancelled.

CAUTION! Because the software upgrade process was interrupted, the software in the standby software load bank may no longer be suitable to reboot the system. Do not set it to be the next active load unless you first commit the current active software load, or complete a new software upgrade.

Figure 18: Software Upgrade Step 3 - Downloading the New Software Load



Verifying a Successful Download

Verify that the new software downloaded successfully with the following command:

```
/system/show loads verify
```

The *verify* option calculates and verifies the checksum. A bad checksum indicates an issue with the load. If there are any issues, perform the download again.

Example

```
/system# show loads verify

Application BankA
-----------------
Sw Version:      BA100 9.0.0.S.2009.01.05.16.35 (r20884)
State:           Running (next reboot)
CommitState:     committed
Md5Sum:          OK

Application BankB
-----------------
Sw Version:      BA100 8.0.8.D.2008.09.18.18.18 (r19148)
State:           Shadow
CommitState:     committed
Md5Sum:          OK

Bootloader Info
---------------
PPC405EP Common Bootloader Version 4.06 11/06/2008
```

Activating a Software Load

To activate a software load, enter the following:

```
/system/reboot
```

The *reboot* command is only available if you are logged in as *root*.

This command forces the AP to execute with the new load and completes the activation process.

When upgrading several APs in a network, BelAir Networks recommends that you reboot the most remote AP first and progress towards the near-end, AP-by-AP. For star topologies, reboot the subscriber station APs before rebooting the associated base station AP.

Note: Rebooting an AP as part of a software upgrade can take significantly longer, up to 20 minutes, depending on the AP's configuration.

Verifying the New Software Load

BelAir Networks recommends that you fully verify the configuration and operation of an upgraded AP before you commit the new load. Use the following steps as guidelines.

1 Fully verify the AP's configuration and operation.
2 If required, adjust any settings and save the new configuration.
3 Reboot the AP and verify that all changes take effect.

If you observe any issues, follow the steps in "Backing Out from a Software Upgrade" on page 252.

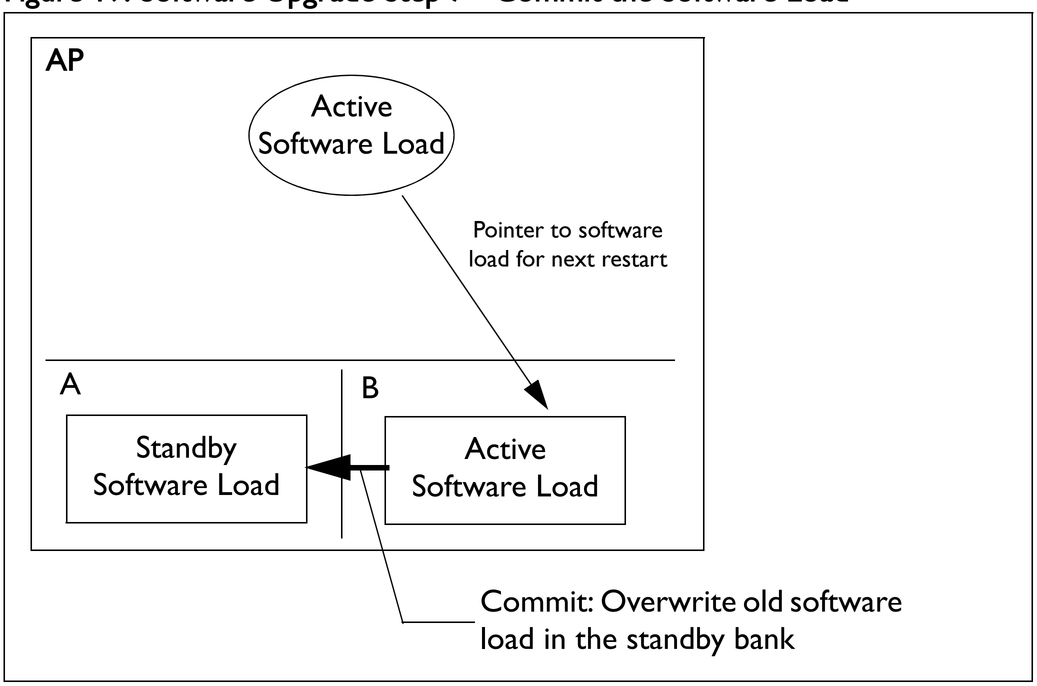
Committing a New Software Load

```
/system/commit load
```

Once you have activated the AP with new software load, you can commit it with this command. See Figure 19.

CAUTION! This command copies the contents of the active software bank to the standby bank. For example, if the active software bank is A, its contents overwrite those of bank B. Backing out is no longer possible after the new software load has been committed. After the new software load has been committed, you can no longer back out of the upgrade; but you can downgrade the AP. For instructions on how to downgrade an AP, contact BelAir Networks.

Figure 19: Software Upgrade Step 7 - Commit the Software Load

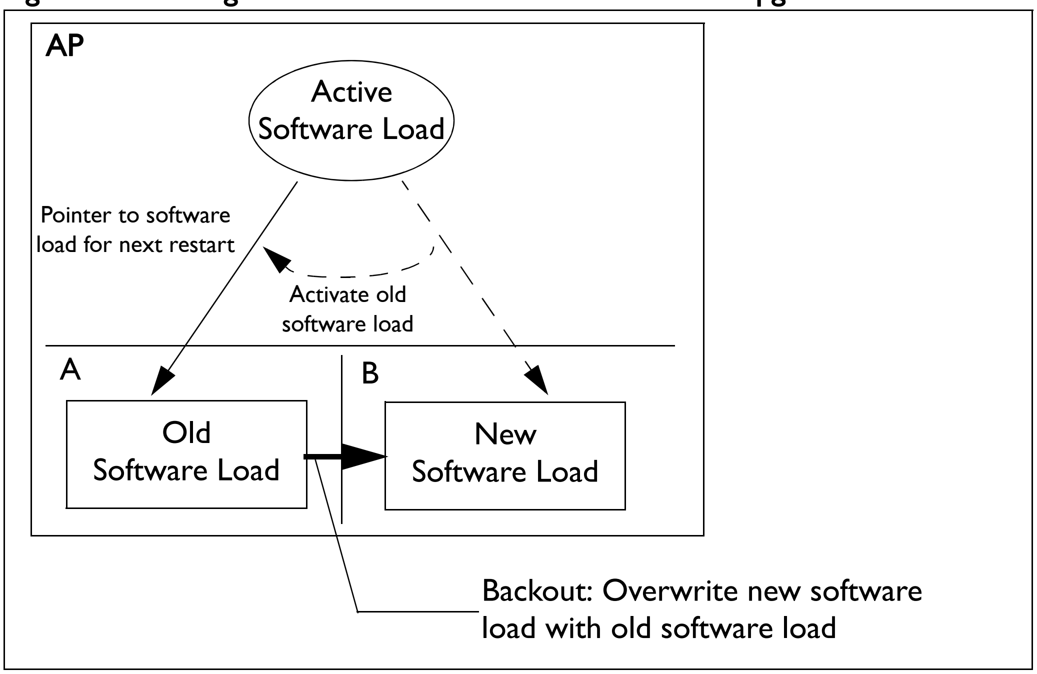


The *commit* command copies the system software and the configuration database to the adjacent bank at the time of execution. However, changes to the active load's configuration after the *commit* command is executed are not automatically stored in the standby bank. To keep both banks synchronized, you must use the *commit* command after every configuration change of the active load.

Backing Out from a Software Upgrade

It is possible to back out from a software upgrade in case its effects are undesired, but only if the new software load has not been committed. See Figure 20 on page 252.

Figure 20: Backing Out from an Uncommitted Software Upgrade



When you back out of a software upgrade, the old load overwrites the new software load.

To back out from an upgrade, do the following steps:

1 Determine which bank has the old software load with the following command:

```
/system/show loads
```

2 Set the old software load to be the next active load with the following command:

```
/system/set next-load {A|B}
```

If you have just upgraded the software, you must set the AP to reboot with the currently standby load. For example, if the old software load is in bank A, as shown in Figure 20, and the new software load is in bank B, then you must activate bank A with the following command:

```
/system/set next-load A
```

Alternatively, steps 1 and 2 can be combined with the following command:

```
/system/set next-load {current|inactive}
```

If you specify *inactive*, at the next reboot the system uses the bank containing a load other than the one that is running. Specify *current* to switch back to the bank containing the active load.

3 Reboot the system, with the *reboot* command.

Note: Rebooting an AP as part of a software upgrade can take significantly longer, up to 20 minutes, depending on the AP's configuration.

4 Run the *commit* command.

Running the *commit* command is not necessary if the system is already executing the old software load (because you have decided, for example, to back-out of the upgrade before activating the new load). In this case, the content of the old software load (which is active) overwrites the contents of the new undesired software load.

Displaying the Status of the Software Upgrade

```
/system/show upgrade status
```

This command displays the status of the software upgrade process.

Clearing the Upgrade Failure Alarm

```
/system/clear alarm upgrade-failure
```

This command allows you to clear the alarm generated when a software upgrade fails.

Auto-upgrade

```
/system/show auto-upgrade
/system/set auto-upgrade {enabled|disabled}
```

This command allows you to control whether an AP can be upgraded automatically through BelView NMS. The default setting is *enabled*, meaning that BelView NMS can automatically upgrade the AP,

For details, refer to the *BelView NMS User Guide.*

Alarm and Event Reporting

The AP alarm and event reporting subsystem monitors both active alarms and alarm history. Active alarms are stored in system memory and are not persistent. The AP maintains the history of the last 10 000 reported alarms. The alarm history is persistent during normal operation.

The alarm and event subsystem allows you to:

- display active alarms, filtered by alarm type and severity level
- display the alarm history, filtered by alarm type and severity level

This chapter contains the following sections:

See also "Alarm and Event Definitions" on page 325.

Alarm Types and Severity

Table 18 shows the types of alarms that BelAir Networks APs can generate.

Table 18: Alarm Types

Type	Description
dcom	data communication
eqpt	equipment (for instance, equipment failures)
sw	software (software errors)
qos	quality of service
env	environment (for instance, temperature too low or too high)
secu	security
sys	system

APs can produce alarms with the following severity: critical, major, minor, warning and information.

Displaying Active Alarms

```
/system/show alarms <max_num_of_alarms>
         [type {all|dcomm|eqpt|sw|qos|env|secu|sys}]
         [severity {all|critical|major|minor|warning|info}]
```

This command allows you to display up to “n” active alarms, filtered by alarm type or alarm severity. If the alarm severity is to be specified, then the alarm type must also be specified, but can be specified as *all* if no filtering by type is desired.

The *type* and *severity* specifications can have multiple values separated by a vertical bar. For example, specifying *type dcom|eqpt|env* shows all data communications, equipment and environment alarms.

In the active alarm display:

- The *Id* field indicates the log index number.
- The *Ignored* field indicates whether or not a Syslog and SNMP trap notification was sent for this item.

Example

In the following example, only one alarm is displayed because only one alarm was active at the time the command was issued.

```
/# system/show alarms 20
Displaying 1 active alarms of 1 total:
Id     Date/Time (UTC)     Severity  Status    Ignored   Entity   Type     Description
-----------------------------------------------------------------------------------------------
0      2004-11-05 19:16:06 critical  Set       No        brm1     dcom     Link Down
```

Displaying the Alarm History

```
/system/show alarm history <max_num_of_alarms>
         [type {all|dcomm|eqpt|sw|qos|env|secu|sys}]
         [severity {all|critical|major|minor|warning|info}]
         [<log_idx>]
```

This command allows you to display up to the last “n” reported alarms, filtered by alarm type or alarm severity. If the alarm severity is to be specified, then the alarm type must also be specified, but can be specified as *all* if no filtering by type is desired.

The *type* and *severity* specifications can have multiple values separated by a vertical bar. For example, specifying *type dcom|eqpt|env* shows all data communications, equipment and environment alarms.

The *<log_idx>* parameter specifies the most recent alarm log to display. It defaults to the last index generated.

In the alarm history display:

- The *Id* field indicates the log index number.
- The *Ignored* field indicates whether or not a notification (through Syslog or through SNMP traps) was sent for this item.

The *<max_num_of_alarm>* parameter cannot be greater than 200. To display alarms that occurred previous to that, note the log index number of the last displayed alarm and re-issue the *show alarm history* command with the appropriate *<log_idx>* parameter. See the following examples.

Example 1

The following example displays the five most recent alarms.

```
/# system/show alarm history 5
Displaying 5 alarm history entries:
Id     Date/Time (UTC)     Severity  Status    Ignored   Entity   Type     Description
-----------------------------------------------------------------------------------------------
9      2006-01-23 19:40:43 minor     Clr       No        scm      eqpt     SNTP server not available
8      2006-01-23 19:39:20 critical  Clr       No        brm3     dcom     Link Down
7      2006-01-23 19:39:06 critical  Set       No        brm3     dcom     Link Down
6      2006-01-23 19:38:00 critical  Clr       No        brm2     dcom     Link Down
5      2006-01-23 19:37:45 critical  Set       No        brm2     dcom     Link Down
```

Example 2

The following example displays the next two most recent alarms.

```
/# system/show alarm history 2 type all severity all 4
Displaying 2 alarm history entries:
Id     Date/Time (UTC)     Severity  Status    Ignored   Entity   Type     Description
-----------------------------------------------------------------------------------------------
4      2006-01-23 19:36:54 minor     Set       No        scm      eqpt     SNTP server not available
3      2006-01-23 19:36:29 warning   Set       No        brm3     eqpt     Battery missing
```

Example 3

In the following example, only two alarms are displayed because only two alarms were active at the time the command was issued.

```
/# system/show alarm history 20
Displaying 2 alarm history entries:
Id     Date/Time (UTC)     Severity  Status    Ignored   Entity   Type     Description
---------------------------------------------------------------------------------------------
```

```
1       2004-11-08 14:04:43 critical  Set        No         brm3     dcom     Link Down
0       2004-11-05 19:16:06 critical  Set        No         brm1     dcom     Link Down
```

Using Syslog

In addition to the alarm subsystem, the BelAir Networks APs can generate other event notifications. With the System Log (Syslog) functions you can:

- send the event notifications to a remote server, including lawful intercept data
- have them displayed on a CLI session as they occur
- filter the severity of the events that are logged

This chapter contains the following sections

Displaying the Syslog Configuration

```
/syslog/show config
```

This command displays the Syslog configuration.

Example

```
/syslog# show config

 System Log Information
 ----------------------
 Log Status       : Enable
 Lawful-Intercept: Disabled
 Monitor Logging : Enable
 Log Server IP    : 10.1.1.88
 Hostname Option : Mac Address
 Log Levels       : critical
 Alive Message    : interval 1hr 30min
```

Configuring the Syslog Server IP Address

```
/syslog/logserver {enable [<ip address>] |disable}
```

This command sets the Syslog server IP address for remote logging. Only one server can be defined at a time. If a different IP address was configured before, this command closes the previous connection. Use the *disable* parameter to remove a Syslog server.

Example

```
/syslog# logserver enable 10.6.4.52
```

Sending Syslog Messages to a CLI Session

```
/syslog/monitor logging {enable|disable}
```

This command instructs the AP to send Syslog messages to the current CLI session for display as they are generated. If you continue to use the current CLI session, the Syslog messages are interleaved with regular command input and output.

This command affects only the current CLI session. A new CLI session does not have this option enabled. This feature allows the Syslog messages to be displayed in one CLI session while another CLI session is used for regular command input and output.

To use this feature, you must first enable a log server with the *logserver {enable [<ip address>]* command.

Enabling this feature disables the normal CLI session inactivity timer. The CLI session remains open until this feature is explicitly disabled.

Example

```
/syslog# monitor logging enable
```

Configuring the Log Level

```
/syslog/loglevel {debug|info|notice|warn|error|
                        critical|alert|emerg}
```

This command defines the maximum severity level for messages to be sent to the remote Syslog server or the CLI session. (See “Configuring the Syslog Server IP Address” on page 259 and “Sending Syslog Messages to a CLI Session” on page 259.)

This command restricts logging to messages at the specified level and below (in the sequence of appearance in the command).

Note: The Syslog message severity levels are separate and distinct from the alarm severity levels.

The default level is *error.*

Example

```
/syslog# loglevel error
```

In the preceding example, after the command is issued, the AP generates *error*, *critical*, *alert* and *emerg* messages.

Configuring the Hostname Option

```
/syslog/set hostname-type {ip-address|mac-address}
```

This command lets you send the host name as either an IP address or a MAC address. The default is to send the host name as an IP address.

Configuring the Keep-alive Interval

```
/syslog/set alive-message {disable |
                          enable interval [hr <hrs>] [min <mins>]}
```

This command lets you send a keep-alive message to the remote Syslog server at a regular interval. The interval should not be shorter than 1 minute.

Configuring Lawful Intercept Data Retrieval

```
/syslog/set lawful-intercept {enable|disable}
```

This command lets you gather network data pursuant to lawful authority for the purpose of analysis or evidence. Specifically, when Network Address Translation (NAT) is enabled, many wireless clients can share a single public IP address. By enabling lawful intercept data retrieval, the gathered Syslog data contains the public IP address being used as well as the wireless client IP address and MAC address. The additional data is delivered in log entries with a severity level of *warning*.

By default, lawful intercept data retrieval is disabled.

To enable lawful intercept data retrieval:

1 Ensure NAT is enabled. If NAT is disabled, the */syslog/set lawful-intercept* command is disabled automatically. See “Network Address Translation” on page 196.

2 Ensure Syslog is enabled:

```
/syslog# logserver enable 10.1.1.88
```

3 Enabled lawful intercept data retrieval:

```
/syslog# set lawful-intercept enable
Lawful Intercept is enabled
```

4 Ensure the log level is correct:

```
/syslog# loglevel warn
```

Sample Output

```
Jan 16 09:46:15 172.16.0.235 Intercept 00:21:6a:78:fb:a4 UDP start 192.168.5.254/1102 <--->
239.255.255.250/1900 rxBytes:0 txBytes:0
Jan 16 09:48:51 172.16.0.235 Intercept 00:21:6a:78:fb:a4 UDP end 192.168.5.254/1102 <--->
239.255.255.250/1900 rxBytes:0 txBytes:322
```

In the previous sample output:

- *172.16.0.235* is the IP address of the BelAir Networks gateway.
- *00:21:6a:78:fb:a4* is the wireless client's MAC address.
- *UDP* is the protocol in use. It can also be TCP.
- *192.168.5.254/1002* is the wireless client's IP address and port.
- *239.255.255.250/1900* is the destination IP address and port.
- *rxBytes* and *txBytes* is the number of Bytes received and sent by the wireless client.

Gathering Additional Troubleshooting Information

This chapter shows you how to gather and display additional information that may be useful in resolving potential operational issues.

This chapter contains the following sections:

Determining Service Health Levels

```
/interface/wifi-<n>-<m>/set service-health-level-threshold
                            {noise-floor
                             |access-tx-error-rate
                             |access-rx-error-rate
                             |access-rx-duplicate-frame-rate
                             |access-low-modulation-rate
                             |mesh-link-rssi
                             |mesh-link-tx-error-rate}
                             |ch-busy-non-local
                             |ch-busy-noise
                             |WMOS}
                            {good-threshold|marginal-threshold}
                            <threshold value>
/interface/wifi-<n>-<m>/show service-health-level-thresholds
/interface/wifi-<n>-<m>/show service-health-levels
```

These commands provide equivalent functionality as the BelView NMS RF Health Audit tool, allowing you to view the current state of RF parameters in qualitative terms (good, marginal, or bad) instead of quantitative terms.

The *set* command lets you specify the threshold of what would be considered good or marginal health for each of the RF parameters.

The *show service-health-level-thresholds* command let you display the current threshold settings. The parameter health is considered:

- *good* if it is above the Good Threshold
- *marginal* if it is above the Marginal Threshold but below the Good Threshold
- *bad* if it is below the Marginal Threshold

Thresholds are measured in dBm for noise floor and RSSI, and % for error and modulation rates

The *show service-health-level* command let you display the current health levels of the RF parameters.

Example 1

```
/interface/wifi-1-2# show service-health-level-thresholds

Threshold Type                       Good Threshold    Marginal Threshold
---------------------------------------------------------------------
Noise Floor                               -90                  -80
Access Tx Error Rate                       10                   25
Access Rx Error Rate                       10                   25
Access Rx Duplicate Error Rate             10                   25
Access Low Modulation Rate                 10                   25
Mesh Link RSSI                            -75                  -80
Mesh Link Tx Error Rate                    10                   25
```

Example 2

```
/interface/wifi-1-2# show service-health-levels

    Health Level Type                    Health Level
-----------------------------------------------------------------------
     Noise Floor                           Good
     Access Tx Error Rate                  Good
     Access Rx Error Rate                  Good
     Access Rx Duplicate Error Rate        Good
     Access Low Modulation Rate            Good
     Mesh Link RSSI:
         Link 1: ................... Unknown
         Link 2: ................... Unknown
         Link 3: ................... Unknown
         Link 4: ................... Unknown
         Link 5: ................... Unknown
         Link 6: ................... Unknown
         Link 7: ................... Unknown
         Link 8: ................... Unknown
     Mesh Link Tx Error Rate:
         Link 1: ................... Unknown
         Link 2: ................... Unknown
         Link 3: ................... Unknown
         Link 4: ................... Unknown
         Link 5: ................... Unknown
         Link 6: ................... Unknown
         Link 7: ................... Unknown
         Link 8: ................... Unknown
```

Gathering Hardware Log Files

BelAir Networks hardware generates its own operational log files, recording information in a custom format. This information may be used by your BelAir Networks representative to identify a potential issue.

TFTP Transfer of Internal Log Files

```
/syslog/export logs remoteip <IP_addr>
                                 [flightrecorder]
                                 [logs]
                                 [commands]
                                 [slot <slot_no>]
                                 [filter <string>]
```

This command instructs the AP to package internal operational and state data into a flight recorder file, a log file and a commands file, and send them to a remote file system through TFTP. The resulting files can then be analyzed by your BelAir Networks representative to identify potential issues. Flight recorder and log files can be produced for all BelAir Networks cards.

The *flightrecorder*, *logs* and *commands* parameters allows you to specify whether to send the card's flight recorder information, log information, or a list of commands that were executed at that AP.

The *slot* parameter allows you to specify a particular card. Use the */mode* command to identify the slot number for the card. If unspecified, files are created and sent for each card in the AP.

The *filter* parameter allows you to restrict the scope of the information gathered and sent. Only lines containing the specified *<string>* are included in the files that are sent. The string can specify items such as a date or month. The specified string is not case sensitive.

The files that are produced and sent through TFTP are named as follows: <ip><card_type><slot><file_type><date_and_time>.txt (for example, *10.1.1.10htm1Logread2007.12.19.13.27.39.txt)*, where:

- 10.1.1.10 is the IP address of the AP containing the card.
- The card is an HTM located in slot 1.
- The file contains log information, instead of flight recorder information.
- The file was created on December 19, 2007, at 13:27:39.

Troubleshooting Wireless Client Connections

This section provides troubleshooting methods for wireless client access issues.

- “Troubleshooting Client Access” on page 265
- “Troubleshooting Client Association and DHCP” on page 267
- “Authentication History Log Messages” on page 268

See also “Wi-Fi Client Statistics” on page 144.

Troubleshooting Client Access

When a customer reports their wireless client cannot access the Internet, the corrective steps include the following:

1 Verify the customer’s computer settings for Access Point (AP) connectivity.
2 Reboot a radio (HTM or DRU) with CLI commands.
3 Physically access an AP and power it off and on.
4 Reconfigure an AP. (Requires tier 2 or tier 3 troubleshooting personnel)
5 Replace an AP. (Requires BelAir Networks technical support)

To troubleshoot customer access problems you need to obtain the wireless client’s physical location and a map with the location of the network APs. See Figure 21.

Figure 21: Sample Network Map for the Example

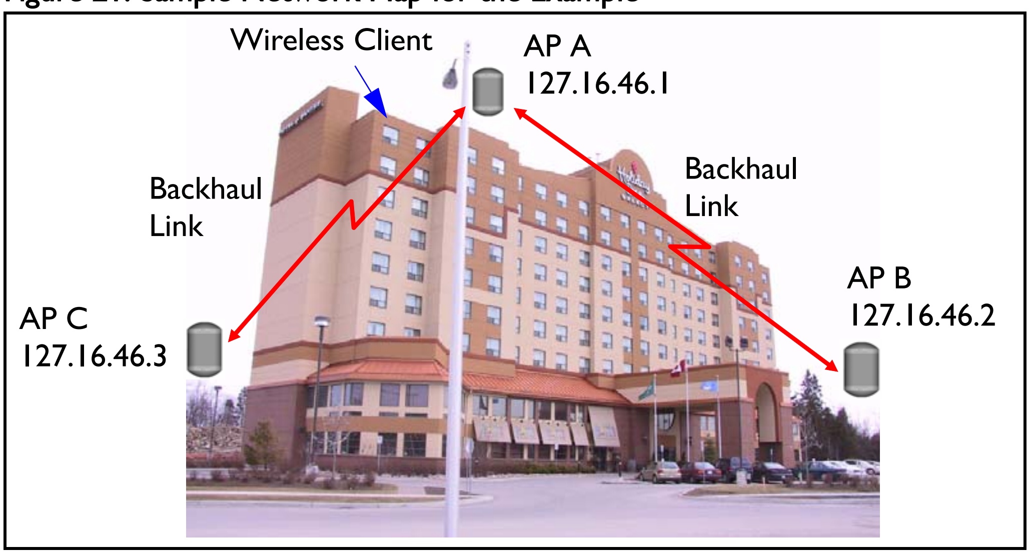


Figure 22 on page 266 provides a troubleshooting method, including CLI commands, to isolate the fault.

Figure 22: Troubleshooting Wireless Client Access

1 Are there any known outages? If not, go to step 2.

2 Determine the client's location. Use the network map to identify the AP associated with the client. For example, AP A at 172.16.46.1.

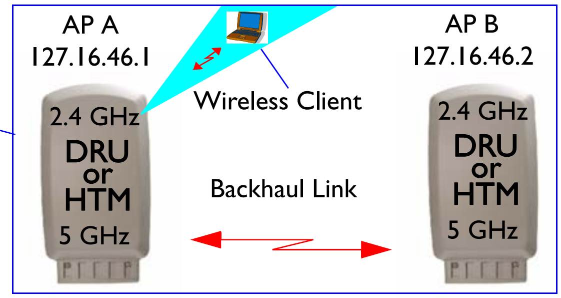
3 Use Telnet to access the AP's radio interface.
   a If AP access succeeds, go to step 4.
   b If AP access failed, go to step 6.

4 Check the AP's list of clients.
   a If there are clients, the AP is operational. The problem is with the client, not the network.
   b If there are no clients, go to step 5.

5 See if that AP can detect other APs.
   a If other APs are active (AGE < 2 seconds), go to step 7.
   b If the AP survey fails, reboot the radio card. Go to step 3.
   c If the radio card reboot fails, power the AP off and on. Go to step 3.
   d If the problem persists, replace the AP. Go to step 3.

6 Access a connecting AP and obtain the backhaul link state.
   a If the backhaul link state is *up* and the source AP's *AGE* is < 2 seconds, it is likely a configuration error. Escalate the problem to tier 2 or 3 troubleshooting personnel.
   b If backhaul link access fails, reboot the backhaul link radio and check that the link state is up. Go to step 3.
   c If the backhaul link radio reboot fails, power the AP off and on. Go to step 3.
   d If the problem persists, replace the AP. Go to step 3.

7 See if a connecting AP's AP's can detect other APs.
   a If the source AP is present (SSID and MAC address) and active (AGE < 2 seconds), the AP is functional. The problem is with the client, not the network.
   b If the source AP is not present, power the source AP off and on. Go to step 3.
   c If the problem persists, replace the source AP. Go to step 3.




```
> telnet
> open 127.16.46.1
BelAir login: xxxxxxxx
Password: xxxxxxxx
```

```
/interface/wifi-<n>-<m>/show clients
```

```
/interface/wifi-<n>-<m>/show rf-survey
```

```
/card/<card_type>-<n>/reboot
```

```
1  Remove the BATT connector
2  Remove the AC connector
3  Reconnect the AC connector
4  Reconnect the BATT connector
```

```
> telnet
> open 127.16.46.2
BelAir login: xxxxxxxx
Password: xxxxxxxx
/wifi-<n>-<m>/show backhaul status
```

```
/card/<card_type>-<n>/reboot
```

```
1  Remove the AC connector
2  Reconnect the AC connector
```

```
/interface/wifi-<n>-<m>/show rf-survey
```

```
1  Remove the AC connector
2  Reconnect the AC connector
```

Troubleshooting Client Association and DHCP

The AP offers authentication history commands to help you troubleshoot client association or DHCP issues.

```
/interface/wifi-<n>-<m>/show authentication history [mac <mac_addr>]
                                                     [ssid <ssid_index>]
/interface/wifi-<n>-<m>/set authentication history filter mac
                                       {<client_mac_addr>|all}
/interface/wifi-<n>-<m>/del authentication history
/interface/wifi-<n>-<m>/set authentication history probes
                                      {enable|disable}
```

These commands allow you to display authentication and DHCP log information.

The displayed information includes:

- a log index number
- the client's MAC address
- the date and time the event occurred
- log messages as described in "Authentication History Log Messages" on page 268.

You can use the following to control or focus the information being displayed:

- Specifying a filter in the *set* command restricts the recording of log messages to a specific MAC address. The default filter is FF:FF:FF:FF:FF:FF, meaning that filtering is disabled.
- Enabling probes allows probe information to the displayed. By default, probe information is not shown.
- Specifying a particular MAC address or SSID index in the *show* command restricts the display to the log events for the client with that MAC address or SSID index.

Use the *del* parameter to clear the recorded log information from the AP.

Example

```
/interface/wifi-1-1# show authentication history mac 00:05:4E:4F:39:D8

Client Authentication History - [filter: FF:FF:FF:FF:FF:FF] [probes: disabled]
--------------------------------------------------------------------
002 [00:05:4E:4F:39:D8] 2006-09-28 02:52:59 DHCP [192.168.219.1]->[192.168.219.1] - [request]->[ack]
003 [00:05:4E:4F:39:D8] 2006-09-28 02:52:59 DHCP [192.168.219.1]->[192.168.219.1] - [offer]->[request]
004 [00:05:4E:4F:39:D8] 2006-09-28 02:52:59 DHCP [0.0.0.0]->[192.168.219.1] - [discover]->[offer]
005 [00:05:4E:4F:39:D8] 2006-09-28 02:52:59 DHCP [0.0.0.0]->[0.0.0.0] - [init]->[discover]
006 [00:05:4E:4F:39:D8] 2006-09-28 02:52:59 <g> WPA authentication complete
007 [00:05:4E:4F:39:D8] 2006-09-28 02:52:55 <r> EAP Replay counter mismatch
008 [00:05:4E:4F:39:D8] 2006-09-28 02:52:53 <r> Client failing to reply to EAP packet...retrying.
009 [00:05:4E:4F:39:D8] 2006-09-28 02:52:50 WPA assoc Complete
```

------------------------------end---------------------------------

Authentication History Log Messages

The following success or failure codes precede the displayed log messages:

- *<r>*, (red), indicating a failure
- *<g>*, (green), indicating a successful or complete association or authentication
- *<b>*, (blue), indicating a significant non-failure event, such as the beginning of authentication

Information events do not display a preceding success or failure code.

The following sections describe the different types of events that the log messages describe:

- "Normal Network Events" on page 268
- "Normal Client Events" on page 269
- "Network Failure Events" on page 270
- "Client Failure Events" on page 270
- "Client EAP Failure Events" on page 271

Each section lists the actual displayed log message followed by a brief explanation.

Normal Network Events

RADIUS server accepted client

This log message is generated when the RADIUS server sends the *access-accept* packet.

DHCP [previous state]->[new state] – [previous IP]->[new IP]

The DHCP exchange between the client and the DHCP server generate several log messages with this format. Refer to Table 19 for a description of the various states. *Previous IP* and *new IP* are extracted from the captured packets.

Table 19: DHCP State Descriptions

DHCP State	Description
Init	Initialized state
Discover	The client sent a DHCP *discover* packet.

Table 19: DHCP State Descriptions (Continued)

DHCP State	Description
Offer	The server sent a DHCP *offer* packet to the client.
Request	The client sent a DHCP *request* packet.
Decline	The server declined the requested IP from the client.
Ack	The server acknowledges the IP requested by the client.
Nack	The server sends a negative acknowledgement for the IP requested by the client.
Release	The server releases the client of its IP.
Inform	The client sends a DHCP *inform* packet.
Arp_response	An ARP response packet from the client was captured. The IP in this packet is the client's IP.
Static	A static IP was detected.

Normal Client Events

<b> Starting authentication (open/shared key)

The client has sent an authentication packet to start the authentication process. The log indicates whether the authentication was *open* or *shared key*.

<?> "ENCRYPTION_TYPE" association complete

The client has completed its association. The encryption type is one of *open*, *wep*, *dot1x*, *wpa*, *wpapsk*, *wpa2* or *wpa2psk*.

The following success or failure codes apply to this log:

- *<g>* when the encryption type is *open* or *wep*
- none for all other encryption types

For *open* and *wep*, the log message indicates the client is authorized to carry packets.

For all other encryption types, the log message indicates that clients are now EAP-authorized (that is, able to send EAP packets) and EAP processing begins.

<g> "ENCRYPTION_TYPE" authentication complete

EAP processing has completed successfully. The encryption type is one of *dot1x*, *wpa*, *wpapsk*, *wpa2* or *wpa2psk*.

<r> Disassociation packet received

The client has sent a disassociation or deauthentication packet to invoke a disconnection from the BelAir Networks authenticator.

Received EAP identity: %s

The authenticator has captured the client's EAP identity during EAP authentication.

Network Failure Events

<r> Cannot reach RADIUS server

For *dot1x*, *wpa1* or *wpa2* encryption, the authenticator must contact a configured RADIUS server.

<r> RADIUS server rejected client - please refer to Radius Server logs for reason

The RADIUS server has sent an *access-reject* packet. If the client is not authorized or is not configured properly for the RADIUS server that it is currently trying to connect to, the RADIUS server sends a failure message to the client.

Depending on the RADIUS configuration, this failure can be for any number of reasons. Refer to the RADIUS server logs for the specific failure reason.

Client Failure Events

<r> Client has wrong WPA PSK key configured

This applies only to WPA1 and WPA2.

<r> Wrong WEP key configured
<r> encryption problems on client

These log messages occur after five continuous decrypting failures on packets sent by the client.

The *Wrong WEP key configured* log message is displayed if the client uses *wep* encryption and *open* authentication to carry traffic. The other log message is displayed for all other encryption types.

<r> denied by ACL

The client MAC address is not in the ACL.

<r> does not have proper WPA or RSN IE's in assoc req
<r> WPA IE does not match the advertised WPA IE
<r> RSN IE does not match the advertised RSN IE

The information element in the association packet does not match the configured AP information element. For example, this can happen when the AP is configured for WPA2 and the client has selected WPA or when the client has WPA with AES selected when the SSID is configured for WPA with TKIP.

Note: Not all clients reproduce this error. Some clients do not try to associate to an AP if their configured information element is different than the APs.

Client EAP Failure Events

<r> Client timed out while trying to connect with the RADIUS server

The client has failed to respond to the RADIUS server packets within a 30 second interval.

<r> EAP packet from client, but not EAP-enabled SSID[%d]

The SSID is not configured for EAP but the client is sending EAP packets.

<r> Client failing to reply to EAP packet...retrying

The EAP packet, used for *dot1x*, *wpa1, wpa1psk, wpa2* and *wpa2psk*, did not reach the client or the client did not properly decrypt the packet. The authenticator retries the EAP exchange three times, then times out and restarts the entire authentication process.

<r> timed out WPA1 EAP exchange
<r> timed out WPA2 EAP exchange

The client has failed to respond to the EAP packet after three retries and the EAP process restarts.

<r> EAP replay counter mismatch

The EAP replay counter does not match the number of key packets sent.

The EAP key contains a replay counter that increments with each EAP key packet to protect against issues with key exchange. If the counter does not match the number of key packets sent, the client restarts the EAP authentication.

This applies only to WPA1 and WPA2.

<r> Received msg didn't contain same IE as in assoc req

The EAP key contains an information element that should match the information element in the association request packet.

This applies only to WPA1 and WPA2.

<r> EAP key descriptor doesn't match

The EAP packet contains information about what encryption type to use. The client must supply the information so that it matches the AP encryption type.

This applies only to WPA1 and WPA2.

<r> MIC failure %d in %d seconds on ssid %d

The BelAir Networks authenticator considers this event as an attack. The offending client is deauthenticated and no associations are allowed for two minutes.

Running Link Diagnostics

This chapter describes tools to help you determine the relative health of your links.

This chapter contains the following sections:

Path Trace Tool

```
/diagnostics/trace path <ip_address>
```

This command displays the number of hops between you and the supplied IP address.

The *trace path* command only operates on BelAir Networks APs. If there is a non-BelAir Networks AP in between source AP and the destination AP, the trace result displays *unreachable*.

Example

```
/diagnostics# trace path 10.9.9.110

PING 10.9.9.110 (10.9.9.110): 56 data bytes
64 bytes from 10.9.9.110: icmp_seq=0 ttl=64 time=37.7 ms
64 bytes from 10.9.9.110: icmp_seq=1 ttl=64 time=17.1 ms
64 bytes from 10.9.9.110: icmp_seq=2 ttl=64 time=11.3 ms

--- 10.9.9.110 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 11.3/22.0/37.7 ms

hop 1: IP 10.9.9.201
hop 2: IP 10.9.9.200
hop 3: IP 10.9.9.51
hop 4: IP 10.9.9.110
```

Traffic Tool

```
/diagnostics/test link IP <ip_addr> rate-kbps <num_str>
                         { hop-by-hop | end-to-end }
                          [update_interval <num_str>]
                          [duration <num_str>]
                          [dir {rx|tx|both}]
                           [ip_scope <ip_addr>]
/diagnostics/stop {all | session <session_id> ip_scope <ip_addr>}
/diagnostics/show status
```

This command first runs a path trace and then runs traffic between you and a supplied IP address.

To perform multiple simultaneous link tests, each to a different destination IP address, use multiple CLI sessions with each session running its own link test.

The *rate-kbps* parameter specifies amount of traffic to be run, in kbps.

The *hop-by-hop* and *end-to-end* parameter specify the type of test result information that is displayed:

- The *hop-by-hop* option displays test results in multiple columns, with each column displaying the test results for each hop taken to reach the destination IP address. For example, if the destination IP address is separated from the BelAir Networks AP by an intermediate AP, then two columns of test results are displayed. One column has the test results for the hop from the BelAir Networks AP to the intermediate AP. The second column has the test results for the hop from the intermediate AP to the destination IP address.
- The *end-to-end* option displays as single column of test results showing the traffic rate from the BelAir Networks AP to the destination IP address.

The *update_interval* parameter specifies in seconds the interval that the result is sampled. It ranges from 1 to 5. The default value is 1 second. The *duration* parameter must be a multiple of the *update_interval* parameter.

The *duration* parameter specifies how long to run traffic in seconds. It ranges from 10 to 30 and must be larger than the *update_interval* parameter. The default value is 10 seconds.

If *update_interval* is 2 seconds, and *duration* is 10 seconds, 5 sample results are displayed every 2 seconds.

The *dir* parameter specifies the traffic direction. The default value is *rx*.

The *ip_scope* parameter is used when an intermediate AP in the path to the destination IP address is busy running a previous specified link test. Normally specifying a second link test through the same intermediate AP would fail. However, by specifying a non-default IP scope, you can proceed with the second link test. The *ip_scope* parameter accepts values of the following format: xxx.yyy.zzz.255. You can use any valid IP range except 192.168.1.255, 192.168.2.255 and 192.168.3.255. These three ranges are reserved for internal use by BelAir Networks APs.

Use the *stop test* command to stop one or all running tests. Use the s*how status* command to display the test that are currently running and their session

ID. The *session_id* parameter identifies each session, The *session_id* parameter ranges from 1 to the maximum number of radios in the AP.

Example 1 - Hop-by-hop

```
diagnostics# test link IP 10.1.1.201 rate 1 hop-by-hop

Trace path:
PING 10.1.1.201 (10.1.1.201): 56 data bytes
64 bytes from 10.1.1.201: icmp_seq=0 ttl=64 time=22.3 ms
64 bytes from 10.1.1.201: icmp_seq=1 ttl=64 time=31.7 ms
64 bytes from 10.1.1.201: icmp_seq=2 ttl=64 time=36.6 ms

--- 10.1.1.201 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 22.3/30.2/36.6 ms

hop 1: IP 10.1.1.202
hop 2: IP 10.1.1.201

Test Hop By Hop. scope 192.168.3.0

Test link between 10.1.1.100 and 10.1.1.201, for 10 sec at 1
mbps, update interval 1 sec using unidirectional TCP test: RX.
(Default output in Kbit/s).

Link test started:
Time      hop1        hop2
 Sec      Rx/Tx        Rx/Tx
          Kbit/s       Kbit/s
   1    866/0K   808/0K
   2    864/0K   831/0K
   3    949/0K   631/0K
   4    966/0K   452/0K
   5    976/0K   432/0K
   6    986/0K   336/0K
   7    987/0K   335/0K
   8    988/0K   324/0K
   9    992/0K      *
  10   989/0K   299/0K
```

Example 2 - End-to-end

```
/diagnostics# test link 1 IP 10.1.1.201 rate 1 end-to-end

Trace path:
PING 10.1.1.201 (10.1.1.201): 56 data bytes
64 bytes from 10.1.1.201: icmp_seq=0 ttl=64 time=14.5 ms
64 bytes from 10.1.1.201: icmp_seq=1 ttl=64 time=42.2 ms
64 bytes from 10.1.1.201: icmp_seq=2 ttl=64 time=59.9 ms

--- 10.1.1.201 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 14.5/38.8/59.9 ms

hop 1: IP 10.1.1.202
```

```
hop 2: IP 10.1.1.201

Test Enb By End. scope 192.168.3.0

Test link between 10.1.1.100 and 10.1.1.201, for 10 sec at 1
mbps, update interval 1 sec using unidirectional TCP test: RX.
(Default output in Kbit/s).

Link test started:
Time
 Sec       Rx/Tx
           Kbit/s
   1     858/0K
   2     924/0K
   3     946/0K
   4     971/0K
   5     976/0K
   6     987/0K
   7     988/0K
   8     988/0K
   9     992/0K
  10     989/0K
```

Example 3

```
/diagnostics# show status

Traffic test status on this node:
session 2 on IP scope 192.168.3.0
session 1 on IP scope 192.168.3.0
```

Web Radio Troubleshooting Tools

The Web interface provides the following tools to display radio performance metrics:

- a throughput meter
- histogram display of various performance metrics

These tools allow you to:

- monitor your network in greater detail
- identify APs that are approaching their maximum capacity so network improvements can be made
- identify clients that are heavy users
- identify channels that are approaching their maximum capacity, so that network changes can be made to improve system performance.

Tool Access

Access the Web interface as described in "Web Interface" on page 24.

Each tool has its own web page under each radio physical interface. See Figure 23 on page 278.

Throughput Meter

This tool provides throughput statistics on the following entities in an AP:

- the entire AP
- individual SSIDs
- clients, identified by their MAC address and sorted under their appropriate SSID
- multipoint-to-multipoint mesh links

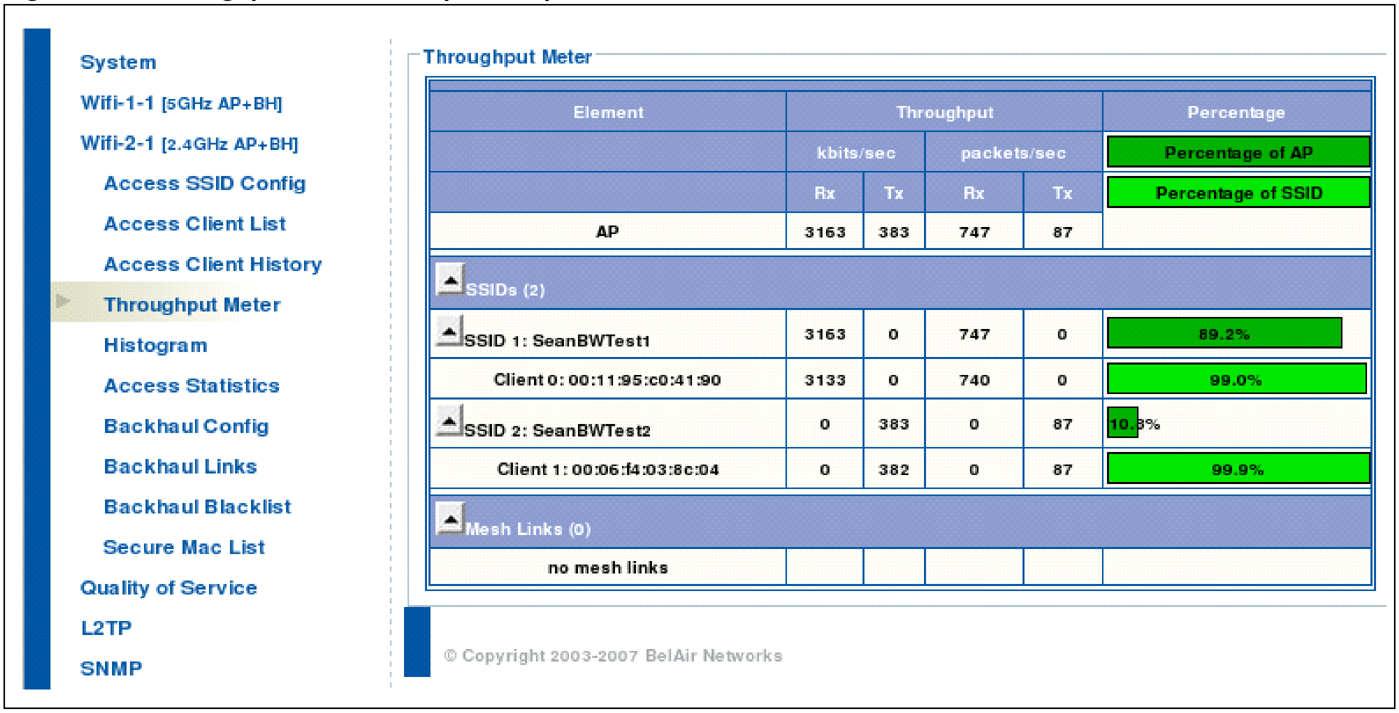
The following statistics are captured and displayed for each entity:

- throughput in kb/sec and packets/sec
- percentage of bandwidth used:

—SSID bandwidth, as a percentage of the bandwidth of the entire AP

—client bandwidth, as a percentage of the SSID bandwidth

Figure 23: Throughput Meter Sample Output



Histogram

This tool collects data from the radio and records it in a histogram table. See Figure 24 on page 279.

Histogram Modes

A histogram can be displayed for the following types of data, as specified by the *Mode* list:

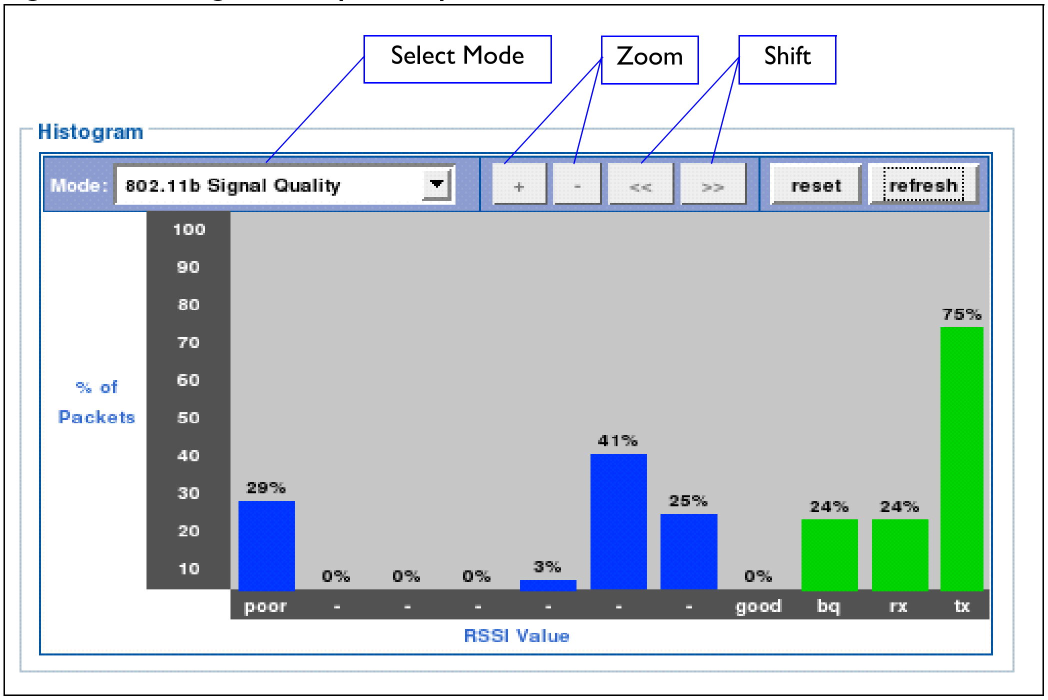
- Valid Packet Rx Host (rh) - displays a distribution of all valid incoming packets destined for the local AP.

Zoom and Shift Functions

Histogram bins can be shifted and zoomed for more or less precision. See Figure 24 on page 279.

- zoom - changes the displayed bin width, giving you more or less information what makes up a particular bin. For example, if 80% of the traffic is displayed in a bin representing -75 to -80 dBm, then successively clicking on the *zoom in* button changes the definition of each bin to be -2 dBm wide instead of -5 dBm. Thus, the 80% of traffic is displayed among more bins giving you more information about the traffic distribution.
- shift - displays more bins from one direction while hiding bins from the other

Figure 24: Histogram Sample Output



AP LED Descriptions

This chapter contains the following sections describing the LEDs available for each AP:

- "BelAir20" on page 280
- "BelAir100i WCS" on page 282
- "BelAir20E" on page 283
- "BelAir20EO" on page 285
- "BelAir100N and BelAir2100" on page 286
- "BelAir100SN and BelAir100SNE" on page 288

BelAir20

The BelAir20 includes four status LED indicators described in Figure 25 and Table 20 on page 281.

Figure 25: LEDs

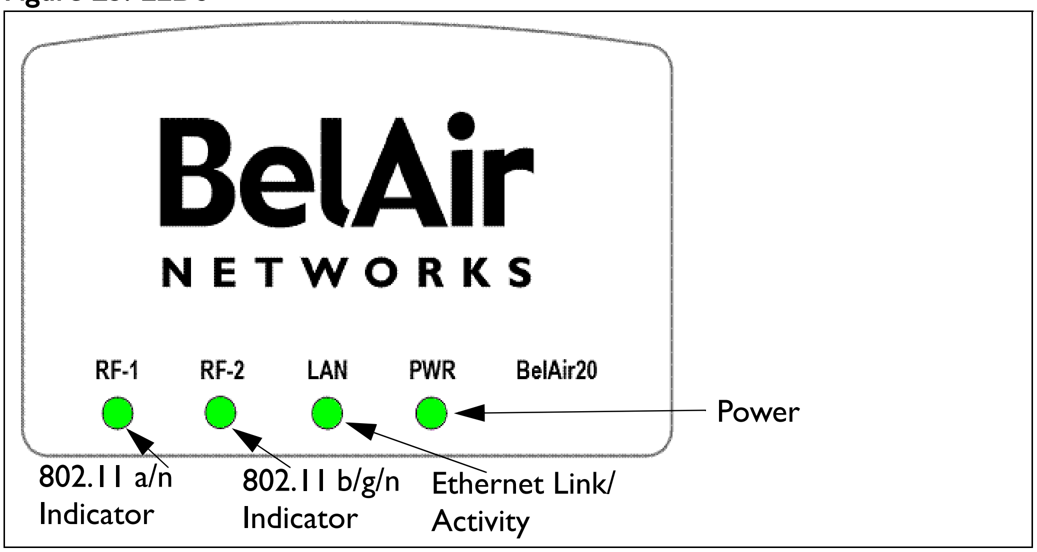


Table 20: LED Behavior

LED	Status	Description
RF-1 (802.11 a/n 5.8 GHz)	Off	No power to unit or unit cannot boot.
	Flashing Green	802.11 a/n is disabled.
	Green	802.11 a/n is enabled, backhaul is disabled.
	Flashing Blue	802.11 a/n is enabled, some backhaul links are down.
	Blue	802.11 a/n is enabled, all backhaul links are up.
RF-2 (802.11 b/g/n 2.4 GHz)	Off	No power to unit or unit cannot boot.
	Flashing Green	802.11 b/g/n is disabled.
	Green	802.11 b/g/n is enabled, backhaul is disabled.
	Flashing Blue	802.11 b/g/n is enabled, some backhaul links are down.
	Blue	802.11 b/g/n is enabled, all backhaul links are up.
LAN	Off	There is no connection on the LAN port.
	Blue	Indicates a 1000 Mbps link.
	Green	Indicates a 100 Mbps link.
	Orange	Indicates a 10 Mbps link.
	Flashing	Indicates activity.
PWR	Off	Indicates that there is no power to the unit.
	Flashing Red	Indicates that a hardware fault has been detected.
	Red	Indicates that there is a software error, system cannot boot.
	Flashing Amber	Indicates that the reset button has been pushed. (RF-1 and RF-2 are flashing cyan.)
	Amber	Indicates that the system is booting. (RF-1 and RF-2 are initially cyan, then turn off as the unit completes the boot process.)
	Flashing Green	Indicates that configuration data is being downloaded or that unit is searching for a configuration server
	Green	Indicates that the unit is up and running.

BelAir100i WCS

The BelAir100i WCS includes four status LED indicators described in Figure 25 and Table 20 on page 281.

Figure 26: LEDs

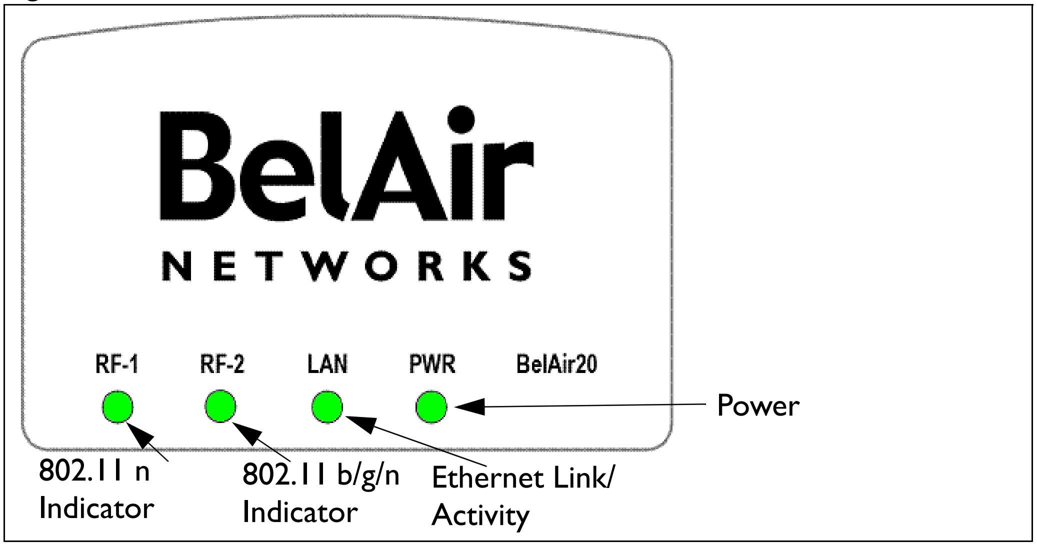


Table 21: LED Behavior

LED	Status	Description
RF-1 (802.11 n 2.3 GHz)	Off Flashing Green Green Flashing Blue Blue	No power to unit or unit cannot boot. 802.11 n is disabled. 802.11 n is enabled, backhaul is disabled. 802.11 n is enabled, some backhaul links are down. 802.11 n is enabled, all backhaul links are up.
RF-2 (802.11 b/g/n 2.4 GHz)	Off Flashing Green Green Flashing Blue Blue	No power to unit or unit cannot boot. 802.11 b/g/n is disabled. 802.11 b/g/n is enabled, backhaul is disabled. 802.11 b/g/n is enabled, some backhaul links are down. 802.11 b/g/n is enabled, all backhaul links are up.

Table 21: LED Behavior (Continued)

LED	Status	Description
LAN	Off	There is no connection on the LAN port.
	Blue	Indicates a 1000 Mbps link.
	Green	Indicates a 100 Mbps link.
	Orange	Indicates a 10 Mbps link.
	Flashing	Indicates activity.
PWR	Off	Indicates that there is no power to the unit.
	Flashing Red	Indicates that a hardware fault has been detected.
	Red	Indicates that there is a software error, system cannot boot.
	Flashing Amber	Indicates that the reset button has been pushed. (RF-1 and RF-2 are flashing cyan.)
	Amber	Indicates that the system is booting. (RF-1 and RF-2 are initially cyan, then turn off as the unit completes the boot process.)
	Flashing Green	Indicates that configuration data is being downloaded or that unit is searching for a configuration server
	Green	Indicates that the unit is up and running.

BelAir20E

The BelAir20E includes four status LED indicators described in Figure 25 and Table 20 on page 281.

Figure 27: LEDs

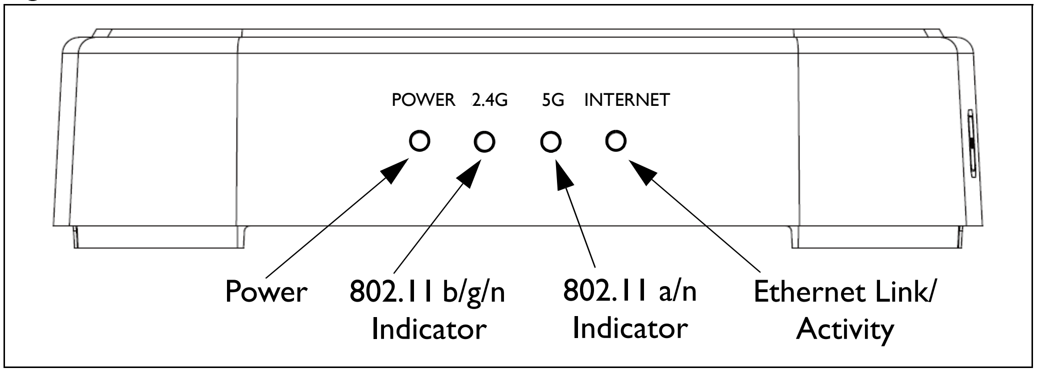


Table 22: LED Behavior

LED	Status	Description
POWER	Off	No power to the AP.
	Red	Hardware fault, software error, or system cannot boot.
	Flashing Blue	Configuration data is being downloaded or that AP is searching for a configuration server
	Blue	AP is up and running.
2.4G (802.11 b/g/n 2.4 GHz)	Off	No power to AP or AP cannot boot.
	Flashing Blue	Interface is disabled, or 802.11 b/g/n is enabled and some backhaul links are down.
	Blue	Backhaul is disabled, or 802.11 b/g/n is enabled and all backhaul links are up.
5G (802.11 a/n 5 GHz)	Off	No power to AP or AP cannot boot.
	Flashing Blue	Interface is disabled, or 802.11 a/n is enabled, some backhaul links are down.
	Blue	Backhaul is disabled, or 802.11 a/n is enabled, all backhaul links are up.
INTERNET	Off	No power to AP or AP cannot boot.
	Flashing Blue or Steady Blue	WAN port has Ethernet connectivity.

BelAir20EO

The BelAir20EO includes four status LED indicators described in Figure 25 and Table 20 on page 281.

Figure 28: LEDs

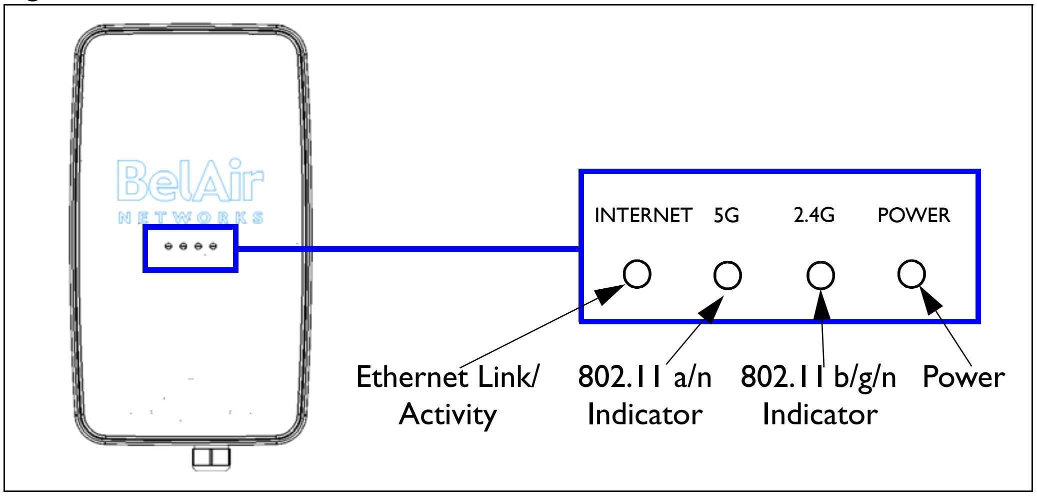


Table 23: LED Behavior

LED	Status	Description
POWER	Off	No power to the AP.
	Red	Hardware fault, software error, or system cannot boot.
	Flashing Blue	Configuration data is being downloaded or that AP is searching for a configuration server
	Blue	AP is up and running.
2.4G (802.11 b/g/n 2.4 GHz)	Off	No power to AP or AP cannot boot.
	Flashing Blue	Interface is disabled, or 802.11 b/g/n is enabled and some backhaul links are down.
	Blue	Backhaul is disabled, or 802.11 b/g/n is enabled and all backhaul links are up.
5G (802.11 a/n 5 GHz)	Off	No power to AP or AP cannot boot.
	Flashing Blue	Interface is disabled, or 802.11 a/n is enabled, some backhaul links are down.
	Blue	Backhaul is disabled, or 802.11 a/n is enabled, all backhaul links are up.

Table 23: LED Behavior (Continued)

LED	Status	Description
INTERNET	Off	No power to AP or AP cannot boot.
	Flashing Blue or Steady Blue	WAN port has Ethernet connectivity.

BelAir100N and BelAir2100

The unit has three external LEDs as described in Table 24.

Table 24: LED Behavior - BelAir100N, BelAir100NE or BelAir2100

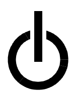
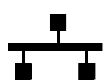
LED Name	LED State	Unit State	Description
Power 	Off	Off	No power to the unit. Check power cable connection and power source.
	Amber	Initialization	The unit is initializing.
	Flashing Green	Autoconfiguring	The unit is downloading autoconfiguration data.
	Green	Operational	Self-test passed and autoconfiguration completed (if applicable)
	Red	Not operational	Self-test failed. Restart the unit.
Ethernet 	Off	No cable	A cable is not connected between the Ethernet port and the far-end.
	Green	Cable is connected	A cable is connected between the Ethernet port and an active far-end.
	Flashing Green	Operational	Data is being transferred across the link.

Table 24: LED Behavior - BelAir100N, BelAir100NE or BelAir2100

LED Name	LED State	Unit State	Description
Radio or Mesh	Off	Hardware failure	Hardware failure, no power to the unit or radio initialization
	Amber	Not operational	All of the P-to-P and P-to-MP links are down.
	Flashing Amber	P-to-P and/or P-to-MP link failure	One or more, but not all, of the P-to-P and/or P-to-MP links are down.
	Flashing Green	MP-to-MP link failure	One or more of the MP-to-MP links are down.
	Green	Operational	All links are operational.

BelAir100N and BelAir2100 Power-up LED Sequence

Table 25 shows the normal power-up LED sequence.

Table 25: Normal Power-Up LED Sequence

Power-up Sequence	Power	Ethernet	Radio/Mesh
Off	Off	Off	Off
On	Amber	Off	Off
After 1 minute	Green	Off	Amber
After 2 minutes	Green	Off[1]	Green

Note: Light is either off or flashing green if data is transferred across the Ethernet link.

BelAir100SN and BelAir100SNE

The unit has three external LEDs as described in Table 26.

Table 26: LED Behavior - BelAir100SNE and BelAir100SNE

LED	Colour	State	Description
Power	Off	Off	No power to the unit. Check power cable connection and power source. If the voltage is low, 45 VAC or less, check the cable connection between the AP and the power tap. You may need to use a solid 0.5-inch cable rather than a lossy 75-ohm cable.
	Amber	Initialization	The unit is initializing.
	Flashing Green	Autoconfiguring	The unit is downloading autoconfiguration data.
	Green	Operational	Self-test passed and autoconfiguration completed (if applicable)
	Red	Not operational	Self-test failed. Restart the unit.

Table 26: LED Behavior - BelAir100SNE and BelAir100SNE (Continued)

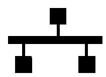
LED	Colour	State	Description
Cable Modem or Ethernet 	Off	Not operational	Cable Modem link is down.
	Flashing Blue	Initialization	Synchronizing with the Cable Modem Termination System (CMTS). May take up to 5 minutes. After 5 minutes, this state indicates that the RF signal strength is out of range, the MAC address may not be recorded at the CMTS or an IP address may not be assigned to the unit. Note the unit's MAC address located at the bottom of the unit and call the Network Operating Centre to confirm MAC address registration and IP address assignment. After verifying the IP address, check L2TP tunneling configuration.
	Blue	Operational	Cable Modem is operational
	Green	Not operational	Cable Modem link is down. A cable is connected between the Ethernet port and an active far-end.
	Flashing Green	Not operational	Cable Modem link is down. Data is being transferred across the Ethernet link.

Table 26: LED Behavior - BelAir100SNE and BelAir100SNE (Continued)

LED	Colour	State	Description
Radio or Mesh	Off	Hardware failure	Hardware failure, no power to the unit or radio initialization
	Amber	Not operational	All of the P-to-P and P-to-MP links are down.
	Flashing Amber	P-to-P and/or P-to-MP link failure	One or more, but not all, of the P-to-P and/or P-to-MP links are down.
	Flashing Green	MP-to-MP link failure	One or more of the MP-to-MP links are down.
	Green	Operational	All links are operational.

BelAir100SN and BelAir100SNE Power-up LED Sequence

Table 25 shows the normal power-up LED sequence.

Table 27: Normal Power-Up LED Sequence

Power-up Sequence	Power	Cable Modem/ Ethernet	Radio/Mesh
Off	Off	Off	Off
On	Amber	Off	Off
After 1 minute	Green	Off	Amber
After 2 minutes	Green	Off[1]	Green
After 2+ minutes	Green	Flashing Blue	Green
After 7 minutes (maximum)	Green	Blue	Green

For More Information

BelAir Networks documentation is modular and organized to be of best use to you during the logical process of setting up a network of BelAir devices.

Use the documents as outlined in the following sections.

Installation Guide

Use this document when you are:

- determining infrastructure requirements
- pre-configuring the units
- installing units
- problem-solving on the site
- mounting units
- commissioning the units

BelAir OS User Guide

Use this document when you are:

- becoming accustomed to the CLI interface
- becoming accustomed to the SNMP interface
- accessing the Web interface
- configuring the unit:
  —IP parameters
  —data and time
  —Ethernet interfaces
- configuring the radios:
  —antenna and link features
  —access channel numbers
  —transmission power levels
  —radio transmission rates
  —wireless security
- configuring Quality of Service (QoS)

- upgrading the unit
- saving and restoring the configuration
- troubleshooting and in need of technical support
- looking up system configuration details:
  —Alarms and events
  —System logs
  —Statistics

Technical Support

This section provides direction should you have questions about your AP.

Support Resources

In general, BelAir Networks recommends that you do the following steps to seek the information you want:

1 Refer to the *BelAirOS User Guide* to see if it describes your situation. If it does, do the provided corrective actions.

2 If the user guide does not cover your situation, contact your BelAir Networks product representative

3 If you still need assistance, use the BelAir Networks online support center at http://support.belairnetworks.com

4 Finally, if your issue is not resolved, contact BelAir Networks:

—613-254-7070, option 2

—1-877-BelAir1 (235-2471), option 2

—techsupport@belairnetworks.com

Warranty and Limitations

To review BelAir's product warranty, refer to the document called *BelAir Products Warranty and Limitations* available on the BelAir Networks Website, or contact your BelAir Representative.

Definitions and Acronyms

ACL	Access Control List
AES	Advanced Encryption System
AP	Access Point. A wireless LAN data transceiver that uses radio waves to provide connectivity services to a network
Beacon	A protocol packet that signals the availability and presence of a wireless device
BID	Bridge identifier used in spanning-tree calculations
BPDU	Bridge protocol data unit. When the spanning tree protocol is enabled, bridges send and receive spanning-tree frames, called BPDUs, at regular intervals and use the frames to maintain a loop-free network.
BSS	Basic Service Set: A set of 802.11-compliant stations that operate as a fully connected wireless network
Client	A device that uses the services of a wireless access point to connect to a network
CLI	Command Line Interface
DHCP	Dynamic Host Configuration Protocol
IP	Internet Protocol
IP address	The Internet Protocol (IP) address of a station. Expressed in dotted notation, for instance, 10.21.1.14
IP subnet mask	The number used to identify the IP sub-network.
LAN	Local Area Network
LPM	Line and Power Module
MAC	Media Access Control
MAC Address	Media Access Control address. A unique 48-bit number used in Ethernet data packets to identify an Ethernet device.
MAU	Medium Attachment Unit
MIB	SNMP Management Information Base
MPDU	MAC Protocol Data Unit
NAS	Network Access Server
OAM	Operations, Administration and Maintenance

OUI	Organizationally Unique Identifier (first 3 bytes of a MAC address)
PVID	Port VLAN identifier
PDU	Protocol Data Unit
QoS	Quality of Service
RADIUS	Remote Authentication Dial-In User Service. An Internet protocol (RFC 2138) for carrying dial-in users' authentication information and configuration information between a shared, centralized authentication server (the RADIUS server) and a network access server (the RADIUS client) that needs to authenticate the users of its network access ports
RTS	Request to Send
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SSH	Secure Shell
SSID	Service Set Identifier (also referred to as Network Name or Id). A unique identifier used to identify a radio network and which stations must use to be able to communicate with each other or to an access point
SSL	Secure Socket Layer
TCP	Transmission Control Protocol
TKIP	Temporal Key Integrity Protocol, an optional IEEE 802.11 function that offers frame transmission privacy. Like WEP, it is based on RC4 encryption. It generates new encryption keys for every 10 kilobytes of data transmitted.
TU	Wireless Time Unit, as defined in IEEE 802.11, a measure of time equal to 1024 microseconds
UDP	User Datagram Protocol
VLAN	Virtual Local Area Network
WEP	Wired Equivalent Privacy, an optional IEEE 802.11 function that offers frame transmission privacy. The Wired Equivalent Privacy generates secret shared encryption keys that both source and destination stations can use to alter frame bits to avoid disclosure to eavesdroppers.
WPA	Wi-Fi Protected Access

Appendix A: AP Configuration Sheets

You can use this sample worksheet to document the basic configuration of an AP. Store your worksheets in a secure location because they contain sensitive information (super-user password and privacy keys).

AP part number (located on the sticker on to the AP):____________________________

AP serial number (located on the sticker on to the AP):____________________________

Super-user password: ______________________________

System Name: _______________ Location: _____________ Contact: ________________

Base MAC Address: _______________

IP Address: ______________Subnet:_______________ Gateway: _______________

Cable Modem MAC Address (BA00SN and BA100SNE only): __________________________________

Layer 2 Configuration: STP Priority: ________

Client to VLAN mapping: Y or N

Wi-FI Access Point (AP) Settings (if configured)

Interface: wifi-___-___

Channel: _________

Table 28: AP Privacy Setting Table (Optional)

SSID (1 to 8)	ACL	Encryption and Authentication
__________________	Y or N	wep40 RADIUS or 5-byte pre-shared key: ______________________________
		wep104 RADIUS or 13-byte pre-shared key: ______________________________
		wpa encryption (TKIP or AES):____________________ RADIUS or 8 to 63-byte pre-shared key: ______________________________
		wpa2 encryption (PSMv2 only: TKIP or AES. Others: AES only):____________________ RADIUS or 8 to 63-byte pre-shared key: ______________________________
		dot1x (RADIUS (EAP) authentication) 1. ________________ 2. ________________ 3. ________________ 4. ________________
__________________	Y or N	wep40 RADIUS or 5-byte pre-shared key: ______________________________
		wep104 RADIUS or 13-byte pre-shared key: ______________________________
		wpa encryption (TKIP or AES):____________________ RADIUS or 8 to 63-byte pre-shared key: ______________________________
		wpa2 encryption (PSMv2 only: TKIP or AES. Others: AES only):____________________ RADIUS or 8 to 63-byte pre-shared key: ______________________________
		dot1x (RADIUS (EAP) authentication) 1. ________________ 2. ________________ 3. ________________ 4. ________________

Wi-Fi Backhaul Setting (if configured)

Interface: wifi-___-___

Channel: _________

Link ID: _______________________

AES Privacy (Y or N):___________ Key (16 characters):____

Topology (P-to-P, MP-to-MP mesh, P-to-MP star): ___________________________________

P-to-MP star role (base-station or subscriber-station): ______________________________

P-to-MP star link index: ______________________________

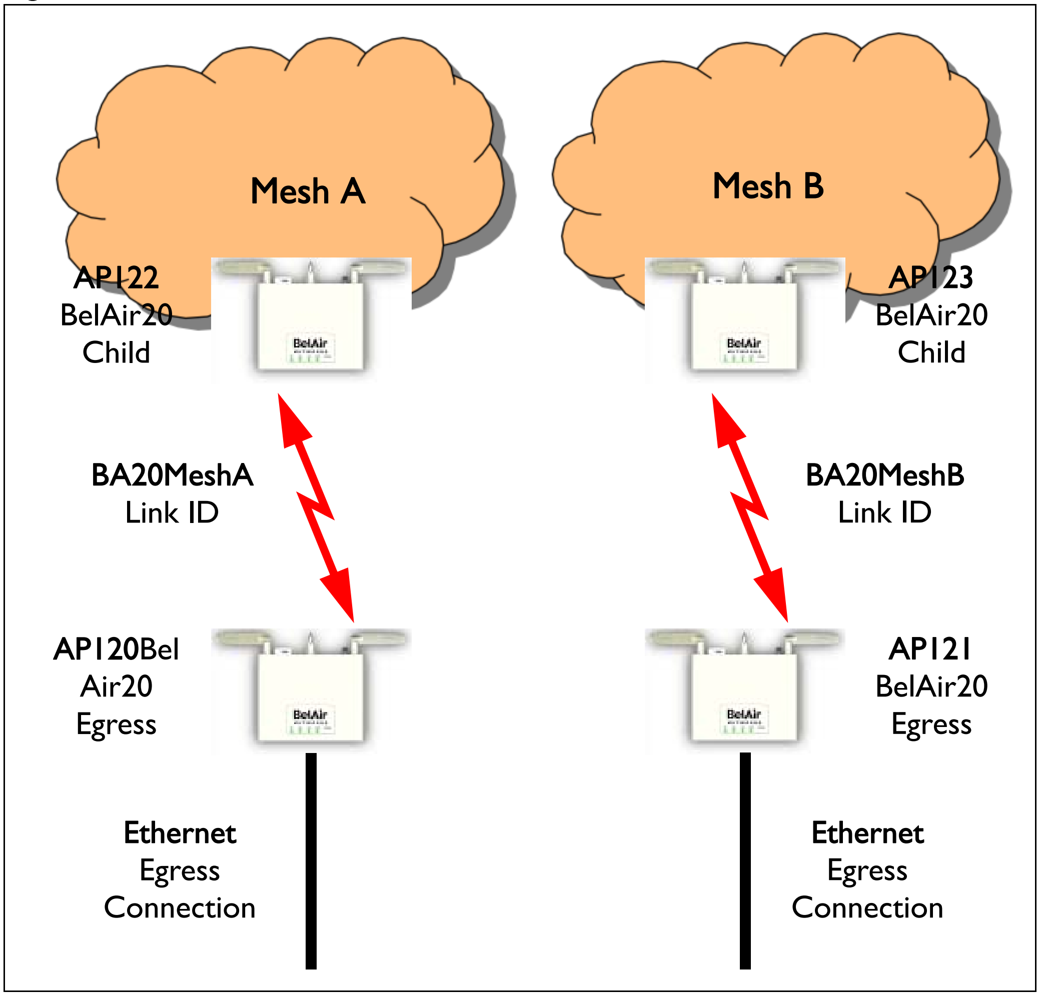
Appendix B: Mesh Auto-connection Example

This example uses two meshes of BelAir20 APs to show how mesh auto-connection operates.

Setup and Initial Conditions

See Figure 29.

Figure 29: Auto-connection Initial Conditions



To setup auto-connection:

- The first six bytes of the respective link IDs must match. This is true in our example (*B20MeshA* and *B20MeshB*).
- The auto-connection admin state in the child APs must be enabled.

- The egress AP of each mesh must have its system egress point set to either *yes direct* or *yes indirect*. See "Setting the Network Egress Point" on page 72 for details.

The following series of CLI commands show this for both meshes.

AP122 (Child AP of Mesh A)

Display the backhaul configuration.

```
/interface/wifi-1-1# show config backhaul
Slot: 1, Card Type: htm, revision: 1, Port: 1, Radio: HTMv1  5GHz 802.11n
admin state: ................. Enabled
channel: ..................... 161
  mode: ...................... ht20
  mimo: ...................... 3x3
  tx power: .................. 18.0 (dBm per-chain), 23.0 (dBm total)
antenna gain: ................ 5.0  (dBi)
link distance: ............... 1 (km)
tx aggregation:............... Enabled
base radio MAC : ............. 00:0d:67:10:e8:92
Backhaul:
  Common:
    privacy: ................. Disabled
    mesh-min-rssi............. -100 (dbm)
  Stationary Backhaul:
    link admin state: ........ Enabled
    link id: ................. B20MeshA
    topology: ................ mesh
  Mobile Backhaul:
    mobile admin state: ...... Disabled
    mobile link id: .........
    mobile link role: ........ ss
  Protection Backhaul:
    protection admin state: .. Disabled
Blacklist:
  No blacklist entries
Link Failure Detection: ...... Disabled
Backhaul T1 Bandwidth limit:.. Disabled
```

Display the mesh topology.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:0c:22:4b fwd  fwd   -46  wifi-1-1 180.7.4.120
```

Enable auto-connection and verify it.

```
/services/auto-conn# set admin enabled
/services/auto-conn# show config
admin state: ................. Enabled
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable      Use Alternate Mesh
-----------    ----------           ----------------      ----------------
up             down                 no                    no
```

AP120 (Egress AP of Mesh A)

Display the mesh topology.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:10:e8:92 fwd  fwd   -44  wifi-1-1 180.7.4.122
```

Identify AP120 as an egress AP.

```
/system# set system-egress-point yes direct
/system# show system-egress-point
egress point:................. direct
```

Enable auto-connection and verify it.

```
/services/auto-conn# set admin enable
/services/auto-conn# show config
admin state: ................. Enabled
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable      Use Alternate Mesh
-----------    ----------           ----------------      ----------------
up             up                   yes                   no
```

AP123 (Child AP of Mesh B)

Display the backhaul configuration.

```
/interface/wifi-1-1# show config backhaul
Slot: 1, Card Type: htm, revision: 1, Port: 1, Radio: HTMv1  5GHz 802.11n
admin state: ................. Enabled
channel: ..................... 153
  mimo: ...................... 1x1
  tx power: .................. 18.0 (dBm per-chain), 18.0 (dBm total)
antenna gain: ................ 5.0  (dBi)
link distance: ............... 1 (km)
tx aggregation:............... Enabled
base radio MAC : ............. 00:0d:67:10:f8:d7
Backhaul:
```

```
  Common:
    privacy: ................. Disabled
    mesh-min-rssi............. -100 (dbm)
  Stationary Backhaul:
    link admin state: ........ Enabled
    link id: ................. B20MeshB
    topology: ................ mesh
  Mobile Backhaul:
    mobile admin state: ...... Disabled
    mobile link id: ..........
    mobile link role: ........ ss
  Protection Backhaul:
    protection admin state: .. Disabled
Blacklist:
  No blacklist entries
Link Failure Detection: ...... Disabled
Backhaul T1 Bandwidth limit:.. Disabled
```

Display the mesh topology.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:0c:22:29 fwd  fwd   -49  wifi-1-1 180.7.4.121
```

Enable auto-connection and verify it.

```
/services/auto-conn# set admin enabled
/services/auto-conn# show config
admin state: ................. Enabled
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable      Use Alternate Mesh
-----------    ----------           ----------------      ----------------
up             down                 no                    no
```

AP121 (Egress AP of Mesh B)

Display the mesh topology.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:10:f8:d7 fwd  fwd   -41  wifi-1-1 180.7.4.123
```

Identify AP121 as an egress AP.

```
/system# set system-egress-point yes direct
/system# show system-egress-point
egress point:................. direct
```

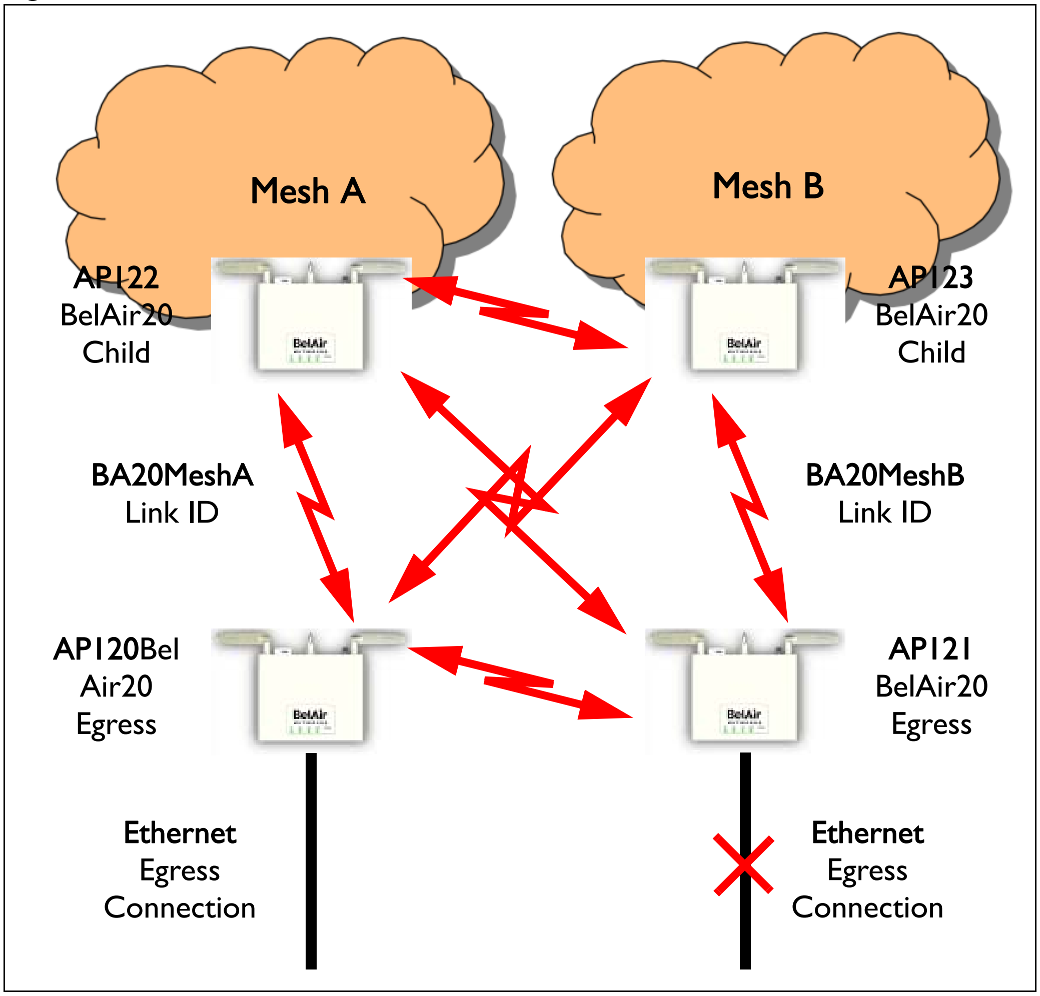
Enable auto-connection and verify it.

```
/services/auto-conn# set admin enable
/services/auto-conn# show config
admin state: ................. Enabled
/services/auto-conn# sh status
Oper State     Ether Link State     Egress Reachable      Use Alternate Mesh
-----------    ----------           ----------------      ----------------
up             up                   yes                   no
```

Fault Conditions

At this point, the Ethernet connection used by the Mesh B egress AP (AP121) becomes unavailable. The “Mesh B” APs (AP121 and AP123) connect to the Mesh A APs and all traffic flows through the Mesh A egress AP (AP120). AP121 and AP123 become members of Mesh A. See Figure 30 on page 304.

Figure 30: Auto-connection and Fault Conditions



AP120 (Egress AP of Mesh A)

Display the mesh topology.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac          State(L,R) RSSI Radio     Node IP       Node Name
 ----- ----------------- ---------- ---- -----     --------      ----------
 [S] 1 00:0d:67:10:e8:92 fwd  up    -46  wifi-1-1 180.7.4.122
 [S] 2 00:0d:67:0c:22:29 fwd  fwd   -36  wifi-1-1 180.7.4.121
 [S] 3 00:0d:67:10:f8:d7 fwd  up    -64  wifi-1-1 180.7.4.123
```

Display the auto-connect topology. It shows that the Mesh A egress AP still operates normally.

```
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable     Use Alternate Mesh
-----------    ----------           ----------------     ----------------
up             up                   yes                  no
```

AP122 (Child AP of Mesh A)

Display the mesh topology.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:0c:22:4b up   fwd   -51  wifi-1-1 180.7.4.120
 [S] 2 00:0d:67:0c:22:29 fwd  fwd   -41  wifi-1-1 180.7.4.121
 [S] 3 00:0d:67:10:f8:d7 fwd  up    -58  wifi-1-1 180.7.4.123
```

Display the auto-connect topology.

```
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable     Use Alternate Mesh
-----------    ----------           ----------------     ----------------
up             down                 yes                  no
```

AP123 (Child AP of Mesh B)

Display the backhaul configuration.

```
/interface/wifi-1-1# show config backhaul
Slot: 1, Card Type: htm, revision: 1, Port: 1, Radio: HTMv1  5GHz 802.11n
admin state: ................. Enabled
channel: ..................... 153
  mimo: ...................... 1x1
  tx power: .................. 18.0 (dBm per-chain), 18.0 (dBm total)
antenna gain: ................ 5.0  (dBi)
link distance: ............... 1 (km)
tx aggregation:............... Enabled
base radio MAC : ............. 00:0d:67:10:f8:d7
Backhaul:
  Common:
    privacy: ................. Disabled
    mesh-min-rssi............. -100 (dbm)
  Stationary Backhaul:
    link admin state: ........ Enabled
    link id: ................. B20MeshB
    topology: ................ mesh
  Mobile Backhaul:
```

```
    mobile admin state: ...... Disabled
    mobile link id: ..........
    mobile link role: ........ ss
  Protection Backhaul:
    protection admin state: .. Disabled
Blacklist:
  No blacklist entries
Link Failure Detection: ...... Disabled
Backhaul T1 Bandwidth limit:.. Disabled
```

Display the mesh topology.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:10:e8:92 up   fwd   -58  wifi-1-1 180.7.4.122
 [S] 2 00:0d:67:0c:22:29 fwd  fwd   -47  wifi-1-1 180.7.4.121
 [S] 3 00:0d:67:0c:22:4b up   fwd   -67  wifi-1-1 180.7.4.120
```

Display the auto-connect topology.

```
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable      Use Alternate Mesh
-----------    ----------           ----------------      ----------------
up             down                 yes                   yes
```

AP121 (Egress AP of Mesh B)

Display the auto-connect topology. It shows that it is using the alternate mesh as an egress point.

```
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable      Use Alternate Mesh
-----------    ----------           ----------------      ----------------
up             down                 yes                   yes
```

Recovery Conditions

At this point, the Ethernet connection used by the Mesh B egress AP (AP121) is re-established. Because it is an egress AP, AP121 automatically reverts back to its own mesh and begins to use the Ethernet connection to egress its traffic. However, its child APs (for example, AP123) continue to use the Mesh A egress AP until an explicit revert command is issued on each child you want to return to using AP121 as an egress.

AP121 (Egress AP of Mesh B)

Display the auto-connect topology after the Ethernet connection is re-established.

```
/services/auto-conn# show status
Oper State     Ether Link State     Egress Reachable      Use Alternate Mesh
-----------    ----------           ----------------      ----------------
up             up                   yes                   no
```

Display the AP's links to neighboring mesh, even after the Ethernet connection is re-established.

```
/services/auto-conn# show alternate-mesh
Alternate Mesh:
   Radio Interface --- wifi-1-1
   Mesh ID         --- B20MeshA
   Channel         --- 161
   Status          --- Up
```

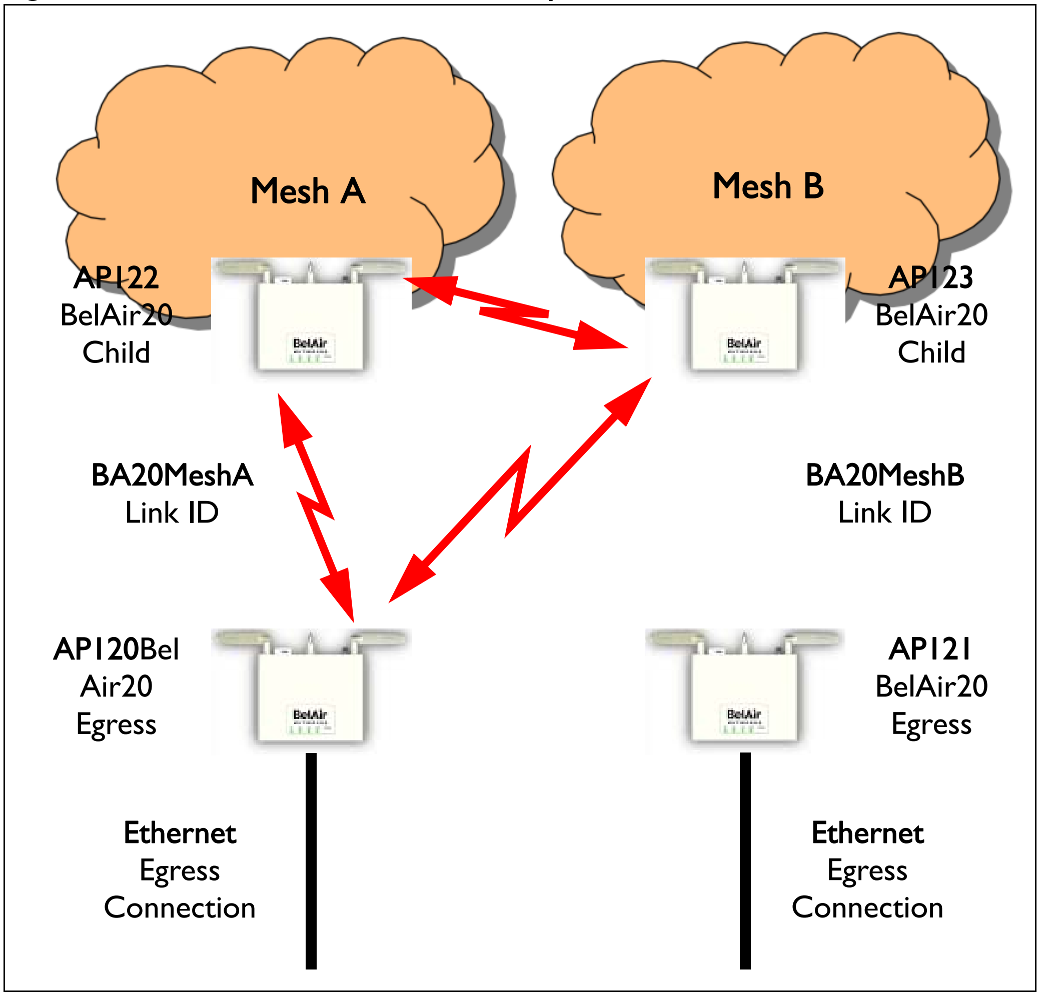
AP122 (Child AP of Mesh A)

Display the mesh topology after the Ethernet connection is re-established on AP121 but before the auto-connection revert command is given.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac         State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:0c:22:4b fwd  fwd   -49  wifi-1-1 180.7.4.120
 [S] 3 00:0d:67:10:f8:d7 fwd  fwd   -58  wifi-1-1 180.7.4.123
```

See Figure 31 on page 308.

Figure 31: Auto-connection after Recovery before Revert



Display the mesh topology after the Ethernet connection is re-established on AP121 and after the auto-connection revert command is given.

```
/interface/wifi-1-1# show backhaul status
WiFi backhaul states:: stationary=[Enabled] mobile=[Disabled] protection=[Disabled]
Backhaul Links:
 Link  Radio Mac          State(L,R) RSSI Radio    Node IP       Node Name
 ----- ----------------- ---------- ---- -----    --------      ----------
 [S] 1 00:0d:67:0c:22:4b fwd  fwd   -49  wifi-1-1 180.7.4.120
```

After the revert command is given, the mesh topology returns to that shown in Figure 29 on page 299.

Appendix C: Scripting Guidelines

This appendix provides guidance so you can create, manage and run scripts for BelAirOS™ platforms.

General Scripting Guidelines

This chapter introduces you to the concepts of creating and managing scripts for platforms that use the BelAirOS. The following sections are provided:

Overview

In general, a script is a series of programming language statements to allow control of one or more software applications or devices. Scripts are distinct from the core code of an application, as they are created by the end-user. Scripts are often interpreted, whereas the applications they control are traditionally compiled to native machine code.

For BelAirOS APs you can create scripts consisting of valid and supported CLI commands to:

- make repetitive tasks quicker and easier to do
- automate the configuration of an AP when it starts up

Your script file must contain special declarations for the following cases:

- If you want to specify and control physical interfaces, such as *wifi-1-1*, use the declarations described in "Specifying Physical Interfaces" on page 312.
- Depending on the CLI commands in your script, you may need to reboot the BelAirOS AP. If this case, use the declarations described in "Including a Reboot Command in a Script" on page 316.

Creating a BelAirOS Script

Use the following general guidelines to create a script file:

- Make sure the script contains only valid and supported CLI commands. If you are using an older script, make sure the CLI commands that it contains are still valid and supported.
- Some functions, such as Network Address Translation (NAT), require that you reboot the AP after you configure them. If your script is for auto-configuration at startup and if it must include the *reboot* command,

then your script must include special declarations. For details, see "Including a Reboot Command in a Script" on page 316.

Caution! Using the *reboot* command in an auto-configuration script without the correct declarations may cause the AP to enter a continuous *reboot* loop.

- Test the final script to ensure all commands are valid, syntactically correct and appropriate for the installed hardware. To help debugging, redirect the output of the script to a file. Use the optional *<output_file>* parameter of the *run script* command.

When you are satisfied with your script:

1 Put the final version of it on a TFTP, FTP or FTPS server to transfer the script file to the AP.

2 Use the commands described in "Manually Transferring Files to and from an AP" on page 310 to transfer the script to the APs you want to control.

3 Use the commands described in "Managing and Manually Running Script Files" on page 311 as required.

The process of downloading and running a script file on startup can be automated. For details, see the "AP Auto-configuration" on page 78.

Manually Transferring Files to and from an AP

Use the following CLI commands to manually transfer files, such as script files, to and from an AP:

```
/system/tftpget remoteip <ip_addr> remotefile <filename>
                                  [localfile <filename>]
/system/tftpput remoteip <ip_addr> localfile <filename>
                                   [remotefile <name>]
/system/getfile remoteip <ip_addr> remotefile <filename>
                [localfile <filename>]
                [{tftp|
                  ftp [user <username> password <password>]|
                  ftps [user <username> password <password>]}]
```

For the *tftpget* and *getfile* commands, if you do not specify a local file name, then the transferred file maintains the same name as on the remote file system.

For the *tftpput* command, if you do not specify a remote file name, then the transferred file maintains the same name as on the local file system.

For the *getfile* command:

- The default protocol is TFTP.
- For FTP, the default user name is *anonymous* and the default password is *root@* followed by the AP IP address. For example, if the AP has 148.16.4.123 as an IP address, then the default password is root@148.16.4.123.

- For FTPS, the default user name is the AP's MAC address stripped of colons. The default password is AP's MAC address stripped of colons, followed by @, followed by the AP IP address. For example, if the AP has 11:22:33:44:55:66 as a MAC address and 148.16.4.123 as an IP address, then the default user name is 112233445566 and the default password is 112233445566@148.16.4.123.

CAUTION! Do not use these commands to perform a software upgrade on an AP. Use the upgrade load command instead. Refer to "Performing a Software Upgrade" on page 246 for full details on performing software upgrades.

Managing and Manually Running Script Files

Use the following commands as required:

```
/system/copy script <script file> <copied file name>
/system/delete script <script file>
/system/rename script <script file> <new name>
/system/show script <script file>
```

```
list scripts
run script <scriptname> [<output_file>]
```

The *copy*, *delete*, *rename* and *show script* commands are available in *system* mode and allow you to manage and customize script files as you require.

The *list* and *run script* commands are available from any mode. The *list scripts* command displays the scripts that are available to you. The *run script* command allows you to execute a previously created script file.

Tip

If you have a simple script that does not specify physical interfaces and does not contain a *reboot* command, you can also run it by copying it and pasting it into a CLI session window. If you use this method:

1. Paste only 20 to 25 commands at a time. Otherwise, you may overfill the command buffer used for the CLI session. If you overfill the command buffer, you need to determine exactly which commands were executed and which were not before proceeding.
2. After pasting a block of commands, verify that your script behaved as expected; that is, that the pasted commands produced the expected configuration.
3. After verifying the script behavior, manually enter the *config-save* and *reboot* commands as required.

Specifying Physical Interfaces

If you want your script file to specify and control physical interfaces, such as *wifi-1-1*, then your script must contain the declarations described in the following sections:

- "Physical Interface Declaration Summary" on page 312
- "Physical Interface Declaration Specifications" on page 312

As well, this chapter contains examples of the setup, contents and results of a typical script.

Physical Interface Declaration Summary

Table 29 summarizes the declarations required in your script file to specify a physical interface.

Table 29: BelAir Networks Script Declaration Summary

Script Declaration	Description
`int[-<asbly>]-<iftype>[-<desc>]-<instance>`	Used to define a physical interface to which the following CLI commands apply to. For a definition of *<asbly>*, *<iftype>*, *<desc>*, and *<instance>*, see "Physical Interface Declaration Specifications" on page 312.
`/`	Precedes a CLI command that is not directed to the specified physical interface. The CLI command must start with a slash (/) followed by the mode(s) containing that command. For details, see "Physical Interface Declaration Specifications" on page 312.
`int-stop`	Terminates a command sequence associated with a previous declaration

Physical Interface Declaration Specifications

Script files can use the following method to ensure commands are applied to the correct physical interface:

1 Begin the command sequence by specifying the physical interface with the following declaration:

```
int[-<asbly>]-<iftype>[-<desc>]-<instance>
```

<asbly> specifies the AP's assembly code. This part of the declaration is optional. If provided, it must match at least part of the text in the *Assembly code* field output by the */system/show phyinv* command. <asbly> must start with *BelAir* or *BA*. See also "Common AP Assembly Codes" on page 319.

<iftype> specifies the type of physical interface. This part of the declaration is mandatory. It must be one of *wifi*, *wimax*, *pwe*, *eth* or *opt.*

<desc> specifies a description of the interface to uniquely identify it. This part of the declaration is optional. If provided, it must be at least three characters long and match at least part of the text in the *Description* field in the Physical Interface Table output by the */system/show phyinv* command. See also "Common Radio Card Descriptions" on page 320.

<instance> specifies which instance of the interface to apply the commands to. It must be a digit between 1 and 127.

Use a dash (**-**) to separate each part in the declaration.

The system uses the information in your declaration to determine which physical interface the following commands apply to.

2 List the CLI commands. These may be commands directed to the physical interface specified by step 1 or they may be other commands. Any commands not directed to the specified physical interface must start with a slash (/) followed by the mode(s) containing that command. In all cases, make sure you follow the guidelines in "Creating a BelAirOS Script" on page 309.

3 Terminate the command sequence with the following declaration:

```
int-stop
```

If the AP cannot identify a physical interface based on the information in the *int* declaration, then it skips the list of commands and continues executing the script after the *int-stop* declaration.

The following example shows the setup, script and output of a typical application of this functionality for a BelAir100T.

Physical Interface Script Example - Setup

The following output of the *show phyinv* command shows the configuration of the BelAir100T where the script will run:

```
/system# show phyinv

System Name:     BelAir100T

Type         Class        Serial number          Assembly code              BA order code
BelAir100    triRadios    BELAB0407             BELAIR100T_20-BC08         1TNYYXJ0KXX31-H
```

```
Physical Inventory Table
Slot  Card type        Version  Serial number    Assembly code
   1  LPM              2.2.8    K002092633       B2CH082AA-B B08
   2  BRM              3.2.1    K001362023       B2CC033AA-B B01
   3  BRM              3.2.1    A000003408       B2CC033AA-B B01

Physical Interface Table
Name        Type                      Slot  Card type    Description
wifi-1-1    Wifi 802.11                  1  LPM          LPMv2 4.9GHz 802.11a
eth-1-1     Ethernet                     1  LPM          1x100baseTx  [Electrical: Single]
wifi-2-1    Wifi 802.11                  2  BRM          BRMv3 5GHz 802.11a
wifi-3-1    Wifi 802.11                  3  BRM          BRMv3 5GHz 802.11a
```

Physical Interface Script Example - Script

The following is a listing of the script contents:

```
int-wifi-2.4GHz-1
set channel 11
set admin-state enabled
show config
int-stop

int-wifi-4.9GHz-1
set channel 10
set admin-state disabled
show config
int-stop

int-wifi-5GHz-1
set channel 155
set backhaul admin-state disabled
show config
int-stop

int-wifi-5GHz-2
set channel 148
set backhaul admin-state disabled
show config
int-stop

int-BELAIR100T_20-wifi-5GHz-1
show config
int-stop

int-BELAIR20-11-wifi-5GHz-1
show config
int-stop

int-BELAIR100-wifi-1
show config
int-stop
```

Physical Interface Script Example - Output

The following shows the output generated by the script:

```
Unknown interface ---> int-wifi-2.4GHz-1, skipping
```

```
Interface stop
/#

Interface int-wifi-4.9GHz-1 ---> /interface/wifi-1-1/ start
/# /interface/wifi-1-1/set channel 10

/# /interface/wifi-1-1/set admin-state disabled

/# /interface/wifi-1-1/show config

Slot: 1, Card Type: lpm, revision: 2, Port: 1, Radio: LPMv2 4.9GHz 802.11a
admin state: ................. Disabled
frequency band: .............. 4900MHz SchemeA
channel: ..................... 10
  tx power: .................. 20.0 (dBm)
  bandwidth: ................. 10.0 (MHz)
antenna gain: ................ 9.5  (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:00:48:52

Interface stop
/#

Interface int-wifi-5GHz-1 ---> /interface/wifi-2-1/ start
/# /interface/wifi-2-1/set channel 155

/# /interface/wifi-2-1/set backhaul admin-state disabled

/# /interface/wifi-2-1/show config

Slot: 2, Card Type: brm, revision: 3, Port: 1, Radio: BRMv3 5GHz 802.11a
admin state: ................. Enabled
channel: ..................... 155
  tx power: .................. 20.0 (dBm)
  tx-power-optimize: ......... Disabled
antenna gain: ................ 10.5 (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:00:44:49
Interface stop
/#

Interface int-wifi-5GHz-2 ---> /interface/wifi-3-1/ start
/# /interface/wifi-3-1/set channel 148

/# /interface/wifi-3-1/set backhaul admin-state disabled

/# /interface/wifi-3-1/show config

Slot: 3, Card Type: brm, revision: 3, Port: 1, Radio: BRMv3 5GHz 802.11a
admin state: ................. Enabled
channel: ..................... 148
  tx power: .................. 20.0 (dBm)
  tx-power-optimize: ......... Disabled
antenna gain: ................ 10.5 (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:00:c4:6b
```

```
Interface stop
/#

Interface int-BELAIR100T_20-wifi-5GHz-1 ---> /interface/wifi-2-1/ start
/# /interface/wifi-2-1/show config

Slot: 2, Card Type: brm, revision: 3, Port: 1, Radio: BRMv3 5GHz 802.11a
admin state: ................. Enabled
channel: ..................... 155
  tx power: .................. 20.0 (dBm)
  tx-power-optimize: ......... Disabled
antenna gain: ................ 10.5 (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:67:00:44:49

Interface stop
/#
assembly code tag does not match
Unknown interface ---> int-BELAIR20-11-wifi-5GHz-1, skipping
Interface stop
/#

Interface int-BELAIR100-wifi-1 ---> /interface/wifi-1-1/ start
/# /interface/wifi-1-1/show config

Slot: 1, Card Type: lpm, revision: 2, Port: 1, Radio: LPMv2 4.9GHz 802.11a
admin state: ................. Disabled
frequency band: .............. 4900MHz SchemeA
channel: ..................... 10
  tx power: .................. 20.0 (dBm)
  bandwidth: ................. 10.0 (MHz)
antenna gain: ................ 9.5  (dBi)
link distance: ............... 1 (km)
base radio MAC : ............. 00:0d:5e:36:88:ff

Interface stop
/#
```

Including a Reboot Command in a Script

Some functions, such as Network Address Translation (NAT), require that you reboot the AP after you configure them. If your script must include a *reboot* command, then your script must contain the declarations described in the following sections:

- "Reboot Declaration Summary" on page 317
- "Reboot Declaration Specification" on page 317

As well, this chapter contains a typical script as an example.

Reboot Declaration Summary

Table 29 summarizes the declarations required in your script if it needs to include a *reboot* command.

Table 30: Script Declaration Summary for Reboot Command

Script Declaration	Description
`check-db-change-start`	Verifies and records whether the following commands change the AP's settings. For details, see "Reboot Declaration Specification" on page 317
`check-db-change-stop`	Stops verifying whether commands change the AP's settings. For details, see "Reboot Declaration Specification" on page 317
`int-db-change-start`	Used in conjunction with the previous *check-db-change* declarations. The *int-db-change-start* declaration instructs the AP to execute the commands that follow if the AP's settings have changed. For details, see "Reboot Declaration Specification" on page 317
`int-stop`	Terminates a command sequence associated with a previous declaration

Reboot Declaration Specification

If your script must include the *reboot* command, then your script must include the declarations described in this section.

Caution! Using the *reboot* command in an auto-configuration script without the correct declarations may cause the AP to enter a continuous *reboot* loop.

The declarations for using the *reboot* command in a script are an extension of those for specifying a physical interface in a script. See "Specifying Physical Interfaces" on page 312.

The declarations are:

- *check-db-change-start*. This declaration verifies and records whether the following commands change the AP's settings. It ignores commands that change a setting to be the current setting. For example, if a physical interface's administrative state is enabled, the s*et admin-state enabled* command for that physical interface is ignored.
- *check-db-change-stop*. This declaration stops verifying whether commands change the AP's setting.

- *int-db-change-start*. This declaration is used with the previous *check-db-change* declarations. The *int-db-change-start* declaration instructs the AP to execute the commands that follow if the AP's settings have changed.

Typically, your script uses the declarations in the following sequence:

1 Use valid CLI commands and physical interface declarations as required.
2 Use the *config-save* command to save the changes to this point to the AP's database.
3 Include the *check-db-change-start* declaration. (Begin recording whether the following commands change the APs settings.)
4 Use the CLI commands for the functionality that requires a reboot, for example */protocol/nat/set* commands.
5 Include the *check-db-change-stop* declaration. (Stop recording whether the following commands change the AP's settings.)
6 Use more valid CLI commands and physical interface declarations as required.
7 At the end of the script, include the *int-db-change-start* declaration.
8 Use the *config-save* command to save any remaining changes to the AP's database.
9 Include the */system/reboot* CLI command.
10 Include *y*. (Confirm the reboot.)
11 Include the *int-stop* declaration, as a terminator for the *int-db-change-start* declaration.

The first time the auto-configuration script is run (during initial startup), the *check-db-change-start* and *check-db-change-stop* declarations record the fact that the NAT commands have changed NAT settings. The condition for the *int-db-change-start* declaration is therefore true. The *config-save* and *reboot* commands at the end of the script are executed. The second time the auto-configuration script is run (during the second startup), the NAT commands do not change the NAT settings. Hence the condition for the *int-db-change-start* declaration is false, and the *config-save* and *reboot* commands at the end of the script are not executed.

Reboot Script Example

The following is a listing of a typical script:

```
int-wifi-2.4GHz-1
set channel 11
set admin-state enabled
```

```
show config
int-stop

int-wifi-5GHz-1
set channel 155
set backhaul admin-state disabled
show config

config-save

int-BELAIR-20
check-db-change-start
/protocol/nat/set scope 1 dhcp-server vlan 401 based-ip 45.89.233.0 lease-time 30
/protocol/nat/set scope 1 status enabled
/protocol/nat/set admin-state enabled
check-db-change-stop
int-stop

int-db-change-start
config-save
/system/reboot
y
int-stop
```

Common AP Assembly Codes

This section lists the most common AP assembly codes that can be used when specifying a physical interface in a script. Additional assembly codes are possible. For details, contact your BelAir Networks representative.

Table 31: Common AP Assembly Codes

AP	Assembly Code
BelAir200-12	BELAIR200_12
BelAir200-13	BELAIR200_13
BelAir200-04	BELAIR200_04
BelAir200-13R	BELAIR200_13R
BelAir100-10	BELAIR100_10
BelAir100-11	BELAIR100_11
BelAir100M-10	BELAIR100M_10
BelAir100M-11	BELAIR100M_11

Table 31: Common AP Assembly Codes (Continued)

AP	Assembly Code
BelAir100T-12	BELAIR100T_12
BelAir100T-21	BELAIR100T_21
BelAir100T-12R	BELAIR100T_12R
BelAir100T-21R	BELAIR100T_21R
BelAir100S-10	BELAIR100S_10
BelAir100S-11	BELAIR100S_11
BelAir100N-10	BA100N-10
BelAir100N-11	BA100N-11
BelAir100N-10R	BA100N-10R
BelAir100N-11R	BA100N-11R
BelAir100SN-10	BA100SN-10
BelAir100SN-11	BA100SN-11
BelAir100SN-10R	BA100SN-10R
BelAir100SN-11R	BA100SN-11R
BelAir20-11	BELAIR20-11

Common Radio Card Descriptions

This section lists the most common card descriptions for radios so you can specify a physical interface in a script. Additional card descriptions are possible. For details contact your BelAir Networks representative.

Table 32: Common Radio Card Descriptions

Card	Description	Notes
ARMv3	ARMv3 2.4GHz 802.11b/g	
BRMv3	BRMv3 5GHz 802.11a	
BRMv4	BRMv4 5GHz 802.11a	
ERMv1	ERMv1 5GHz Multiband 802.11a	
ERMv2	ERMv2 5GHz 802.11a	
ERMv5	ERMv5 5GHz 802.11n	
PSMv1	PSMv1 4.9GHz 802.11a	
PSMv2	LPMv2 4.9GHz 802.11a	
WRMv1	WRMv1 2.3GHz 5MHz 802.16d	
WRMv2	WRMv2 2.5GHz 5MHz 802.16d	
WRMv3	WRMv3 2.5GHz 10MHz 802.16d	
MRMv1	MRMv1 4.4GHz 802.11n	
HTMv1	HTMv1 5GHz 802.11n	5-GHz radio
	HTMv1 2.4GHz 802.11n	2.4-GHz radio
HTMEv1	HTMEv1 5GHz 802.11n	5-GHz radio
	HTMEv1 2.4GHz 802.11n	2.4-GHz radio
DRUv1	DRUv1 5GHz 802.11n	5-GHz radio
	DRUv1 2.4GHz 802.11n	2.4-GHz radio
DRUv2	DRUv2 5GHz 802.11n	5-GHz radio
	DRUv2 2.4GHz 802.11n	2.4-GHz radio
DRUv3	DRUv3 2.4GHz 802.11n	2.4-GHz radio

Table 32: Common Radio Card Descriptions (Continued)

Card	Description	Notes
DRUv4	DRUv4 5GHz 802.11n	5-GHz radio
	DRUv4 2.4GHz 802.11n	2.4-GHz radio
DRUv5	DRUv5 5GHz 802.11n	5-GHz radio
	DRUv5 2.4GHz 802.11n	2.4-GHz radio
DRUEv1	DRUEv1 5GHz 802.11n	5-GHz radio
	DRUEv1 2.4GHz 802.11n	2.4-GHz radio

Sample Universal Auto-configuration Script

The following script can be used to auto-configure at startup multiple types of BelAir Networks APs, such as the BelAir20, where each type of AP can have different types of radios such as 5-GHz 802.11a radios, 2.4-GHz 802.11g radios and 2.4-GHz 802.11n radios.

```
/protocol/ip/set dhcp-accept dns-domain enable
/protocol/ip/set dhcp-accept dns-server enable
/protocol/ip/set dhcp-accept tftp-download enable
/protocol/ip/set dhcp-accept time-server dis
/protocol/ip/set dhcp-accept time-offset dis
/protocol/ip/set ip-addr-notification enabled
/protocol/te-syst/add tunnel 1 ip xxx.xxx.xxx.xxx name name1
/protocol/te-syst/set engine admin-state enabled
/protocol/snmp/set community 1 community-name commu1 ipaddr xxx.xxx.xxx.xxx privilege
readonly
/protocol/snmp/set community 2 community-name commu2 ipaddr 0.0.0.0 privilege readwrite
/protocol/snmp/set community 3 community-name commu3 ipaddr xxx.xxx.xxx.xxx privilege
readwrite
/protocol/snmp/set trap 1 mgr-addr xxx.xxx.xxx.xxx community commu1 version v2
/protocol/snmp/set trap 2 mgr-addr xxx.xxx.xxx.xxx community commu2 version v2
/protocol/snmp/set trap 3 mgr-addr xxx.xxx.xxx.xxx community commu2 version v2
/protocol/snmp/set trap 4 mgr-addr xxx.xxx.xxx.xxx community commu3 version v2
/protocol/sntp/set ip-address primary xxx.xxx.xxx.xxx
/protocol/sntp/set ip-address secondary xxx.xxx.xxx.xxx
/protocol/sntp/set timeoffset -5
/protocol/sntp/set status enabled

#int-cm-1
#/card/cm-9/set attenuation downstream mode auto
#/card/cm-9/set attenuation upstream mode auto
#int-stop

int-wifi-5Ghz-1
set qos wmm enabled
set qos mapping both
```

```
set rts-cts 2347
set backhaul admin-state disabled
set admin-state enabled
int-stop

int-wifi-5Ghz 802.11n-1
set tx-power 17
set antenna-gain 8
set mimo-mode 2x2
set channel 149
set arp-filter enable
set max-num-clients 50
set dhcp unicast enable
set ap-oos enable
set deauth dos defense disabled
set ssid 2 service-set-identifier dummy broadcast vlan none
set ssid 1 service-set-identifier superwifi broadcast vlan 801
set ssid 1 wireless-bridge disabled
set ssid 1 privacy none
set ssid 1 group-address-filter ipv4
set ssid 1 secure-port disabled
set ssid 1 admin-state enabled
set ssid 2 service-set-identifier optimumwifi broadcast vlan 800
set ssid 2 wireless-bridge disabled
set ssid 2 privacy none
set ssid 2 group-address-filter ipv4
set ssid 2 secure-port disabled
set ssid 2 admin-state enabled
set ssid 3 service-set-identifier maxwifi broadcast vlan 832
set ssid 3 wireless-bridge disabled
set ssid 3 privacy none
set ssid 3 group-address-filter ipv4
set ssid 3 secure-port disabled
set ssid 3 admin-state enabled
int-stop

int-BELAIR20-11-wifi-5Ghz-1
set tx-power 18
set antenna gain 5
set mimo-mode 3x3
set channel 149
int-stop

int-wifi-5Ghz 802.11a-1
set ap admin-state disabled
set admin-state enabled
int-stop

int-wifi-2.4Ghz-1
set qos wmm enabled
set qos mapping both
set rts-cts 2347
set ssid 2 service-set-identifier dummy broadcast vlan none
set ssid 1 service-set-identifier superwifi broadcast vlan 201
set ssid 1 wireless-bridge disabled
set ssid 1 privacy none
```

```
set ssid 1 group-address-filter ipv4
set ssid 1 secure-port disabled
set ssid 1 admin-state enabled
set ssid 2 service-set-identifier ultrawifi broadcast vlan 200
set ssid 2 wireless-bridge disabled
set ssid 2 privacy none
set ssid 2 group-address-filter ipv4
set ssid 2 secure-port disabled
set ssid 2 admin-state enabled
set ssid 3 service-set-identifier maxwifi broadcast vlan 245
set ssid 3 wireless-bridge disabled
set ssid 3 privacy none
set ssid 3 group-address-filter ipv4
set ssid 3 secure-port disabled
set ssid 3 admin-state enabled
set backhaul admin-state disabled
set admin-state enabled
int-stop

int-wifi-2.4Ghz 802.11n-1
set channel auto
set tx-power 23
set antenna-gain 8
set mimo-mode 2x2
set arp-filter enable
set max-num-clients 50
set dhcp unicast enable
set ap-oos enable
set deauth dos defense disabled
int-stop

int-BELAIR20-11-wifi-2.4Ghz-1
set tx-power 20
set antenna gain 5
set mimo-mode 3x3
int-stop

int-wifi-2.4Ghz 802.11b/g-1
set qos schedule edca
set tx-power 27
set antenna-gain 8
set profile mixed_b_g
int-stop

/system/add egress vlan untagged
/interface/eth-1-1/add vlan untagged

/protocol/te-syst/map vlan 200 to 1
/protocol/te-syst/map vlan 201 to 1
/protocol/te-syst/map vlan 245 to 1

/protocol/te-syst/limit tunnel 1 bandwidth transmit 1500000 receive 1500000
/protocol/te-syst/set tunnel 1 bandwidth-limit upstream 1500000 downstream 1500000

config-save
```

Appendix D: Alarm and Event Definitions

Table 33 describes the alarms and events that are displayed by the user interface.

Table 33: User Interface Alarms

Id	Alarm Description
1	Text: Temperature above high temperature threshold Trigger condition: Internal temperature is above 85 degree C. Severity: Major Trap OID Name: belairSysTemperatureChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.3 MIB Module: BELAIR-SYSTEM
2	Text: Temperature below low temperature threshold Trigger condition: Internal temperature is below -40 degree C. Severity: Major Trap OID Name: belairSysTemperatureChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.3 MIB Module: BELAIR-SYSTEM
3	Text: Temperature sensor malfunction Trigger condition: System cannot read the temperature sensor. Severity: Major Trap OID Name: belairSysTemperatureChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.3 MIB Module: BELAIR-SYSTEM
4	Text: Card failed Trigger condition: One of the AP's cards has failed. Severity: Critical Trap OID Name: belairCardStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.7 MIB Module: BELAIR-SYSTEM

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
6	Text: SNTP server not available Trigger condition: System has lost contact with the SNTP server. Severity: Minor Trap OID Name: belairSntpOperStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.1 MIB Module: BELAIR-SYSTEM
7	Text: Software download in progress Trigger condition: User entered the *upgrade* command to start software upgrade. Severity: Warning Trap OID Name: belairSwMgmtStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.2 MIB Module: BELAIR-SYSTEM
8	Text: Software download failed Trigger condition: A software download operation has failed. Severity: Warning Trap OID Name: belairSwMgmtStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.2 MIB Module: BELAIR-SYSTEM
12	Text: System management software started Trigger condition: Management software has successfully started up. Severity: Info Trap OID Name: belairSysGenericTrap Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.6 MIB Module: BELAIR-SYSTEM

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
15	Text: Link Down Trigger condition: Lost backhaul link connectivity. Severity: Critical Trap OID Name: linkDown/linkUp Trap OID Numeric: 1.3.6.1.6.3.1.1.5.3/4 MIB Module: IF-MIB
20	Text: Battery active. Main power failure. Trigger condition: Lost main power and switched to battery operation. Severity: Critical Trap OID Name: belairSysBatteryStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.4 MIB Module: BELAIR-SYSTEM
21	Text: Battery missing. Trigger condition: Battery is not present. Severity: Warning Trap OID Name: belairSysBatteryStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.4 MIB Module: BELAIR-SYSTEM

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
22	Text: Battery charging, voltage low. Trigger condition: Low battery voltage detected while main power is still active. For BelAir200, alarm is set when battery voltage is less than 11.0 V. Clears when voltage is greater than 11.3 V. For all other platforms, alarm is set when battery voltage is less than 7.65 V. Clears when voltage is greater or equal to 7.75 V. Severity: Minor Trap OID Name: belairSysBatteryStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.4 MIB Module: BELAIR-SYSTEM
23	Text: Battery active, voltage low. Trigger condition: Low battery voltage detected and main power has failed. For BelAir200, alarm is set when battery voltage is less than 11.0 V. Clears when voltage is greater than 11.3 V. For all other platforms, alarm is set when battery voltage is less than 7.65 V. Clears when voltage is greater or equal to 7.75 V. Severity: Major Trap OID Name: belairSysBatteryStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.4 MIB Module: BELAIR-SYSTEM

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
24	Text: Battery charging, voltage critically low. Trigger condition: Battery voltage has dropped below critical level while main power is still active. For BelAir200, alarm is set when battery voltage is less than 10.6 V. Clears when voltage is greater than 10.9 V. For all other platforms, alarm is set when battery voltage is less than 7.55 V. Clears when voltage is greater or equal to 7.65 V. Severity: Minor Trap OID Name: belairSysBatteryStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.4 MIB Module: BELAIR-SYSTEM
25	Text: Battery active, voltage critically low. Trigger condition: Battery voltage has dropped below critical level and main power has failed. For BelAir200, alarm is set when battery voltage is less than 10.6 V. Clears when voltage is greater than 10.9 V. For all other platforms, alarm is set when battery voltage is less than 7.55 V. Clears when voltage is greater or equal to 7.65 V. Severity: Critical Trap OID Name: belairSysBatteryStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.4 MIB Module: BELAIR-SYSTEM

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
26	Text: Radar detected on channel X Trigger condition: Radar detected. Severity: Warning Trap OID Name: belairGenericInterfaceTrap Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.10 MIB Module: BELAIR-SYSTEM
27	Text: Channel switch from X to Y without peer acknowledgment Trigger condition: No acknowledge channel switch Severity: Warning Trap OID Name: N/A Trap OID Numeric: N/A MIB Module: N/A
28	Text: Peer initiated channel switch from X to Y Trigger condition: Peer initiated channel switch Severity: Warning Trap OID Name: N/A Trap OID Numeric: N/A MIB Module: N/A
46	Text: Mesh link down Trigger condition: One of the links in the multipoint-to-multipoint topology has lost connectivity. Severity: Info Trap OID Name: linkDown/linkUp Trap OID Numeric: 1.3.6.1.6.3.1.1.5.3/4 MIB Module: IF-MIB

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
49	Text: Manual reboot. Trigger condition: User entered card *reboot* command (instead of an AP *reboot* command). Severity: Info Trap OID Name: belairCardStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.7 MIB Module: BELAIR-SYSTEM
50	Text: Admin down. Trigger condition: User has set card to *admin down* state. Severity: Info Trap OID Name: belairCardStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.7 MIB Module: BELAIR-SYSTEM
51	Text: Communication failure. Trigger condition: System has lost communication with a card. Severity: Critical Trap OID Name: belairCardStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.7 MIB Module: BELAIR-SYSTEM
52	Text: Link down. Trigger condition: One of the links in the star topology has lost connectivity. Severity: Critical Trap OID Name: linkDown/linkUp Trap OID Numeric: 1.3.6.1.6.3.1.1.5.3/4 MIB Module: IF-MIB

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
53	Text: Link down. Trigger condition: One of the links in the point-to-point topology has lost connectivity. Severity: Critical Trap OID Name: linkDown/linkUp Trap OID Numeric: 1.3.6.1.6.3.1.1.5.3/4 MIB Module: IF-MIB
56	Text: Radar blackout on channel X end Trigger condition: Radar blackout has ended Severity: Info Trap OID Name: belairGenericInterfaceTrap Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.10 MIB Module: BELAIR-SYSTEM
59	Text: Interface down. Trigger condition: Cable modem interface fails to respond. Severity: Critical Trap OID Name: linkDown/linkUp Trap OID Numeric: 1.3.6.1.6.3.1.1.5.3/4 MIB Module: IF-MIB
61	Text: Tunnel X down Trigger condition: Tunnel down Severity: Critical Trap OID Name: baTunnelStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.5.1.2.0.1 MIB Module: BELAIR-TUNNEL

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
62	Text: Tunnel X - Main becomes active Trigger condition: Main tunnel active Severity: Info Trap OID Name: baTunnelStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.5.1.2.0.1 MIB Module: BELAIR-TUNNEL
63	Text: Tunnel X - Backup becomes active Trigger condition: Backup tunnel is active Severity: Info Trap OID Name: baTunnelStatusChange Trap OID Numeric: 1.3.6.1.4.1.15768.5.1.2.0.1 MIB Module: BELAIR-TUNNEL
65	Text: SNMP authentication failure Trigger condition: Authentication failure from SNMP requests Severity: Info Trap OID Name: authenticationFailure Trap OID Numeric: 1.3.6.1.6.3.1.5.5 MIB Module: SNMPv2-MIB.mib
71	Text: Egress node not reachable Trigger condition: Cannot reach egress AP Severity: Critical Trap OID Name: N/A Trap OID Numeric: N/A MIB Module: N/A

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
72	Text: Use alternate mesh link to reach egress AP Trigger condition: An alternate mesh link was used to reach the egress AP Severity: Major Trap OID Name: N/A Trap OID Numeric: N/A MIB Module: N/A
82	Text: PLL Lock Detect Failed Trigger condition: PLL Lock Detect Failed Severity: Critical Trap OID Name: belairGenericInterfaceTrap Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.10 MIB Module: BELAIR-SYSTEM
83	Text: Tx Power Failed Trigger condition: Radio transmit power failure Severity: Critical Trap OID Name: belairGenericInterfaceTrap Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.10 MIB Module: BELAIR-SYSTEM
84	Text: No primary link available Trigger condition: No primary link is available Severity: Critical Trap OID Name: noPrimaryLinkAvailable Trap OID Numeric: 1.3.6.1.4.1.15768.6.6.2.0.1 MIB Module: BELAIR-MOBILITY

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
85	Text: No secondary link available Trigger condition: No secondary link is available Severity: Major Trap OID Name: noSecondaryLinkAvailable Trap OID Numeric: 1.3.6.1.4.1.15768.6.6.2.0.2 MIB Module: BELAIR-MOBILITY
86	Text: Switchover to [radio-link-name-Y] from [radio-link-name-Y] (for example, wifi2-1-1) Trigger condition: Switchover from primary to secondary link Severity: Info Trap OID Name: primarySecondarySwitchover Trap OID Numeric: 1.3.6.1.4.1.15768.6.6.2.0.3 MIB Module: BELAIR-MOBILITY
88	Text: IP address changed Trigger condition: IP address change Severity: Info Trap OID Name: belairIpAddressChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.2.2.0.1 MIB Module: BELAIR-IP
89	Text: System configuration changed Trigger condition: Configuration change Severity: Info Trap OID Name: belairConfigChange Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.8 MIB Module: BELAIR-SYSTEM

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
90	Text: Cable modem IP address changed Trigger condition: Cable modem configuration change Severity: Info Trap OID Name: belairCmIpAddressChange Trap OID Numeric: 1.3.6.1.4.1.15768.6.4.2.0.1 MIB Module: BE BELAIR-CABLE-MODEM
91	Text: Secure MAC [AA:BB:CC:DD:EE:FF] spoof Trigger condition: The AP has detected a secure MAC address spoof attack. Severity: Warning Trap OID Name: belairDot11SecureMacSpoofed Trap OID Numeric: : 1.3.6.1.4.1.15768.4.2.0.1 MIB Module: BELAIR-IEEE802DOT11
92	Text: DHCP attack Trigger condition: The AP has detected a secure DHCP starvation attack. Severity: Warning Trap OID Name: belairDot11DhcpAttack Trap OID Numeric: 1.3.6.1.4.1.15768.4.2.0.2 MIB Module: BELAIR-IEEE802DOT11
93	Text: 1-2, 00:01:23:45:67:89 Authenticated Trigger condition: Radio has authenticated a client Severity: Info Trap OID Name: belairDot11ClientAuthenticated Trap OID Numeric: 1.3.6.1.4.1.15768.4.7.2.0.1 MIB Module: BELAIR-IEEE802DOT11-CLIENT **Note:** Due to the frequency of client authentication traps, this trap does not appear in the alarm history.

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
98	Text: Authentication fail: IP_ADDRESS [detail] Trigger condition: Authentication failure when user logs in through CLI or Web interface. Severity: Info Trap OID Name: belairAuthenticationFailure Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.2.0.9 MIB Module: BELAIR-SYSTEM
99	Text: Authentication fail: <%s> [%s] Trigger condition: STP Topology change Severity: Info Trap OID Name: baRstpTopologyChanged Trap OID Numeric: 1.3.6.1.4.1.15768.5.2.2.0.1 MIB Module: BELAIR-RSTP
100	Text: Configuration change unsaved Trigger condition: Unsaved configuration change Severity: Warning Trap OID Name: belairSysConfigUnsaved Trap OID Numeric: 1.3.6.1.4.1.15768.3.1.1.2.16 MIB Module: BELAIR-SYSTEM
103	Text: Protection link down, link x peer 00:0d:67:12:34:56 Trigger condition: When link status for a backhaul protection link changes Severity: Info Trap OID Name: linkDown/linkUp Trap OID Numeric: 1.3.6.1.6.3.1.1.5.3/1.3.6.1.6.3.1.1.5.4 MIB Module: IF-MIB

Table 33: User Interface Alarms (Continued)

Id	Alarm Description
105	Text: Mobile link down, link x peer 00:0d:67:12:34:56 Trigger condition: When link status for a mobile link changes Severity: Info Trap OID Name: linkDown/linkUp Trap OID Numeric: 1.3.6.1.6.3.1.1.5.3/1.3.6.1.6.3.1.1.5.4 MIB Module: IF-MIB
107	Text example: IP address notification Trigger condition: Generated every 10 minutes when *set ip-address notification* is enabled Severity: Info Trap OID Name: belairIpAddressNotification Trap OID Numeric: 1.3.6.1.4.1.15768.3.2.2.0.2 MIB Module: BELAIR-IP
108	Text: 1-2, 00:01:23:45:67:89 Deauthenticated Trigger condition: Client has dissasociated from radio (de-authenticated) Severity: Info Trap OID Name: belairDot11ClientDeauthenticated Trap OID Numeric: 1.3.6.1.4.1.15768.4.7.2.0.2 MIB Module: BELAIR-SYSTEM **Note:** Due to the frequency of client deauthication traps, this trap does not appear in the alarm history.

Appendix E: Resetting to Factory Defaults

You can reset the configuration of an AP to the factory default settings by using a CLI command. For the BelAir20, BelAir100i WCS and the BelAir20E, you can also press a reset button on the AP.

Typically, you would reset to factory defaults only when all other methods of changing the AP's configuration have failed. The reset button is used when there is no way of communicating to the AP.

Resetting to Factory Defaults with a CLI Command

If you are logged in as *root* and have access to *system* commands, you can reset the AP to the factory defaults.

CAUTION! By performing the following procedure, all local configuration data will be replaced by default factory settings. You will not be able to recover any local configuration data.

CAUTION! You may not able to reestablish connectivity to a remotely located AP after you execute this procedure.

Use the following command sequence:

```
cd /system
syscmd restoreDefaultConfig
reboot
```

Note: The parameters of the *syscmd* command are case sensitive.

Resetting to Factory Defaults with the Reset Button

This procedure applies to the BelAir20, BelAir100i WCs and the BelAir20E only.

To perform this procedure, you need physical access to the AP.

CAUTION! By performing the following procedure, all local configuration data will be replaced by default factory settings. You will not be able to recover any local configuration data.

BelAir20, BelAir100i WCS and BelAir20E

To reset the AP configuration to factory defaults, do the following steps:

1 Access the AP rear panel. You may need to detach it from its mounting bracket.

2 With a pen tip or paperclip, gently press the AP's reset button for more than 15 seconds. Refer to Figure 32 and Figure 33.

Figure 32: BelAir20 and BelAir100i WCS Rear Panel with Reset Button

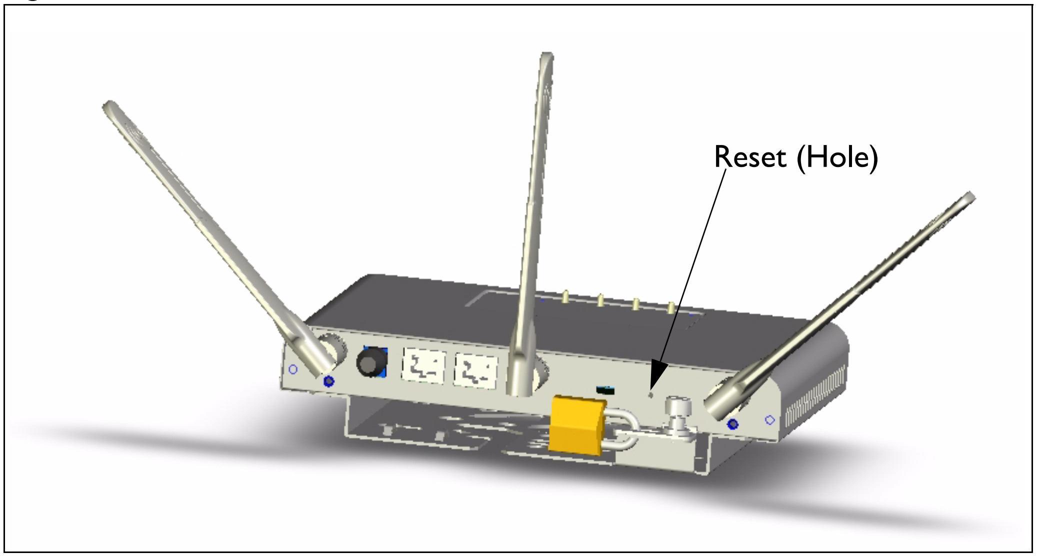
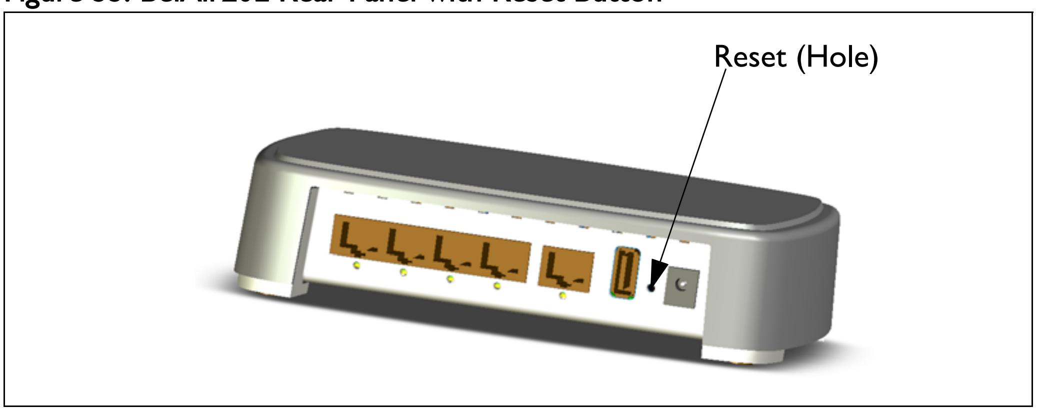


Figure 33: BelAir20E Rear Panel with Reset Button



3 If necessary, re-attach the AP to its mounting bracket.

BelAir100N, BelAir100SN, BelAir100SNE and BelAir2100

To reset the AP configuration to factory defaults, do the following steps:

1 Access the AP connector field:

—For the BelAir100N, see Figure 34 on page 341.

—For the BelAir100SN, see Figure 35 on page 342.

—For the BelAir100SNE, see Figure 36 on page 343.

—For the BelAir2100, see Figure 37 on page 344.

Figure 34: BelAir100N Connector Field

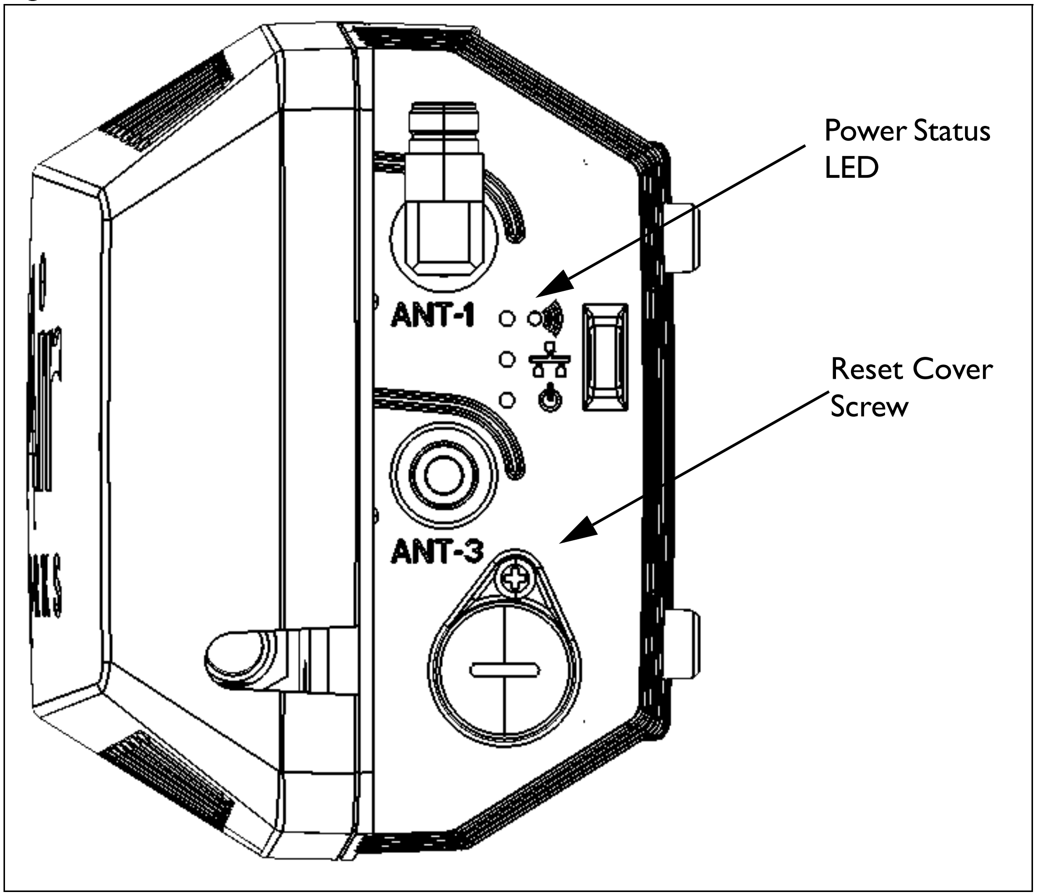


Figure 35: BelAir100SN Connector Field

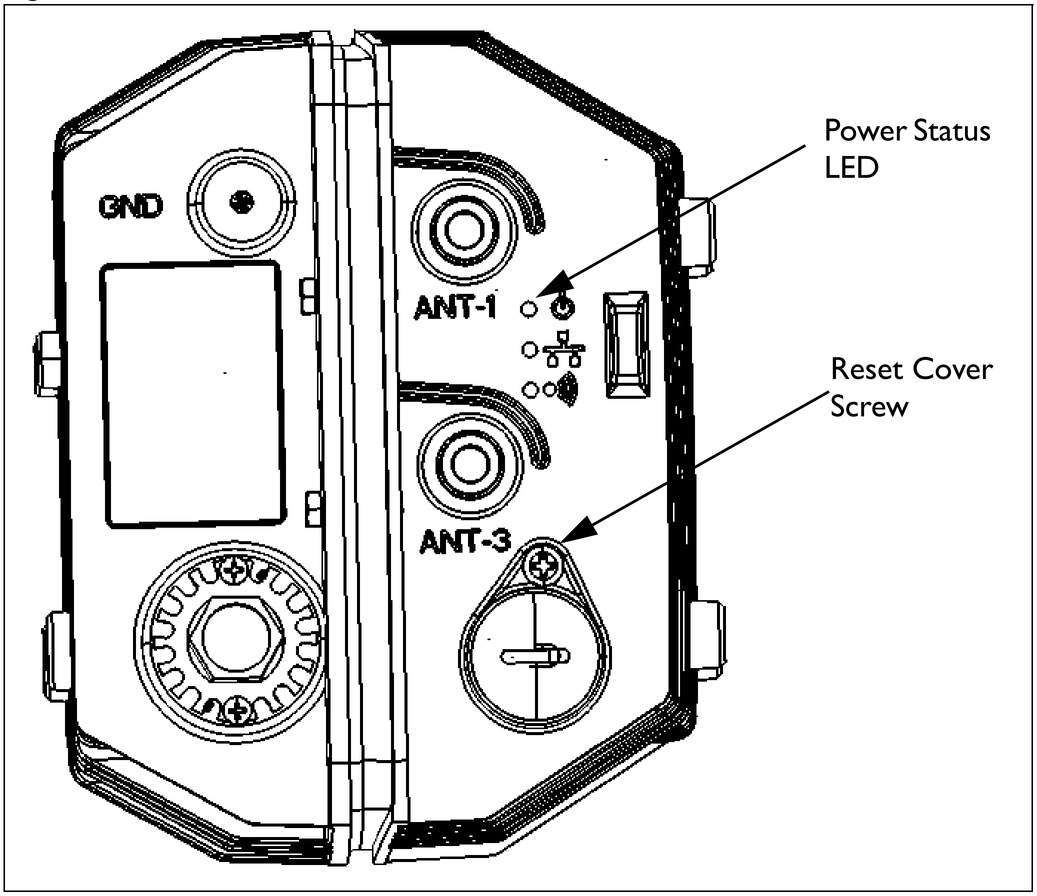


Figure 36: BelAir100SNE Connector Field

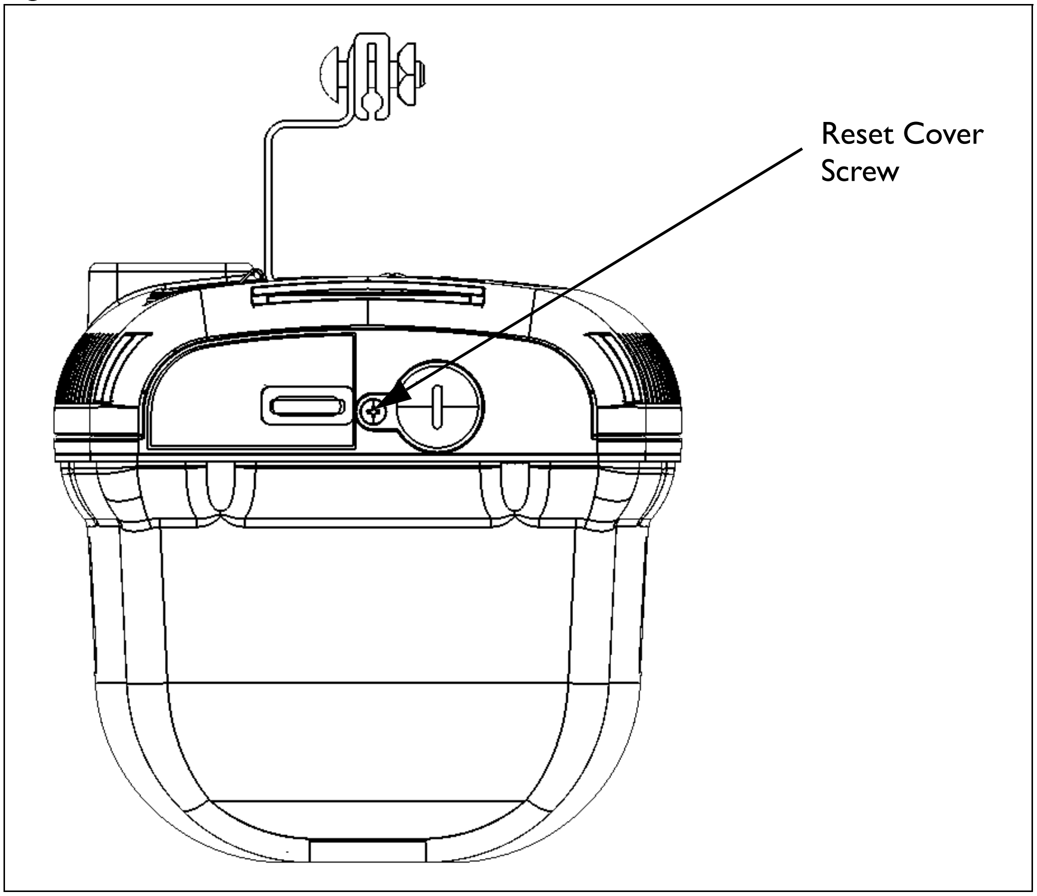
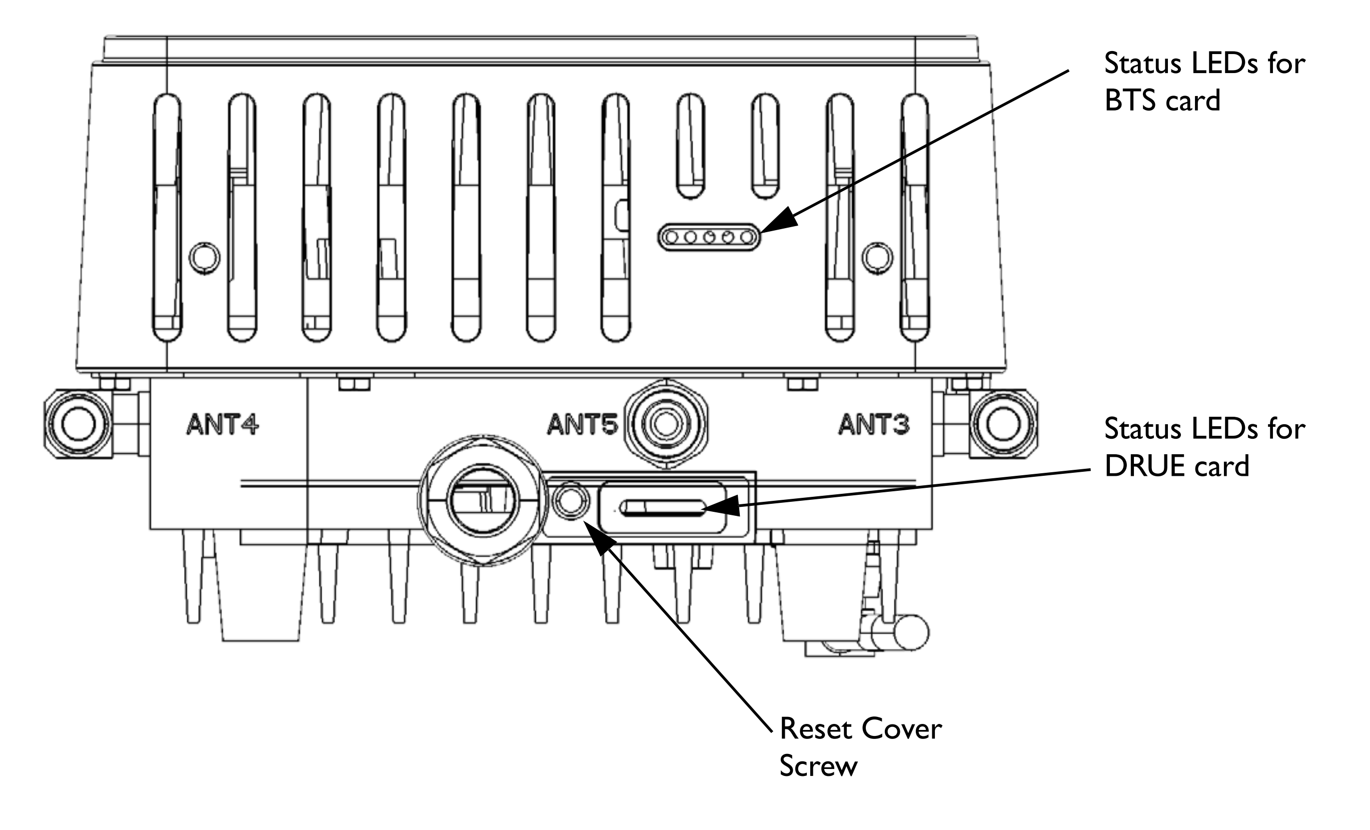


Figure 37: BelAir2100 Connector Field



2 Carefully remove the Reset Cover Screw with its gasket and place it in a secure location.

3 With a pen tip or paperclip, gently press the AP's reset button for more than 5 seconds. The reset button is located in the hole exposed by removing the Reset Cover Screw. Refer to Figure 34 on page 341 to Figure 37 on page 344.

The Power Status LED should become amber once you release the reset button, indicating that the AP is initializing.

Note: The complete LED start up sequence is described in "AP LED Descriptions" on page 280.

4 Reinstall the Reset Cover Screw and its gasket. Make sure you tighten the screw enough so that the gaskets forms a watertight seal over the reset button access hole.

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