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FCC Notice to Users and Operators

Tropos routers comply with Part 15 of the FCC rules. Operation of the Tropos router is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits of a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in an office environment. This equipment generates, uses and radiates radio frequency energy, and if not installed and used in accordance with the instructions, the device may cause harmful interference. However, there is no guarantee that interference will not occur. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by using one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician.
This Part 15 radio device operates on a non-interference basis with other devices operating at this frequency. Any changes or modification to said product not expressly approved by Tropos Networks could void the user's authority to operate this device.
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Preface

This guide contains the information and instructions needed to install, configure and use the Tropos® Control Element Management System to manage your wireless network.

About this Guide

Tropos Control is a comprehensive, real-time management system for Tropos wireless networks. The system allows you to view the status of all Tropos gateways and nodes, modify configurations, and assess network performance, all from a central management station.

This guide contains information and instructions on installing, configuring, and optimizing Tropos Control, and is divided into the following chapters:

Chapter 1, “Overview,” provides an overview of the Tropos network architecture and introduces the system features.

Chapter 2, “Installation,” contains information needed to install the Tropos Control server, including system requirements and step-by-step installation instructions.

Chapter 3, “Getting Started,” contains basic information on using Tropos Control, including how to start and stop the server, establish a new wireless network, and perform discovery.

Chapter 4, “Viewing Network Health Information,” describes how to display detailed information on network connectivity and performance using the Network Health panels in the web interface.

Chapter 5, “Viewing Fault Information,” describes how to display alarm and network event information using the Fault Management panels in the web interface.

Chapter 6, “Viewing Network Configuration Information,” describes how to display device information using the Network Configuration panels in the web interface.

Chapter 7, “Provisioning,” describes how to use the web interface to provision Tropos routers for operation in the wireless network.

Chapter 8, “Performing Administrative Tasks,” describes how to manage router inventory, upgrade router software, and generate diagnostic information using the web interface.

“Glossary” contains definitions of terms relating to Tropos wireless networking.
Tropos Technical Support

If you need technical assistance, you can contact the Tropos Technical Assistance Center by telephone, web, or email.

<table>
<thead>
<tr>
<th>Whom to contact</th>
<th>How to contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Support Toll-free Number</td>
<td>1-877-987-6767</td>
</tr>
<tr>
<td>Website</td>
<td><a href="http://www.Tropos.com">www.Tropos.com</a></td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:Support@Tropos.com">Support@Tropos.com</a></td>
</tr>
</tbody>
</table>

Supporting Documentation

Refer to the Tropos Control online help system for further assistance. For more information about managing and configuring a Tropos wireless network, refer to the following documents which are available on the installation CD or by download:

- Tropos Mesh Router Quick Start Card -- Instructions on installing Tropos routers.
- Tropos Mesh Router User Guide -- Information on configuring and maintaining Tropos routers by way of the Tropos Configuration Utility.
- Tropos Networks Mesh Router Installation Guide, Model 7320—Explains how to install the Tropos 7320 router hardware.
- Tropos Networks Mesh Router Installation Guide, Model 6320 and 6310--Explains how to install the Tropos 6320 and 6310 Mesh router hardware.
- Tropos Networks Mesh Router Installation Guide, Model 5320 and 9532 -- Instructions on installing the Tropos 5320 and 9532 router hardware.
- Tropos Networks Mesh Router Installation Guide, Models 4310 and 9432—Explains how to install the Tropos 4310 and 9432 mobile Mesh router hardware.
- Tropos Networks Mesh Router Installation Guide, Models 4210 and 9422—Explains how to install the Tropos 4210 and 9422 mobile Mesh router hardware.
Document Conventions

The document uses the conventions described here.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Notice Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔄</td>
<td>Note</td>
<td>Useful information (less urgent than Caution or Warning).</td>
</tr>
<tr>
<td>🔄</td>
<td>Caution</td>
<td>Careful attention required to prevent loss of data or damage to equipment.</td>
</tr>
<tr>
<td>🔄</td>
<td>Warning</td>
<td>Careful attention required to avoid bodily injury (NOTE: activities involving electrical connections require extreme caution, constant attention, and strict adherence to standard safety practices).</td>
</tr>
</tbody>
</table>

Nested menu items are separated by an angle bracket (>) (example: Start > Programs > Tropos > Tropos Control EMS).

In parameter tables, default values are listed in bold italics. If there are only two choices, the choices are separated by a vertical line (example: Enabled | Disabled).

Items shown in bold text most often represent a user selection. However, important names or menus are occasionally bolded for emphasis.

Graphical user interface variables are presented in italic font. (example: host.domain.com)

Text entered in a command line is presented in bold courier font. Command output and system file names are presented in courier font.

Command line variables and keyboard buttons are enclosed in brackets. (examples: <Alt>, <filename>).

Keys to be pressed simultaneously are separated by the addition sign (+) (example: <Ctrl> + y).
1 Overview

This chapter provides an overview of the Tropos Networks wireless network architecture and introduces the features of the Tropos Control Element Management System.

Chapter contents:
- Product Overview
- Product Features
- Mid-Tier Mesh Architecture
- Network Management and Administration
Product Overview

Tropos routers make possible wireless computer networking by providing the infrastructure for wireless hot spots and metropolitan scale wireless meshes. Table 1 lists the routers and associated characteristics.

<table>
<thead>
<tr>
<th>Router Model</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| 9532         | • Outdoor use, FCC public safety applications  
               • 802.11a/b/g  
               • 2.4 GHz and 4.9 GHz  
               • AC power |
| 9432         | • Mobile router for use in vehicles, FCC public safety applications  
               • 802.11a/b/g  
               • 2.4 GHz and 4.9 GHz  
               • DC power |
| 9422a        |               |
| 7320         | • Outdoor use  
               • 802.11a/b/g/n  
               • 2.4 GHz and 5.8 GHz (FCC), 2.4 GHz and 5.4 GHz (ETSI)  
               • AC power |
| 7320 DC      | • Outdoor use  
               • 802.11a/b/g/n  
               • 2.4 GHz and 5.8 GHz (FCC), 2.4 GHz and 5.4 GHz (ETSI)  
               • DC power |
| 6320         | • Outdoor use  
               • 802.11a/b/g/n  
               • 2.4 GHz and 5.8 GHz (FCC), 2.4 GHz and 5.4 GHz (ETSI)  
               • DC power |
| 6310         | • Outdoor use  
               • 802.11b/g/n  
               • 2.4 GHz  
               • DC power |
| 5320         | • Outdoor use  
               • 802.11a/b/g  
               • 2.4 GHz and 5.8 GHz (FCC), 2.4 GHz and 5.4 GHz (ETSI)  
               • AC power |
| 5320 DC      | • Outdoor use  
               • 802.11a/b/g  
               • 2.4 GHz and 5.8 GHz (FCC), 2.4 GHz and 5.4 GHz (ETSI)  
               • DC power |
Chapter 1

The term mobile router refers to the Tropos 4310, 4210, 9432, and 9422 models, which are designed for installation and use in moving vehicles. The term stationary routers (or fixed routers) refers to all the other router models, which are designed to be installed in a fixed location.

All Tropos routers are controlled by the Tropos Sphere Network Operating System. The Tropos Control Element Management System (Tropos Control) described in this guide enables network-wide control, management, and router configuration. The Tropos Configuration Utility, described in the Tropos Networks Configuration Guide, provides an interface for direct configuration of individual routers.

Note

The Tropos routers and the Tropos Control EMS server in your network must run compatible versions of software. For compatibility information, refer to the Tropos Control EMS Release Notes for your release.

Product Features

Tropos Control includes the following features:

- Network control from a single management station with convenient web interface (as well as legacy client interface)
- Quick, uniform bulk provisioning of router configuration and security settings
- Automatic discovery and graphical placement of routers
- Google map views of router location, status, and channels
- Reporting of global positioning system (GPS) location data in network maps for mobile nodes
- Network health check with point-and-click graphs

TABLE 1 Router Models (continued)

<table>
<thead>
<tr>
<th>Router Model</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>5210</td>
<td>• Outdoor use</td>
</tr>
<tr>
<td></td>
<td>• 802.11b/g</td>
</tr>
<tr>
<td></td>
<td>• 2.4 GHz</td>
</tr>
<tr>
<td></td>
<td>• AC power</td>
</tr>
<tr>
<td>5210 DC</td>
<td>• Outdoor use</td>
</tr>
<tr>
<td></td>
<td>• 802.11b/g</td>
</tr>
<tr>
<td></td>
<td>• 2.4 GHz</td>
</tr>
<tr>
<td></td>
<td>• DC power</td>
</tr>
<tr>
<td>4310</td>
<td>• Mobile router for use in vehicles</td>
</tr>
<tr>
<td>4210</td>
<td>• Outdoor use</td>
</tr>
<tr>
<td></td>
<td>• 802.11b/g</td>
</tr>
<tr>
<td></td>
<td>• 2.4 GHz</td>
</tr>
<tr>
<td></td>
<td>• DC power</td>
</tr>
</tbody>
</table>

a. For the 5210, 4210, and 9422 routers, software support is limited to the correction of service-affecting bugs. The 3110, 3210, and 5110 routers are no longer supported.
Overview of network performance and optimization priorities
Multiple views of network capacity and wireless link quality
Central configuration and software updates
Point-and-click access to configuration and security information
Support for Federal Information Processing Standards, version 140-2 (FIPS 140-2)
Link state and client connectivity information and monitoring
Quick access to the fault, performance, and statistical information
MAC address filtering
Rogue client blacklisting
Continuous alarm and event monitoring
Automatic collection and monitoring of performance data
Long term trend data
Performance reporting
Remote configuration and software updates
Comprehensive logging

Mid-Tier Mesh Architecture

Each stationary router can be configured to operate as a gateway or node. As a gateway, the router establishes communications between the wired Ethernet network and other routers that operate as nodes; nodes, in turn, form radio communications links with the clients (users) on the network. Gateways can also service clients directly.

Note
Each Tropos mobile router is shipped from the factory with the mobile node setting, but can also operate as a gateway. If a mobile router is operating as a gateway and the wired connection is disabled, the router automatically reverts to mobile node operation.

A Tropos wireless network consists of gateways that are directly connected to the wired network and nodes that deliver wireless communications support for clients and provide wireless backhaul to other upstream Tropos nodes and gateways. The nodes and gateways form a meshed cluster to route wireless signals dynamically from clients through the gateway and on to the wired network.
Figure 1 shows basic Tropos wireless network.

**FIGURE 1  Typical Tropos Wireless Network**

Tropos networks can be deployed on a small or large scale. The largest deployments are able to support thousands of routers over a wide geographic area.

Each node communicates with standard 802.11 clients and passes data back through a wireless link to a gateway that is attached to the wired network. All routers continually monitor the quality of the wireless links and select the optimal path for routing traffic to the wired gateway. By overcoming the effects of interference and multi-path fading across the mesh, the Tropos network is able to deliver consistent throughput up to the maximum available.

Routing decisions are made by way of the Tropos Predictive Wireless Routing Protocol (PWRP®), which manages network routing based on self-organizing principles. The PWRP implements dynamic re-clustering to maximize available throughput and ensure reliability. Dynamic re-clustering refers to the ability of the network to respond to changes in radio signal availability and quality by modifying the paths that data packets take. When a node becomes unavailable or the signal quality degrades due to distance or other ambient conditions, the network automatically reorganizes to create another path from the client through the mesh of nodes back the gateway and the wired network (Figure 2).
Due to dynamic re-clustering, individual paths need not be engineered on a link-by-link basis. The PWRP automatically sets up and maintains routes by dynamically identifying the path that achieves the highest throughput between the wireless client and the wired backhaul connection. Throughput maximization improves overall network performance, and lack of a system-wide point of failure increases reliability.

Tropos wireless networks permit easy addition of new routers to support growth in the number of client subscribers. New nodes may be added to extend coverage at any location that has available power. As the number of subscribers continues to grow, gateways may also be added to further increase coverage, performance, and reliability.

Mobile Router Networks

Tropos mobile routers extend the wireless network to mobile node operation. Installing mobile routers in fire, police, or other public service vehicles allows for immediate high-bandwidth access to network services. As with other Tropos routers, the mobile router dynamically associates to upstream nodes or gateways.

Clients connect to the mobile router through a wireless or wired connection. In a typical vehicle installation, the client computer is connected directly to the mobile router through a wired interface connection.

Since mobile routers may be in motion, special rules apply to the association of wireless clients to and from mobile routers. The following guidelines and properties apply:
A mobile node will always attempt to establish backhaul connection to an upstream stationary Tropos node or gateway. If this is not possible, it will attempt to connect to another mobile router.

A stationary Tropos node will not attempt to establish uplink to a mobile router.

Configuring a separate ESSID for mobile routers is recommended. Wireless clients accessing this ESSID will always attempt to associate with mobile nodes, while clients accessing other ESSIDs will always attempt to associate with stationary nodes. This arrangement prevents typical stationary clients from associating to mobile nodes that may move in and out of coverage, while also permitting special sets of wireless clients (such as passengers on a bus with a mobile node installed) to associate with mobile nodes.

If any router loses backhaul connectivity, it shifts to standalone mode so as not to advertise wireless service to associated clients. When connectivity is recovered, service is automatically restored. (This process takes approximately ten seconds after connectivity is re-established.)

Because a mobile router is more likely to lose wireless connectivity than a stationary node, clients associated with a mobile node may encounter more frequent service disruptions than those associated to stationary nodes. To prevent unsuccessful data transmission attempts from the client when upstream connectivity is lost, the downstream wired interface for the mobile is immediately switched off when connectivity is lost.

Figure 3 shows a typical Tropos network with mobile nodes added, and Figure 4 illustrates automatic rerouting actions if connectivity to the stationary Tropos network is interrupted.

**FIGURE 3  Typical Tropos Mobile Network**
Network Management and Administration

The Tropos Control Element Management System (Tropos Control) enables network operators to administer an entire Tropos network consisting of numerous gateways and nodes distributed over a wide geographical area. Tropos Control presents geographic views of all the routers in a network along with detailed configuration information. Operators can view network health statistics, monitor performance, events, and alarms, and provision individual routers or groups of routers. Support is also provided for batch updates of configurations and software.

Note

Multiple Tropos Control servers may be used to manage a network.

Individual routers may also be provisioned using Tropos Control or the Tropos Configuration Utility. The Tropos Configuration Utility provides a secure HTTPS interface to access and control individual routers, connecting through the wired Management port on the router or association of a laptop client.
2 Installation

This chapter provides Tropos Control installation instructions.

Chapter contents:
- Pre-Installation Requirements
- Installing Tropos Control
- Updating ARP Cache Settings
- Uninstalling the System
- Backing Up and Restoring the Tropos Control Server
- Upgrading the Server
- Resetting the Administrative Password
Pre-Installation Requirements

- Sizing Requirements
- Server and Client System Requirements
- Supported Routers
- Firewall Requirements

Sizing Requirements

Table 2 lists the minimum requirements for a Tropos Control server that uses an external Oracle database and Table 3 lists the Oracle database requirements.

Table 2  Tropos Control Server Requirements (Using an External Oracle Database)

<table>
<thead>
<tr>
<th>Size of Network (# of devices)</th>
<th>Minimum Number of CPU cores</th>
<th>Minimum Memory (RAM) Requirements</th>
<th>Minimum Disk Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 500</td>
<td>2</td>
<td>2 GB</td>
<td>2 GB</td>
</tr>
<tr>
<td>500-2000</td>
<td>2</td>
<td>4 GB</td>
<td>4 GB</td>
</tr>
<tr>
<td>2000-5000</td>
<td>4</td>
<td>8 GB</td>
<td>8 GB</td>
</tr>
<tr>
<td>5000-6500</td>
<td>4</td>
<td>8 GB</td>
<td>8 GB</td>
</tr>
</tbody>
</table>

Table 3  Oracle Database Server Requirements

<table>
<thead>
<tr>
<th>Size of Network (# of devices)</th>
<th>Minimum Number of CPU cores</th>
<th>Minimum Memory (RAM) Requirements</th>
<th>Minimum Disk Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 500</td>
<td>2</td>
<td>2 GB</td>
<td>100 GB</td>
</tr>
<tr>
<td>500-2000</td>
<td>2</td>
<td>4 GB</td>
<td>300 GB</td>
</tr>
<tr>
<td>2000-5000</td>
<td>4</td>
<td>8 GB</td>
<td>500 GB</td>
</tr>
<tr>
<td>5000-6500</td>
<td>4</td>
<td>8 GB</td>
<td>600 GB</td>
</tr>
</tbody>
</table>

Server and Client System Requirements

- CentOS 5 must be installed on the Tropos Control Server. Visit support@tropos.com for instructions and to download a Tropos-customized CentOS installation image.
- There should be only one user account created on the Tropos Control server.
- Table 4 lists the client browser requirements for access to the Tropos Control web client.
### Supported Routers

We recommend that current customers upgrade existing TroposControl installations to Release 7.5 only if all the routers in the network will be running Release 7.1 or later software.

### Firewall Requirements

If the Tropos Control EMS server or routers are behind a firewall, then the ports listed in Table 5 must be opened on the firewall.

### TABLE 4  Client Browser Requirements for Web Client Access

<table>
<thead>
<tr>
<th>Web Browser</th>
<th>Windows</th>
<th>Linux</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Explorer 6</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Firefox 3.5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### TABLE 5  Firewall Ports

<table>
<thead>
<tr>
<th>Port Number and Type</th>
<th>Protocol</th>
<th>Direction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8443 - TCP</td>
<td>HTTPS</td>
<td>Both</td>
<td>EMS Apache Server port</td>
</tr>
<tr>
<td>1099 - TCP</td>
<td>RMI</td>
<td>Both</td>
<td>RMI Registry</td>
</tr>
<tr>
<td>Random/4567 - TCP</td>
<td>TCP</td>
<td>Both</td>
<td>EMS FE Secondary Port</td>
</tr>
<tr>
<td>Random/5008 - TCP</td>
<td>TCP</td>
<td>Inbound only</td>
<td>EMS Transport Provider</td>
</tr>
<tr>
<td>Random/16010 - TCP</td>
<td>RMI</td>
<td>Both</td>
<td>This port is used by the EMS Server for RMI communication</td>
</tr>
<tr>
<td>161 - UDP</td>
<td>SNMP</td>
<td>Both</td>
<td>SNMP Request/Response</td>
</tr>
<tr>
<td>162 - UDP</td>
<td>SNMP</td>
<td>Both</td>
<td>SNMP Informs (Traps)</td>
</tr>
<tr>
<td>5000 - TCP</td>
<td>NUTTCP</td>
<td>Both</td>
<td>Performance Benchmarking</td>
</tr>
<tr>
<td>5001 - TCP</td>
<td>NUTTCP</td>
<td>Both</td>
<td>Performance Benchmarking</td>
</tr>
<tr>
<td>22 - TCP</td>
<td>SSH</td>
<td>Both</td>
<td></td>
</tr>
<tr>
<td>80 - TCP</td>
<td>HTTP</td>
<td>Both</td>
<td>Web Service</td>
</tr>
<tr>
<td>443 - TCP</td>
<td>HTTPS</td>
<td>Both</td>
<td>Secured Web Service</td>
</tr>
<tr>
<td>7 - UDP</td>
<td>ICMP/PING</td>
<td>Both</td>
<td>Ping utility</td>
</tr>
<tr>
<td>0,8 - UDP</td>
<td>ECHO</td>
<td>Both</td>
<td>Echo request/reply</td>
</tr>
<tr>
<td>123 - UDP</td>
<td>NTP</td>
<td>Both</td>
<td>NTP client</td>
</tr>
<tr>
<td>8900 - TCP</td>
<td>TCP</td>
<td>Both</td>
<td>Used by EMS for router configuration</td>
</tr>
</tbody>
</table>
TABLE 5  Firewall Ports (continued)

<table>
<thead>
<tr>
<th>Port Number and Type</th>
<th>Protocol</th>
<th>Direction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1521 (default)</td>
<td>TCP</td>
<td>Both</td>
<td>(connection port - only for Oracle database) Consult your Oracle database administrator to verify the right port before installing Tropos Control</td>
</tr>
</tbody>
</table>

Installing Tropos Control

Complete the installation procedures in the following order:

1. Install CentOS.
2. Configure CentOS to operate in single user mode.
3. Install Tropos Control.

Install CentOS

**Note**
The partitioning portion of the CentOS installation process formats all partitions. Before starting the installation, verify that you have backed up any data that you want to keep.

1. Download and install the pre-configured version of CentOS from support.tropos.com.
2. Boot the server from the CentOS CD.
3. Type `install` and press Enter. (If you need to abort the installation, just remove the CD and reboot the machine.)
4. Click Next.
5. Click Yes when prompted to remove all partitions.
6. On the page that appears, click Edit in the Network Devices area. Select the check box to enable IPv4 support, choose Manual Configuration, and enter the IP address and netmask for the Tropos Control server. Clear the Enable IPv6 Support check box, and then click OK.
7. In the Hostname area of the page, choose manually and enter a host name in the form `host.domain.com`.
8. Enter IP addresses for the network gateway and primary and secondary DNS servers.
9. Click Next.
10. Click a dot on the map to choose the nearest city in your time zone. Verify the selection in the menu below the map, and then click Next.
11. Enter and confirm a root password (minimum eight characters) and click Next.
Chapter 2

The installation begins. This process may take up to 20 minutes. When the process is complete, the system reboots automatically.

12. Remove the CD.

Log in as root using the password that you configured in step 11. If the graphical user interface does not start automatically, enter the command startx.

**Configure CentOS to operate in single user mode**

1. Log in as the root user.
2. Edit the /etc/passwd and /etc/shadow files and remove all the users except root and the pseudo-users. Make sure that the password fields in /etc/shadow for the pseudo-users are either a star (*) or double exclamation mark (!!!). This prevents users from logging in as the pseudo-users.
3. Edit the /etc/nsswitch.conf system file and make files the only option for passwd, shadow, and group. This disables Network Information Service (NIS) and other name services for users and groups.
4. In the /etc/xinetd.d directory, edit the files eklogin, gssftp, klogin, krb5-telnet, kshell, rexec, rlogin, rsh, rsync, telnet, and tftp, and set the value of disable to yes.
5. Reboot the system for the changes to take effect.

**Install Tropos Control**

1. Obtain a static IP address in your network for the Tropos Control server (management station).
2. Obtain the Tropos Control software image (<imagefile>.bin) and copy it to a temporary folder.
3. Set the permission on the image file to execute:
   ```bash
   chmod +x <imagefile>.bin
   ```
4. If you are upgrading Tropos Control, stop the server.
   ```bash
   service watchdog stop
   ```
5. Run the executable file.
   ```bash
   ./<imagefile>.bin
   ```

The installation wizard opens and asks whether you want to install a new release or upgrade from a previous release. Select an option and choose OK.

If you choose **Install Fresh 7.5**, the wizard presents the following prompts:

a. **License** - Choose OK to accept the terms of the license agreement.

b. **Administrative password** - Enter the administrative password (minimum eight characters) for the **ems** user, and choose Next. Reenter the password and choose Next.

c. **Router password** - Enter the router admin password (minimum eight characters) and choose Next. Reenter the password and choose Next. For instructions on changing the
router admin password at a later time, see “Resetting the Administrative Password” on page 16.

d. Select database - Enter Y if you want to use bundled MySQL database or N if you want to use your own Oracle database.

e. (Oracle only) Enter host address - Enter the host IP address where the Oracle database is running.

f. (Oracle only) Enter port number - Enter the port number used by the Oracle database.

g. (Oracle only) Enter global database name - Enter the Oracle global database name.

h. (Oracle only) Enter user name - Enter the user name to connect to Oracle database.

Note
The oracle user must have RESOURCE and Create Session privileges and must be a dedicated user for Tropos Control (not shared with any other applications). If possible, there should be a dedicated tablespace associated with the user.

i. (Oracle only) Enter password - Enter the password for the user.

If you choose Upgrade to 7.5, the installation begins automatically. If the existing Tropos Control installation uses an Oracle database, then the upgrade process prompts for database details as in step e - step i above. If the installation uses a MySQL database, the upgrade continues without the need for any user intervention.

6. When the installation is complete, choose OK.

The server automatically starts, and you can access the web interface. See “Using the Web Interface” on page 19.

Updating ARP Cache Settings

In environments where the devices under management are on the same subnet as the Tropos Control Server, default Address Resolution Protocol (ARP) cache settings on the Linux server should be changed. Execute the following commands to modify the ARP cache settings, and also add the same command lines to the /etc/rc.local file.

```
echo "1024" > /proc/sys/net/ipv4/neigh/default/gc_thresh1
echo "4096" > /proc/sys/net/ipv4/neigh/default/gc_thresh2
echo "8192" > /proc/sys/net/ipv4/neigh/default/gc_thresh3
```

Uninstalling the System

Follow the steps in this section to remove the Tropos Control server from your system.

Note
For installations with an Oracle database: The uninstall script does not remove data from the Oracle database. It removes only files and folders. After uninstalling Tropos Control, you must manually delete the data stored in the database.
Uninstall Tropos Control

1. Go to the bin directory in the Tropos Control installation directory:
   ```bash
cd /<installdirectory>/bin
   ```
2. Shut down the Tropos Control server:
   ```bash
   service watchdog stop
   ```
3. Run the uninstall command:
   ```bash
   ./uninstall.sh
   ```
   The Tropos Control system is uninstalled and removed from the system.

Backing Up and Restoring the Tropos Control Server

Follow the procedures in this section to back up and restore the Tropos Control server.

**Note**

*For installations with an Oracle database:* The backup/restore script does not back up or restore any data from the Oracle database. Follow the Oracle procedures to back up and restore your data.

Back up the TroposControl server

1. Go to the bin directory in the Tropos Control installation directory:
   ```bash
cd /<installdirectory>/bin
   ```
2. Execute the backup script:
   ```bash
   ./backup.sh /<installdirectory>
   ```
3. Enter the database password for the *root* account. This is the password for the *ems* user account, not the root password for the machine.
   The backup is created and stored in the current directory. The following files are created:
   - backup file - Tropos_EMS_Backup_<date>.tar.gz
   - checksum file - Tropos_EMS_Backup_<date>.md5
4. Move the backup and checksum files to /tmp or another temporary location that is not part of the TC installation tree.

Restore the server

1. Copy the backup and checksum files to the bin directory in the Tropos Control installation directory, and go to that directory:
   ```bash
cd /<installdirectory>/bin
   ```
2. Stop the server:
   ```bash
   service watchdog stop
   ```
3. Execute the restore script, using the name of the previously-backed up tar.gz and .md5 files:
   ```
   ./restore_ems.sh /<installdirectory>
   Tropos_EMS_Backup_<date>.tar.gz Tropos_EMS_Backup_<date>.md5
   ```
4. Enter Y to continue.
5. Enter the password for the root account, as prompted.
   The database is restored and the server is restarted.

**Upgrading the Server**

Tropos Control upgrades are supported only from Release 7.3. If you have an earlier version of Tropos Control, you must upgrade to Release 7.3 before upgrading to Release 7.5.

**Upgrade the Tropos Control server from 7.3**

Follow the procedure to install Tropos Control (‘‘Install Tropos Control’’ on page 13). Choose the Upgrade to Release 7.5 option.

**Resetting the Administrative Password**

Follow these steps to reset the Tropos Control administrative password.

**Note**

The administrative password must have a minimum of eight characters. The password change doesn't affect the password stored in the router; it only changes the password that is stored in the Tropos Control server and used for communication between Tropos Control and the routers.

**Reset the administrative password**

1. Go to /<installdirectory>/ems/bin and execute the following command:
   ```
   ./setRouterPasswd
   ```
2. Respond to the prompts to enter and confirm the password.
3 Getting Started

This chapter describes how to start using Tropos Control to manage the network.

Chapter contents:
- Getting Ready to Manage the Network
- Starting and Stopping the Server
- Using the Web Interface
- Discovery
Getting Ready to Manage the Network

To use Tropos Control to manage the Tropos network, you must first configure each router to recognize the Tropos Control server and verify that all routers are in the same wireless routing domain. Use the Tropos Configuration Utility to perform these tasks, as outlined in this section. For detailed information on using the Tropos Configuration Utility, see the Tropos Networks User Guide.

Note
Use the following procedure for initial device configuration after installing Tropos Control. See “About Provisioning Operations” on page 69 for information on configuring devices on an existing network.

Configure routers

1. Perform these tasks as described in the Tropos Mesh Router User Guide.
2. Open the Tropos Configuration Utility for the router.
3. Open the Passwords and Security page and enter the Router-EMS Authentication Key. Confirm that each router in the network has the same wireless routing domain ID. If you make a change, click Store Changes.
4. Commit any changes.
5. Repeat for all the routers to be managed by Tropos Control.

You can now use Tropos Control to discover and manage the routers.

Starting and Stopping the Server

Start the server
- Issue the following command on the server:
  
  service watchdog start

Stop the server
- Issue the following command on the server:
  
  service watchdog stop
Using the Web Interface

The web interface may be reached from the Tropos Control server or from any other web-enabled computer on the network.

Accessing and Exiting the Web Interface

Follow the instructions in this section to access and exit the web interface, display details about the current login session, and access the online help system.

Access the web interface

1. Open the following URL on a web browser that has a network connection to the Tropos Control server:
   https://<Tropos Control Server IP address>:8443
2. If security alerts appear about viewing pages over a secure connection, click Yes to proceed.
3. The login panel opens.
4. Log in with the user name and password used for Tropos Control client access. The default user name is root, and the default password is public.
5. The system prompts you to change the password.

6. Enter and confirm a new password.

7. Click **Submit**.

   The Tropos Control Web Interface opens to display the Network Health Dashboard.

---

**Display session details**

- Click **Clients** in the upper right corner of the web interface.

---

**Access online help**

- Click **Help** in the upper right corner of the web interface. The online help system (based on this guide) opens in a new window.

---

**Exit the web interface**

- Click **Logout** in the upper right corner of the web interface. The current user name is presented along with the Logout link.

---

**Navigating the Web Interface**

The Tropos Control web interface (Figure 5) contains the following elements:

- **Tabs**---Major categories of information:
  - Provisioning---See “**Provisioning**” on page 68.
  - Configuration View---See “**Viewing Network Configuration Information**” on page 58.
  - Administration---See “**Performing Administrative Tasks**” on page 129.

- **Panels**---Detailed information, which varies according to tab and side menu selection.
- Side menu---Access to panels. Contents are specific to each tab, and expandable items are marked with an arrow.
- Alarm summary---Summary of the numbers of alarms of each level of severity.
- Banner text---Optional configurable banner text.

**FIGURE 5 Web Interface**
Using Tables

Much of the information in the web interface is presented in tables.

- Use checkboxes to choose one or more rows, or use the checkbox at the top of the column to select all rows.
- Click a column header to sort the column. Click once for an ascending sort (up arrow) and twice for a descending sort (down arrow).

<table>
<thead>
<tr>
<th>Name</th>
<th>IP Address</th>
<th>Longitude</th>
<th>Latitude</th>
<th>Location</th>
<th>Contact</th>
<th>Display No</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>19.88.2.111</td>
<td>0</td>
<td>0</td>
<td>Sunnyvale, CA</td>
<td><a href="http://www.troposnetworks.com">www.troposnetworks.com</a></td>
<td>BM_N_10</td>
</tr>
<tr>
<td>67890</td>
<td>19.88.2.2</td>
<td>0</td>
<td>0</td>
<td>Sunnyvale, CA</td>
<td><a href="http://www.troposnetworks.com">www.troposnetworks.com</a></td>
<td>BM_GW_1</td>
</tr>
<tr>
<td>12345</td>
<td>19.88.4.106</td>
<td>0</td>
<td>0</td>
<td>Sunnyvale, CA</td>
<td><a href="http://www.troposnetworks.com">www.troposnetworks.com</a></td>
<td>BM_N_1</td>
</tr>
<tr>
<td>98765</td>
<td>19.88.4.101</td>
<td>0</td>
<td>0</td>
<td>Sunnyvale, CA</td>
<td><a href="http://www.troposnetworks.com">www.troposnetworks.com</a></td>
<td>BM_N_6</td>
</tr>
<tr>
<td>54321</td>
<td>19.88.4.104</td>
<td>0</td>
<td>0</td>
<td>Sunnyvale, CA</td>
<td><a href="http://www.troposnetworks.com">www.troposnetworks.com</a></td>
<td>BM_N_4</td>
</tr>
</tbody>
</table>

- Some tables support multiple contiguous selection. Select the checkbox for the first chosen entry and then hold down the Shift key while selecting the checkbox for the last chosen entry.

Using Router Details Windows

Some of the panels list individual routers using an ID link.

Do one of the following to open a router details window:

- Click an underlined router ID in any of web interface panels.
- Enter the router IP address in the Find Device field at the top of the screen, and click **GO**.

This window contains the following tabs:

- Gateway/Node Information---View summary information about the router.
- Configurator---Open the Configuration Utility for the router.
- Map---Open a Google Maps window showing the router location.
Performance History---View recent performance statistics for the router. The following screen shows an example for a fixed gateway or node.

**Performance Information for Gateway 172.20.125.99**

<table>
<thead>
<tr>
<th>Time</th>
<th>Uplink (Mbps)</th>
<th>Downlink (Mbps)</th>
<th>Latency (ms)</th>
<th>Packet Loss</th>
<th>Noise</th>
<th>Tx Rate (kbits)</th>
<th>Rx Rate (kbits)</th>
<th># Associated Clients</th>
<th># Routed Clients</th>
<th># Neighbors</th>
<th># Cluster Routed Clients</th>
<th>Cluster Node Count</th>
<th># Interfering Gateways</th>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 14 07:00:08:00</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>100.0%</td>
<td>-101.9</td>
<td>201.2</td>
<td>192.3</td>
<td>N/A</td>
<td>N/A</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Feb 14 06:00:07:00</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>100.0%</td>
<td>-101.86</td>
<td>182.4</td>
<td>130.4</td>
<td>N/A</td>
<td>N/A</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
</tbody>
</table>

**Discovery**

Discovery is the formal process by which Tropos Control recognizes and establishes router connections. To take advantage of Tropos Control management capabilities, the Tropos gateways in the network must be discovered.

You can configure the system to perform discovery in the following ways:

- **Auto discovery**---See “Using Router Auto Discovery” on page 145.
- **Manual discovery**---See “Updating the Router Database” on page 61.
- **Discover from file**---See “Discovering Gateways from a File” in the next section.

**Discovering Gateways from a File**

Data on the gateways in the network is stored on the Tropos Control server in the following location and in the indicated format:

`/<installdirectory>/ems/conf/server/discover_devices.txt`

Format:

```
<device ip>=<snmp port>;<read only community>;<readwrite community>;<management station ip>;<trap community>;<trap port>;<mesh id>;<router auth key>
```

Example:

```
172.20.125.60=161;public;private;192.168.128.96;public;162;1234123412123412341234
```

Each hour, the Tropos Control server automatically checks the discover_devices.txt file, discovering all the gateways listed in the file that have not already been discovered and that have registered the Tropos Control server. In large networks with numerous gateways, saving discovery parameters to a file can streamline the process of performing discovery, and provides for easy rediscovery if new software is installed.
4 Viewing Network Health Information

This chapter describes the Network Health panels in the web interface and how network health thresholds are defined.

Chapter contents:
- Preparing to Access the Network Health Panels
- Using the Dashboard
- Using the Network Optimization Panels
- Using the Client Optimization Panels
- Using the Voice Optimization Panels
- Using the Device Ping Utility
- Modifying Network Health Thresholds
Preparing to Access the Network Health Panels

If client side certificates are enabled on the routers, you must configure the 
/<installdirectory>/ems/networkhealth/certificateconf file to support Network Health. Configure 
the following parameters in the file (the file contains an example for each):

- CIPHER - Signature algorithm (for example, SHA1)
- CLIENTCERT - location of certificate file
- CLIENTCERTPASS - password for the key store file
- CACERTKEY - location of the key file

Using the Dashboard

When you access the web interface, the Dashboard opens. The Dashboard presents summary 
network status and performance information. The top line shows the total number of clients, 
nodes, and gateways in the network. It also shows the number of gateways that are currently 
operating as nodes, and vice versa. You can return to the Dashboard at any time by choosing 
Dashboard from the side menu on the Network Health tab.
FIGURE 6  Dashboard

14 clients   24 nodes (2 unreachable)  6 gateways (1 unreachable) (2 gateways operating as nodes)

- Number of Clients (Last 24 hours: 49 unique)
- Network Traffic (Last 24 hours: 1.907 GB down/661.5 MB up)
- Mesh Throughput (Last 24 hours)
- Mesh Performance (Dec 06, 8:00-9:00)
- Backhaul Throughput (Last 24 hours)
- Backhaul Performance (Dec 06, 8:00-9:00)
You can display information for the past day (1d), week (1w), month (1m), three months (3m), or year (1yr) by clicking the appropriate link near the top of the page (see circled area in Figure 6). If you choose the days option, you can view historical information for a specific time period within the past week by selecting the time period (last 24 hours - 6 days ago) from the drop-down list.

Graphs display the following information:

- **Number of Clients**---Total number of distinct clients, color-coded and labeled by SSID.
- **Client Network Traffic**---Total upstream (blue) and downstream (green) traffic for all clients (MB).
- **Mesh Throughput**---Average upstream (blue) and downstream (green) wireless throughput between nodes and the gateway (Mbps).
- **Backhaul Throughput**---Average upstream (blue) and downstream (green) throughput between the gateway and the Tropos Control server (Mbps).
- **Mesh Performance**---Performance of the mesh for the past hour (Mbps).
- **Backhaul Performance**---Backhaul performance for the past hour (Mbps).

### Viewing Geographic Maps

You can view network routers in geographic context by using the Google Maps area on the right side of the dashboard.

1. **Note**
   
   *If a map is not visible when you open the dashboard, you must first obtain a map key from Google. This needs to be done only once. Make sure you have Internet connectivity from your browser.*

### Obtain the Google maps key

1. Open the web interface.
2. Click the **Google Map API Key Signup** link in the Google maps area of the dashboard.
3. Enter the IP address and port of the Tropos Control server:
5. Select the checkbox to accept the terms and conditions for use of the key, and click **Generate API Key**.
6. The key is generated and displayed.
7. Copy the key.
8. Click **Upload** in the Google Map area of the Tropos Control web interface.
9. Paste the key into the space provided, and click **Upload**.

10. Click **Close** to close the upload window.
11. Click **refresh** to reopen the page and display the map.

---

**Using the Geographic Maps**

Each router is represented as an icon on the map. The following conventions apply to the maps:

- Square icons represent gateways.
- Round icons represent nodes, include mobile nodes.
- Dual radio routers have a smaller square or circle inside.
- Routers that are currently unreachable are shown with an X.
- Routers and links sharing the same channel are shown in the same color.
- Thin lines represent 2.4 GHz connections; thick lines represent 4.9, 5.4, or 5.8 GHz connections.
- If routers are clustered on the map, you may need to zoom in to display the individual icons.
- If there are no Tropos routers shown on the map, the following message appears:
“We are sorry, but we don’t have maps at this zoom level for this region.”
If you see this message, zoom out and pan as necessary to bring your network into view.

You can perform the following operations:

- View summary information about a router by clicking the router icon. Click the icon once to change the zoom level and then click the router icon again to display the summary information.
- Find a specific router by entering the IP address and clicking **Search**.
- Zoom in or out or pan by using the Google Maps controls.
- Observe updates to the map when a mobile router moves.
- View a standard map, satellite image, or hybrid map and satellite image by using the Google Maps controls.
- View a larger version of the map by clicking the **Large Map** link below the map area.
- View detailed information about a router by clicking the underlined IP address in the bubble. The Gateway/Node information window (**Figure 7**) opens to show additional information.

**FIGURE 7 Gateway/Node Information Window**

<table>
<thead>
<tr>
<th>Device Information</th>
<th>Configurator</th>
<th>Map</th>
<th>Performance History</th>
</tr>
</thead>
</table>

**System**
- **Name**: SV-Pastroipa
- **Serial Number**: 49000
- **SSID**: sunnyvale
- **Type**: Node
- **Location**: Pastroipa
- **Lat/Long**: 37.394501/-122.032877
- **Model**: 5320
- **Software Version**: 7.5.0.4

**Network**
- **Interface**: 2.4 GHz
  - **IP**: 172.20.125.65
  - **MAC**: 00:0d:97:00:50:b8
  - **Channel**: 5
- **Interface**: 5.8 GHz
  - **IP**: 172.20.125.153
  - **MAC**: 00:0d:97:00:50:09
  - **Channel**: 151

You can perform these actions from the Gateway/Node information window:
- Click **Configurator** to open the Configuration Utility. For more information on using the utility, see the *Tropos Networks Configuration Guide*.
- Click **Map** to open a standard Google Maps window that shows the location of the router.
— Click **Performance History** to open a window containing recent performance history for the router.

<table>
<thead>
<tr>
<th>Time</th>
<th>Upstream (Mbps)</th>
<th>Downstream (Mbps)</th>
<th>Latency (ms)</th>
<th>Packet Loss</th>
<th>Noise</th>
<th>PSP</th>
<th>RSP</th>
<th>TP Rate (Mbps)</th>
<th>Rx Rate (Mbps)</th>
<th># Associated Clients</th>
<th># Routed Clients</th>
<th># Neighbors</th>
<th>Hop Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>06/07 13:00-14:00</td>
<td>3.3</td>
<td>2.3</td>
<td>13.3</td>
<td>0.0%</td>
<td>-101.33</td>
<td>93%</td>
<td>9%</td>
<td>10.5</td>
<td>19.2</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>06/07 12:00-13:00</td>
<td>3.6</td>
<td>2.7</td>
<td>6.7</td>
<td>3.0%</td>
<td>-101.58</td>
<td>52%</td>
<td>59%</td>
<td>11.0</td>
<td>18.6</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>1.0</td>
</tr>
<tr>
<td>06/07 11:00-12:00</td>
<td>3.7</td>
<td>2.4</td>
<td>8.4</td>
<td>0.0%</td>
<td>-101.79</td>
<td>60%</td>
<td>45%</td>
<td>84.0</td>
<td>89.1</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>1.0</td>
</tr>
<tr>
<td>06/07 10:00-11:00</td>
<td>3.8</td>
<td>2.2</td>
<td>14.9</td>
<td>0.0%</td>
<td>-101.69</td>
<td>89%</td>
<td>04%</td>
<td>41.6</td>
<td>50.2</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>1.0</td>
</tr>
<tr>
<td>06/07 09:00-10:00</td>
<td>4.5</td>
<td>4.1</td>
<td>3.3</td>
<td>0.0%</td>
<td>-101.69</td>
<td>66%</td>
<td>7%</td>
<td>11.9</td>
<td>24.8</td>
<td>4</td>
<td>3</td>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>06/07 08:00-09:00</td>
<td>6.9</td>
<td>5.0</td>
<td>1.8</td>
<td>0.0%</td>
<td>-101.61</td>
<td>96%</td>
<td>7%</td>
<td>11.2</td>
<td>26.5</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>06/07 07:00-08:00</td>
<td>6.0</td>
<td>5.1</td>
<td>3.4</td>
<td>0.0%</td>
<td>-101.64</td>
<td>96%</td>
<td>7%</td>
<td>12.4</td>
<td>30.1</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>06/07 06:00-07:00</td>
<td>6.6</td>
<td>5.8</td>
<td>2.9</td>
<td>0.0%</td>
<td>-101.69</td>
<td>96%</td>
<td>7%</td>
<td>12.9</td>
<td>30.7</td>
<td>1</td>
<td>NA</td>
<td>10</td>
<td>1.0</td>
</tr>
</tbody>
</table>

— Click **Export** in the Performance History window to save the performance history in csv format.

**Using the Network Optimization Panels**

The Network Optimization panels present statistics to help assess current and recent router behavior and performance.

Thresholds are applied to a variety of performance metrics to determine whether problems exist in the network. If the problem thresholds are not met, the cell is listed as problem free. You can adjust the thresholds based on the network and user preferences for each network health report by selecting from the drop-down lists below the optimization table (see figure). To save the thresholds as defaults, select **Save above thresholds as default thresholds** and click **Submit**.

Access the panels

- Open the Network Health tab and choose **Network Optimization** on the side menu.

The summary Optimization panel opens (**Figure 8**).
### FIGURE 8  Network Optimization Panel

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Submit</strong> Missing Data (Dec 07 09:00 - Dec 08 09:00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routers with missing data for 3 or more hours</td>
<td>4/22(11%)</td>
<td>Poor</td>
</tr>
<tr>
<td>Gateways with missing backhaul throughput data for 3 or more hours</td>
<td>2/6 (33%)</td>
<td>Bad</td>
</tr>
<tr>
<td>Nodes with missing mesh throughput data for 3 or more hours</td>
<td>6/22 (27%)</td>
<td>Bad</td>
</tr>
<tr>
<td><strong>Backhaul Performance (Dec 07 09:00 - Dec 08 09:00)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateways with downstream throughput less than 3.0 Mbps for 3 or more hours</td>
<td>0/6 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Gateways with upstream throughput less than 3.0 Mbps for 3 or more hours</td>
<td>0/6 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Gateways with backhaul utilization exceeding 300 Mbps/hour for 3 or more hours</td>
<td>0/6 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Devices with backhaul latency greater than 10 ms for 3 or more hours</td>
<td>0/6 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Devices with backhaul packet loss greater than 5% for 3 or more hours</td>
<td>4/6 (67%)</td>
<td>Bad</td>
</tr>
<tr>
<td><strong>Mesh Performance (Dec 07 09:00 - Dec 08 09:00)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nodes with downstream throughput less than 1.0 Mbps for 3 or more hours</td>
<td>0/22 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Nodes with upstream throughput less than 1.0 Mbps for 3 or more hours</td>
<td>0/22 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Nodes with packet loss rate greater than 10% for 3 or more hours</td>
<td>1/22 (5%)</td>
<td>Good</td>
</tr>
<tr>
<td>Nodes with latency greater than 20 ms for 3 or more hours</td>
<td>1/22 (5%)</td>
<td>Good</td>
</tr>
<tr>
<td>Nodes with traffic exceeding 100 Mbps/hour for 3 or more hours</td>
<td>2/22 (9%)</td>
<td>Marginal</td>
</tr>
<tr>
<td>Routers with 1 or more 2.4 GHz channel changes per hour for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 1 or more 5.8 GHz channel changes per hour for 3 or more hours</td>
<td>1/28 (4%)</td>
<td>Good</td>
</tr>
<tr>
<td>Routers with 2.4 GHz noise level greater than -65 dBm for 3 or more hours</td>
<td>1/28 (4%)</td>
<td>Good</td>
</tr>
<tr>
<td>Routers with 5.8 GHz noise level greater than -95 dBm for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 2.4 GHz airtime greater than 20% for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 5.8 GHz airtime greater than 20% for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Nodes with default PSP less than 50.0% for 3 or more hours</td>
<td>0/22 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Nodes with default RPSP less than 50.0% for 3 or more hours</td>
<td>0/22 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Nodes that are flapping with PSP less than 50.0% for 3 or more hours</td>
<td>0/22 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Nodes that are flapping with RPSP less than 50.0% for 3 or more hours</td>
<td>0/22 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Nodes with hop count of 3 or more for 3 or more hours</td>
<td>0/22 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 20 or more neighbors in 2.4 GHz channel for 3 or more hours</td>
<td>0/20 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 40 or more 2.4 GHz associated clients for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 40 or more 5.8 GHz associated clients for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 40 or more 2.4 GHz routed clients for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Routers with 40 or more 5.8 GHz routed clients for 3 or more hours</td>
<td>0/28 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Gateways with 20 or more nodes for 3 or more hours</td>
<td>0/6 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Gateways with 10 or more interfering gateways in 2.4 GHz channel for 3 or more hours</td>
<td>0/6 (0%)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Clusters with 180 or more clients for 3 or more hours</td>
<td>0/6 (0%)</td>
<td>Excellent</td>
</tr>
</tbody>
</table>
The Network Optimization panel presents summary statistics for the following categories:

- **Missing Data**—Nodes, gateways, and all routers with errors in transmitting or receiving data.
- **Backhaul performance**—Gateways with throughput, latency, packet loss, and utilization relative to specified thresholds.
- **Mesh performance**—Mesh links, nodes, gateways, and all routers with performance statistics relative to specified thresholds.

Each row in the network optimization panel describes the statistic, the current value (ratio and percentage), and a description of the status, as in the following example.

<table>
<thead>
<tr>
<th>Details</th>
<th>Description</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodes with latency greater than 20 ms for 3 or more hours</td>
<td>1/22 (5%)</td>
<td>Good</td>
</tr>
</tbody>
</table>

This example indicates that 1 of 22 routers have had latency greater than 20ms for 3 or more hours (the other routers have had lower latency), which is considered good performance for this metric.

**Change status key or thresholds**

1. Choose values from any of the pull-down lists on the optimization panel. To use the thresholds as the new defaults, select **Save above thresholds as default thresholds**.
2. Click **Submit**.

**View network optimization details**

- Click the underlined link for the parameter to open the associated details panel.
Each panel includes pull-down lists for setting thresholds, and a table containing statistics for each hour in the selected time period. For 24-hour details, green numbers indicate that the data is within threshold for that hour, red indicates that the data violates the threshold, and black indicates that no data is available.

You can do the following on this panel:

- Choose thresholds from the pull-down lists.
- Click **Show Fail Records** to display all records for routers that violated the threshold during the specified period.
- Click **Show All Records** to display all records for the specified period.
- Click **Show Maps** to open a Google Maps window showing the router location.
- Click an underlined router link to open an information window for the router. For more information, see the description of the Gateway/Node Information window in “Using the Geographic Maps” on page 28.
Click the graph icon on the right to display a graph of the data. For example, the next graph shows link PSP data for a gateway.

![Graph of link PSP data](image)

**Using the Client Optimization Panels**

The Client Optimization panels present detailed statistics on client performance.

**Access the panels**

- Open the Network Health tab and choose **Client Optimization** on the side menu.

  The Client Optimization panel (Figure 9) opens.

**FIGURE 9  Client Optimization Panel**
Each row in the client optimization panel describes the statistic, the current value (ratio and percentage) and a description of the status, as in the following example:

<table>
<thead>
<tr>
<th>Optimization</th>
<th>Value</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clients with SNR less than 10 dB for 3 or more hours</td>
<td>1/78</td>
<td>Good</td>
</tr>
<tr>
<td>Clients with signal less than 77 dBm for 3 or more hours</td>
<td>2/78</td>
<td>Good</td>
</tr>
<tr>
<td>Clients with noise over -80 dBm for 3 or more hours</td>
<td>2/78</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

**Change status key or thresholds**

1. Choose values from any of the pull-down lists on the optimization panel. If you want to use the thresholds as the new defaults, select **Save above thresholds as default thresholds**.
2. Click **Submit**.

**View client optimization details**

- Click the underlined link for the parameter to open the associated details panel.

Each panel includes pull-down lists for setting thresholds, and a table containing statistics for each hour in the selected time period. For the 24-hour details, green numbers indicate that the data is within threshold for that hour, red indicates that the data violates the threshold, and black indicates that no data is available.

You can do the following on this panel:

- Choose thresholds from the pull-down lists.
- Click **Show Fail Records** to display all records for routers that violated the threshold during the specified period.
- Click **Show All Records** to display all records for the specified period.
Click the graph icon on the right to display a graph of the data.

```
Client SNR: 00:0E:35:06:80:07
```

Click an underlined Client MAC address link to open the Client Query window for the selected client (see next section). The MAC addresses include prefixes.

**Understanding the Client Query Reports**

You can access the detailed client information by clicking any of the MAC address links on the Client Optimization page. The Client Query report presents information about the client’s network activity over the past 24 hours.

```
<table>
<thead>
<tr>
<th>Client/CPE Average History Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC Address</td>
</tr>
<tr>
<td>00:19:02:7B:61:63</td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>Clients behind CPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>index</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>Visited Node/Gateway History Average Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Node</td>
</tr>
<tr>
<td>Gateway</td>
</tr>
</tbody>
</table>
```

Table 6 describes information summarized in the Client/CPE Average History Information area at the top of the panel.
The Visited Node/Gateway History Average Information area lists statistics for node and gateway associations. Each row presents information for a node or gateway to which the client associated over the past 24 hours. Table 7 lists the information reported for each associated node and gateway.

**TABLE 6 Client/CPE Average History Information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC Address</td>
<td>MAC address of the client machine about which to be reported</td>
</tr>
<tr>
<td>IP Address</td>
<td>IP address of the client machine about which to be reported</td>
</tr>
<tr>
<td>Rx Kbps</td>
<td>Average Kbps received over the past 24 hours</td>
</tr>
<tr>
<td>Tx Kbps</td>
<td>Average Kbps transmitted over the past 24 hours</td>
</tr>
<tr>
<td>Signal</td>
<td>Average signal strength over the past 24 hours (dB)</td>
</tr>
<tr>
<td>Noise</td>
<td>Average noise level over the past 24 hours (dB)</td>
</tr>
<tr>
<td>SNR</td>
<td>Average signal-to-noise ratio over the past 24 hours</td>
</tr>
</tbody>
</table>

**TABLE 7 Visited Node/Gateway History Average Information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Node or gateway.</td>
</tr>
<tr>
<td>Node IP</td>
<td>IP address of the node or gateway. To view this information, click the underlined line to open the Configuration Utility for the particular node or gateway.</td>
</tr>
<tr>
<td>Node ID</td>
<td>Tropos identifier for the node or gateway.</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>Total number of minutes that the client was associated with the node or gateway in the past 24 hours.</td>
</tr>
<tr>
<td>Signal</td>
<td>Average signal strength for the period of association (dB). Click the underlined line to open a signal and noise graph.</td>
</tr>
<tr>
<td>Noise</td>
<td>Average signal strength for the period of association (dB).</td>
</tr>
<tr>
<td>SNR</td>
<td>Average signal strength for the period of association.</td>
</tr>
<tr>
<td>Rx Kbps</td>
<td>Average Kbps received for the period of association. Click the underlined link to open a graph of the data.</td>
</tr>
<tr>
<td>Tx Kbps</td>
<td>Average Kbps transmitted over the past 24 hours.</td>
</tr>
<tr>
<td>Location</td>
<td>GPS coordinates of the node or gateway, if available.</td>
</tr>
</tbody>
</table>
The Detail Data area, which opens when you click the double arrows on the Detail Data bar, shows the pattern of associations over the past 24 hours.

Each row represents a period of association with one of the nodes or gateways listed in the Visited Node/Gateway area.

**Note**
*If a client associates with more than one node in a given hour, then there will be multiple entries for that time period in the listing.*

Table 7 lists the information reported for association.

### TABLE 8  Detail Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node IP</td>
<td>IP address of the node or gateway. Click the underlined line to open the Configuration Utility for the particular node or gateway.</td>
</tr>
<tr>
<td>Signal</td>
<td>Average signal strength for the period of association (dB). Click the underlined line to open a signal and noise graph.</td>
</tr>
<tr>
<td>Noise</td>
<td>Average signal strength for the period of association (dB)</td>
</tr>
<tr>
<td>SNR</td>
<td>Average signal strength for the period of association</td>
</tr>
<tr>
<td>Rx Kbps</td>
<td>Average Kbps received for the period of association. Click the underlined link to open a graph of the data</td>
</tr>
<tr>
<td>Tx Kbps</td>
<td>Average Kbps transmitted over the past 24 hours</td>
</tr>
<tr>
<td>CPE MAC</td>
<td>MAC address of any customer premise equipment (CPE) between the client and the node or gateway</td>
</tr>
<tr>
<td>ESSID</td>
<td>ESSID of the node or gateway</td>
</tr>
<tr>
<td>VLAN ID</td>
<td>ID of the VLAN to which the node or gateway belongs, if applicable</td>
</tr>
<tr>
<td>Channel</td>
<td>Channel used for communication with the client</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>Total number of minutes that the client was associated with the node or gateway in the past 24 hours.</td>
</tr>
<tr>
<td>Time Period With Date</td>
<td>Interval of association, with the date (mm/dd) followed by start and end times.</td>
</tr>
</tbody>
</table>
To display detailed client statistics and events, click **Troubleshooting**. Use the time filters at the top of the page to restrict the display to a specified time period.

---

### Using the Voice Optimization Panels

The Voice Optimization panels present detailed statistics on voice calls within the network. To access the panel, open the Network Health tab and choose **Voice Optimization** on the side menu.

Each row in the voice optimization panel describes the statistic, the current value (ratio and percentage) and a description of the status.

**Change status key or thresholds**

1. Choose values from any of the pull-down lists on the optimization panel. If you want to use the thresholds as the new defaults, select **Save above thresholds as default thresholds**.

2. Click **Submit**.

**View voice optimization details**

- Click the underlined link for the parameter to open the associated details panel.

Each panel includes pull-down lists for setting thresholds, and a table containing statistics for each hour in the selected time period. For the 24-hour details, green numbers indicate that the data is within threshold for that hour, red indicates that the data violates the threshold, and black indicates that no data is available.
You can do the following on this panel:

- Choose thresholds from the pull-down lists.
- Click **Show Fail Records** to display all records for routers that violated the threshold during the specified period.
- Click **Show All Records** to display all records for the specified period.
- Click the graph icon on the right to display a graph of the data.
- Click an underlined Client MAC address link to open the Client Query window for the selected client (see next section).

**Using the Device Ping Utility**

The Device Ping Utility panel reports on ping operations for specified devices or for all discovered routers. The Ping utility is off by default, but it can be turned on from the web interface.

By default, the devices included in the ping list are listed in the device_pinglist.txt file, which is found in the following location:

`/<installdirectory>/ems/conf/tropos/device_pinglist.txt`. The default file contents are as follows:

```plaintext
# number of threads to do ping
number_threads=20

# interval between every ping cycle, in seconds
ping_interval=20

# number of retries
retries=1

# timeout for each ping request in seconds
timeout=1

# list of IPAddress need to be pinged here
# for gateway use: IPAddress=G,<backhaul IPAddress>
# example: 192.168.128.3=G,192.168.128.4
# for node use: IPAddress=N
# example: 192.168.128.5=N
```

**Add specific devices to the ping list**

1. Open the device_pinglist.txt file.
2. Enter the IP addresses of the devices, according to the format given in the comment text. N refers to note, G to gateway, and B to any non-Tropos device.
3. Save the file.

The entered devices will now appear in the device ping list.
View device ping results

1. Open the Network Health tab and choose **Device Ping Utility** from the side menu. The Device Ping Utility panel (Figure 10) opens.

**FIGURE 10  Device Ping Utility Panel**

![Device Ping Utility Panel](image)

2. Perform any of the following operations:
   - Click **Start Ping** to start performing ping operations. (The button is visible only if ping operations are currently off.)
   - Click **Stop Ping** to stop performing ping operations. (The button is visible only if ping operations are currently on.)
   - Click **Clear Counter** to clear current ping counts.
   - Click **Turn Off Refresh** to prevent information from being automatically refreshed as new ping results come in. (This button is visible only if refresh is currently turned on.)
   - Click **Turn On Refresh** to allow information to be automatically refreshed as new ping results come in. (This button is visible only if refresh is currently turned off.)
   - Click **Add IPs in topo DB** to add all the discovered gateways and nodes to the list of devices to which ping messages are sent. Devices specified in the device_pinglist.txt file will continue to be included.
   - Click **Remove topo IPs** to remove all the discovered gateways and nodes the list of devices to which ping messages are sent. Devices specified in the device_pinglist.txt file will continue to be included.

The Device Ping Utility table includes the following columns of information:

**TABLE 9  Device Ping Utility Table**

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device IP</td>
<td>IP address of device</td>
</tr>
<tr>
<td>Type</td>
<td>Gateway, node, or backhaul</td>
</tr>
<tr>
<td>Status</td>
<td>Up (responding to ping commands) or down (not responding)</td>
</tr>
</tbody>
</table>
Chapter 4

Modifying Network Health Thresholds and Report Options

The default Network Health thresholds and report selection options are appropriate for most deployments; however, you can modify them, if necessary, by editing the appropriate configuration files.

Modifying Network Health Thresholds

Thresholds are applied to a variety of performance metrics to determine whether problems exist in the network. If the problem thresholds are not met, the cell is listed as problem free.

The thresholds are set in the file threshold.txt, which is in the following location:

`/<installdirectory>/ems/networkhealth`

If you choose to edit the file, be sure to maintain a backup copy with the default values.

Default file contents

```
# used for worst used link
# if linkpsp is below MINUSEDLINKPSP or MINUSEDLINKRPSP and the link activity is above the MINUSEDLINKPSP
# this link will be included into the Lowest used link
# link activity defined as the link was seen by node for a given hour.
# example: linkA was in the node 20 minutes, it means that this link's activity is 20/60 = 0.33
#
# MINUSEDLINKPSP values = 0..1
# MINUSEDRPSP values = 0..1
# MIN
MINUSEDLINKPSP0.65
MINUSEDLINKRPSP0.65
MINUSEDLINKPSPACTIVITY0
```

### TABLE 9  Device Ping Utility Table (continued)

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success Rate</td>
<td>Percentage of successful ping responses</td>
</tr>
<tr>
<td>Last Ping Time</td>
<td>Time last ping request was sent</td>
</tr>
<tr>
<td>Backhaul IP</td>
<td>IP address of device used to check backhaul connectivity</td>
</tr>
<tr>
<td>Failed Ping Count</td>
<td>Number of failed ping attempts</td>
</tr>
<tr>
<td>Total Ping Count</td>
<td>Total number of ping attempts</td>
</tr>
</tbody>
</table>
# used for deciding the redundant path
# if the link psp is > MINLINKACTIVITY and > MINLINKPSP, this link will be counted as redundant path
# MINLINKPSP 0.65
MINLINKPSP 0.65
MINLINKRPSP 0.65
MINLINKACTIVITY 0

# max hops is used to test if node should be put into highest hop count
# if hops is above this MAXHOPS, the node will be put into highest hop count
MAXHOPS 4

# is used for lowest psp
# if psp is below this MINPSP, the node will be included into lowest psp
# value between 0..1
MINPSP 0.65

# for lowest rpsp
# if rpsp is below this MINRPSP, the node will be included into lowest rpsp
MINRPSP 0.65

# for high noise
# if noise is above this MAXNOISE, the node will be included into the highest noise
MAXNOISE -80

# for reachability
# if the reachability is below this MINREACHABILITY, the node will be included in the reachability category
MINREACHABILITY 97

# if client has snr below this LOWESTSNR, the client will be included into the lowest SNR client
LOWESTSNR 15
# if node has redundancy below this LOWESTREDUNDANCY, the node will be included into the Insufficient Redundancy
LOWESTREDUNDANCY2
#
#
# if node throughput (up/down) is lower than MINTHROUGHPUT (UP/DOWN), the node will be included into
# the Lowest estimated throughput
MINTHROUGHPUTUP 256
MINTHROUGHPUTDOWN 512

Modifying Report Options

Drop-down lists on the Network Optimization page determine the thresholds that apply to network optimization reports.

These thresholds are controlled by the following files, which are located in /<installdirectory>/conf/server/:

- fhp_ems_networkhealth_report_threshold.properties.txt -- determines the possible choices of values for the drop-down list.
- server_networkhealth_threshold.txt -- determines the default value that is preselected in the drop-down list.

Note the following:

- If you choose to edit these files, be sure to maintain a backup copy with the default values.
- You can modify only the parameters that are in a given file. You cannot create new entries.
- If you change a default value in the server_networkhealth_threshold.txt file, make sure that the value is included in the possible selections for that parameter in the fhp_ems_networkhealth_report_threshold.properties.

The parameters in the files map to values and report names as follows.

- messageCountOptions=10000,5000,2000,1000,500,300,200,150,100,50,10 - it is used by— message count report
- BackhaulThroughputOptions=1.0,2.0,3.0,4.0,5.0,8.0,10.0,20.0,30.0,50.0,80.0 - it is used by— Gateways with downstream throughput report
— Gateways with upstream throughput report
ThroughputOptions=0.25,0.5,0.75,1.0,1.5,2.0,2.5,3.0,3.5,4.0,5.0 - it is used by
  — Nodes with downstream report
  — Nodes with upstream report

LatencyOptions=2000,500,200,100,50,30,20,15,10,5,1 it is used by
  — Devices with backhaul latency report
  — Nodes with latency report

LinkOptions=30,40,50,60,65,70,80,90,100 it is used by
  — Nodes with default PSP report
  — Nodes with default RPSP report
  — Nodes that are flapping with PSP report
  — Nodes that are flapping with RPSP report

NoiseOptions=-150,-100,-90,-85,-80,-70,-60,-50 - it is used by
  — Clients with noise report
  — Routers with 2.4 GHz noise level report
  — Routers with 5.8 GHz noise level report
  — Routers with 24.9 GHz noise level report

ChChangeOptions=1,2,3,4,5,6,7,8,9,10 - it is used by
  — Routers with 2.4 GHz channel change report
  — Routers with 5.8 GHz channel change report
  — Routers with 4.9 GHz channel change report

AirtimeOptions=40,50,60,70,80,90 - it is used by
  — Routers with 2.4 GHz airtime report
  — Routers with 5.8 GHz airtime report
  — Routers with 4.9 GHz airtime report

MissingDataOptions=1,2,3,4,6,8,12,24 - it is used by the:
  — Routers with missing data report
  — Gateways with missing backhaul report
  — Nodes with missing mesh throughput report

voiceMissingDataOptions=1 - not currently used

MissingDataOptionsWithZero=0,1,2,3,4,6,8,12,24 - not currently used

nodeNumberOptions=1,2,3,4,5,6,7,8,9,10,15,20,30,40,50,60,70,80 - it is used by
  — Routers with 2.4 GHz associated client report
  — Routers with 5.8 GHz associated client report
  — Routers with 4.9 GHz associated client report
  — Routers with 2.4 GHz routed client report
  — Routers with 5.8 GHz routed client report
  — Routers with 4.9 GHz routed client report
  — Gateways with nodes report
- gatewayNumberOptions=1,2,3,4,5,10,15,20,25,30,35,40 - it is used by
  - Routers with neighbors report
  - Gateway with interfering gateways (in 2.4 GHz channel) report
- clientNumberOptions=1,5,10,30,50,70,80,90,100,120,150,200 - not currently used
- clusterclientNumberOptions=1,10,20,30,50,80,100,120,150,200,300,500 - it is used by
  - Clusters with clients report
- trafficOptions=50,80,100,120,150,200,300,500,1000,2000,3000,4000,5000,10000 - it is used by
  - Gateways with backhaul utilization report.
  - Nodes with traffic report
  - Clients with traffic report
- packetLossOptions=1,5,10,15,20,25,30,40 - it is used by
  - Devices with backhaul packet loss report
  - Nodes with packet loss report
- hopCountOptions=1,2,3,4,5,6,7,8,9,10 - it is used by
  - Nodes with hop count report
- signalOptions=-100,-90,-85,-80,-75,-70,-60,-50 - it is used by
  - Clients with signal report
- SNROptions=1,5,10,15,20,25,30,50,80 - it is used by
  - Clients with SNR report
- ClientRateLimitOptions=1,5,10,20,30,40,50 - it is used by
  - Clients rate limited report
- marginalOptions=3,5,8,10,15,20,25,30,40 - it is used as marginal options
- poorOptions=10,15,20,25,30,40,50,60,70 - it is used as poor options
- badOptions=15,20,25,30,40,50,60,70,80,90 - it is used as bad options
- voiceCallsOptions=0,1,2,3,4,5,6,7,8,9,10,25,50,100 - it is used by
  - Routers with number of voice calls
- voiceCallsDowngradedOptions=0,1,2,3,4,5,6,7,8,9,10,25,50,100 - it is used by
  - Routers with number of downgraded voice calls
- voiceCallsTimeOptions=0,10,30,60,120,240,360 - it is used by
  - Routers with total minutes voice calls

Default fhp_ems_networkhealth_report_threshold.properties file:
messageCountOptions=10000,5000,2000,1000,500,300,200,150,100,50,10
BackhaulThroughputOptions=1.0,2.0,3.0,4.0,5.0,8.0,10.0,20.0,30.0,50.0,80.0
ThroughputOptions=0.25,0.5,0.75,1.0,1.5,2.0,2.5,3.0,3.5,4.0,5.0
LatencyOptions=2000,500,200,100,50,30,20,15,10,5,1
LinkOptions=30,40,50,60,65,70,80,90,100
NoiseOptions=-150,-100,-90,-85,-80,-70,-60,-50
ChChangeOptions=1,2,3,4,5,6,7,8,9,10
AirtimeOptions=40,50,60,70,80,90
MissingDataOptions=1,2,3,4,6,8,12,24
voiceMissingDataOptions=1
MissingDataOptionsWithZero=0,1,2,3,4,6,8,12,24
nodeNumberOptions=1,2,3,4,5,6,7,8,9,10,15,20,30,40,50,60,70,80
gatewayNumberOptions=1,2,3,4,5,10,15,20,25,30,35,40
clientNumberOptions=1,5,10,30,50,70,80,90,100,120,150,200
clusterclientNumberOptions=1,10,20,30,50,80,100,120,150,200,300,500
trafficOptions=50,80,100,120,150,200,300,500,1000,2000,3000,4000,5000,10000
packetLossOptions=1,5,10,15,20,25,30,40
hopCountOptions=1,2,3,4,5,6,7,8,9,10
signalOptions=-100,-90,-85,-80,-75,-70,-60,-50
SNROptions=1,5,10,15,20,25,30,50,80
ClientRateLimitOptions=1,5,10,20,30,40,50
marginalOptions=3,5,8,10,15,20,25,30,40
poorOptions=10,15,20,25,30,40,50,60,70
badOptions=15,20,25,30,40,50,60,70,80,90
voiceCallsOptions=0,1,2,3,4,5,6,7,8,9,10,25,50,100
voiceCallsDowngradedOptions=0,1,2,3,4,5,6,7,8,9,10,25,50,100
voiceCallsTimeOptions=0,10,30,60,120,240,360

Default server_networkhealth_thresholds.txt file
nodeMissingThroughputDataThreshold=3
nodeNoiseThreshold=-85
clientNoiseThreshold=-85	nodeRoutedClientThreshold=40	nodeAssociateClientThreshold=40
clientSignalThreshold=-75
clientRateLimitThreshold=5
voiceCallsDowngradedThreshold=10
gatewayMissingThroughputDataThreshold=3
missingStatsThreshold=3	nodeAssociateClient1Threshold=40
gatewayTrafficThreshold=300	nodeTrafficThreshold=100
poorThreshold=10
voiceCallsThreshold=10
gatewayInterferingCountThreshold=10
clientSNRThreshold=10
nodeMissingDataThreshold=3
failureTimeThreshold=3
clientTrafficThreshold=100
nodeNoise1Threshold=-85
nodeNoise4_9Threshold=-85;
nodeAssociateClient4_9Threshold=40
nodeRoutedClient4_9Threshold=40
nodeChChangeThreshold=1
nodeChChange1Threshold=1
nodeChChange4_9Threshold=1
nodeAirtimeThreshold=60
nodeAirtime1Threshold=60
nodeAirtime4_9Threshold=60
5 Viewing Fault Information

This chapter describes the Fault Management panels in the web interface.

Chapter contents:
- Viewing Network Events
- Viewing Alarms
- Viewing Event Counts
- Configuring Alarms
Viewing Network Events

Network events convey general information or current status of devices within the network.

**View network events**
- Open the Network Health tab and choose **Network Events** on the side menu.

The Network Events panel (Figure 11) opens to display a list of current events for devices configured in the network.

**FIGURE 11  Network Events Panel**

Table 10 lists the columns of information presented in the Network Events table.

**TABLE 10  Network Events List**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Status</td>
<td>Color code for the severity of the event:</td>
</tr>
<tr>
<td></td>
<td>• Red—Critical</td>
</tr>
<tr>
<td></td>
<td>• Orange—Major</td>
</tr>
<tr>
<td></td>
<td>• Yellow—Minor</td>
</tr>
<tr>
<td></td>
<td>• Blue—Warning</td>
</tr>
<tr>
<td></td>
<td>• Green—Clear</td>
</tr>
<tr>
<td></td>
<td>• White—Information</td>
</tr>
<tr>
<td>• IP address</td>
<td>IP address of the router that generated the event.</td>
</tr>
<tr>
<td>• Display name</td>
<td>The alphanumeric name assigned to the router.</td>
</tr>
<tr>
<td>• Event Details/Message</td>
<td>Brief summary of the event message. Click the underlined link to open the Event Properties window for the event.</td>
</tr>
<tr>
<td>• Date/Time</td>
<td>Date and time that event occurred.</td>
</tr>
<tr>
<td>• Source</td>
<td>Serial number of the router.</td>
</tr>
<tr>
<td>• Category</td>
<td>Type of event.</td>
</tr>
<tr>
<td>• Information</td>
<td>Full text of event message.</td>
</tr>
</tbody>
</table>
Viewing Alarms

Alarms call attention to serious events concerning devices in the network.

**View alarms**
- Open the Network Health tab and choose **Alarms** on the side menu.

The Alarms panel (Figure 11) opens to display a list of current alarms for devices configured in the network.

**FIGURE 12  Alarms Panel**

Table 11 lists the columns of information presented in the table.

**TABLE 11 Alarms List**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Color code for the severity of an event:</td>
</tr>
<tr>
<td></td>
<td>• Red---Critical</td>
</tr>
<tr>
<td></td>
<td>• Orange---Major</td>
</tr>
<tr>
<td></td>
<td>• Yellow---Minor</td>
</tr>
<tr>
<td></td>
<td>• Blue---Warning</td>
</tr>
<tr>
<td></td>
<td>• Green---Clear</td>
</tr>
<tr>
<td></td>
<td>• White---Informational</td>
</tr>
<tr>
<td>IP address</td>
<td>IP address of the router that generated the event.</td>
</tr>
<tr>
<td>Actions</td>
<td>Icons for alarm pickup and annotation:</td>
</tr>
<tr>
<td></td>
<td>For alarm pickup, click the icon to assign the alarm to your user ID.</td>
</tr>
<tr>
<td></td>
<td>For annotation, click the icon to open the pop-up Annotation window. Enter</td>
</tr>
<tr>
<td></td>
<td>a comment and click <strong>Annotate</strong>. Click <strong>Close</strong> to close the Annotation</td>
</tr>
<tr>
<td></td>
<td>window.</td>
</tr>
<tr>
<td>Display Name</td>
<td>The alphanumeric name assigned to the router.</td>
</tr>
<tr>
<td>Alarm Details/Message</td>
<td>Brief summary of the alarm message. Click the underlined link to open the</td>
</tr>
<tr>
<td></td>
<td>Alarm Properties window for the event.</td>
</tr>
<tr>
<td>Date/Time</td>
<td>Date and time that the event occurred.</td>
</tr>
<tr>
<td>Failure Object</td>
<td>Code for the type of failure.</td>
</tr>
</tbody>
</table>
Viewing Event Counts

The Event Counts panel provides a consolidated summary of event for each router.

View alarms
1. Open the Network Health tab and choose Event Count on the side menu.
2. The Event Count panel (Figure 13) opens to display a summary of events by router IP address.

FIGURE 13  Event Count Panel

You can choose the following options from the Event Counts panel:
— To restrict the reporting time interval, select from the pull-down list at the top of the panel, and click Submit.
— To display all the events for a given router, click an underlined link in the Total column.
— To display details about a router, click the underlined IP address.
— To access the Configuration Utility for the router, click the underlined IP address link.
— To open an SSH window to access the router CLI, click an underlined link in the SSH column.

Table 12 lists the columns of information presented in the Event Count table.
Configuring Alarms

The Alarm Settings panel allows you to create alarm notifications based on filtering criteria. You can set up an alarm actions to send email notification or an SNMP trap under specified conditions, or create an exception whereby a notification is not sent in response to a condition.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node IP</td>
<td>IP address of the router that generated the event</td>
</tr>
<tr>
<td>Host name</td>
<td>Unique numeric ID assigned to the node</td>
</tr>
<tr>
<td>Node type</td>
<td>Gateway, node, or mobile</td>
</tr>
<tr>
<td>Total</td>
<td>Total event count</td>
</tr>
<tr>
<td>Router Reachability</td>
<td>Count of events concerning the ability to reach other routers</td>
</tr>
<tr>
<td>SNMP Timeout</td>
<td>Counts of SNMP timeout events</td>
</tr>
<tr>
<td>Gateway Becomes Node</td>
<td>Number of times a gateway has lost uplink to the wired network and automatically taken on node status</td>
</tr>
<tr>
<td>Configurator Login</td>
<td>Number of times someone has logged into the Tropos Configuration Utility to access the router</td>
</tr>
<tr>
<td>Failed Install New Image</td>
<td>Number of times an attempt to install a new software image on the router has failed</td>
</tr>
<tr>
<td>SSH Login</td>
<td>Number of times someone has accessed the router CLI through an SSH connection</td>
</tr>
<tr>
<td>Hardware Fault</td>
<td>Number of times a hardware problem has been detected</td>
</tr>
<tr>
<td>Software Start</td>
<td>Number of times the router software has been restarted</td>
</tr>
<tr>
<td>Others</td>
<td>Count of other events that do not fit into the specific categories list in this table</td>
</tr>
</tbody>
</table>

TABLE 12 Event Count Information
To manage alarm settings

1. Open the Network Health tab and choose **Alarm Settings** on the side menu to open the panel and view the list of currently defined alarm actions.

**FIGURE 14  Adding Alarm Actions**

<table>
<thead>
<tr>
<th>Name</th>
<th>Delete</th>
<th>Enable/Disable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router Unreachable 1</td>
<td>✗</td>
<td>Disable</td>
</tr>
<tr>
<td>Battery action</td>
<td>✗</td>
<td>Disable</td>
</tr>
</tbody>
</table>

2. Perform any of the following actions on this panel.

   — To add a new action, click **Add Actions** and follow the instructions in “To add new alarm actions” on page 54.

   — To edit an action, link the action name and modify settings as described in **Table 13**.

   — To Delete the action, click the **Delete** icon.

   — To activate an action, click the **Enable** link.

   — To inactivate an action, click the **Disable** link.

   — To export action settings, click **Save Actions**, specify a file name, and click **Save**. Actions are saved in the /<installdirectory>/ems/conf directory.

   — To load previously saved actions, click **Load Actions**. Specify the file name from the /<installdirectory>/ems/conf directory, and click **Load**.

**To add new alarm actions**

1. Click **Add Actions**.

**FIGURE 15  Adding Alarm Actions**
2. Configure the settings in Table 13.

3. You can associate actions that have already been defined, or create new actions and then associate them.
   - To create a new email action, click New Email Action, configure the settings described under New Email action in the table, and click Submit.
   - To create a new suppression action, click New Suppression Action, specify a name for the action, and click Submit.
   - To associate actions, highlight them in the Available Actions column and use the arrows to move it them to the Associated Actions column.
   - To edit an existing action, select it and click Edit.

4. Click Submit to save the actions and return to the Alarm Settings page.
### TABLE 13 Alarm Settings

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Enter a unique name to identify the action.</td>
</tr>
<tr>
<td>Source</td>
<td>Click the link to select the devices to include in the action. Select the devices that you want to include in the Available Routers list, and click the right-facing arrow to move them to the Selected Routers area. You can use the links near the bottom of the screen to select or sort the groups of devices in the list, or use the double arrows to move the entire list.</td>
</tr>
<tr>
<td>Severity</td>
<td>Select an alarm severity, or select <strong>All</strong> to include alarms of all severities.</td>
</tr>
</tbody>
</table>
| Category          | Select one of the following alarm categories or select **Any Category** to include alarms in all categories:  
  - Router Reachability: There has been a change in the ability to reach the device.  
  - Gateway Becomes Node: Gateway has lost its wired connection and switched to node operation.  
  - Switched to Battery: Router has lost power and switched to battery operation.  
  - Configurator Login: User has logged into the router’s Configuration Utility.  
  
  **Note:** The alarm categories take precedence over the severity settings. For example, all router reachability alarms are of critical severity. If you choose Router Reachability as the category with a non-critical severity, the alarm action is still treated as critical. |
| New Email Action  | Specify the following settings:  
  - Notification Name: Name to identify the email action.  
  - SMTP Server: IP address or host name of the Simple Mail Transfer Protocol (SMTP) server.  
  - SMTP Account Name: User name for access to the SMTP server.  
  - Password: User password for access to the SMTP server.  
  - To Address: Email address that will appear in the To line of the email notification.  
  - From Address: Email address that will appear in the To line of the email notification.  
  - Aggregate after (secs): Number of seconds to enter if you want to collect all matching alarms during that interval and then send them in one email notification.  
  - Message: Body of the email notification.  
  - Select drop down list: Preset entries that you can add to the message: category, severity, and source. |
SNMP Trap Forwarding

Use the SNMP trap forwarding page to forward SNMPv3 traps to an external trap manager.

**Forward SNMP traps**

1. Open the Network Health tab and choose *Trap Forwarding* on the side menu.

2. Configure the settings in the following table.
3. Click *Submit*.

**TABLE 13 Alarm Settings (continued)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Suppression Action</td>
<td>Enter a name to identify the action.</td>
</tr>
</tbody>
</table>

**TABLE 14 Alert Filter Settings**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trap Destination IP</td>
<td>Enter the IP address of the external server designated to receive the SNMP traps.</td>
</tr>
<tr>
<td>SNMP User Name</td>
<td>User name for SNMP access.</td>
</tr>
<tr>
<td>Auth Type</td>
<td>Choose the cryptographic algorithm (MD5, SHA, or No Auth) to use in authenticating communications between Tropos Control and the external server.</td>
</tr>
<tr>
<td>Auth Key</td>
<td>Enter an authentication key to secure the communications between Tropos Control and the external server designated to receive the SNMP traps.</td>
</tr>
<tr>
<td>SNMP Port</td>
<td>Enter the Tropos Control server port to use for SNMP communications.</td>
</tr>
</tbody>
</table>
6 Viewing Network Configuration Information

This chapter describes how to display device information using the Network Configuration panels in the web interface.

Chapter contents:

- Network Configuration Panels
- Configuration View Actions
- Updating the Device Database
- Configuring Gateways for Multi-Subnet Roaming
Network Configuration Panels

The Configuration View tab presents device information from the Tropos Control database. The information shown in each panel is described in “ Provisioning Forms” on page 78.

Note

The Configuration View displays only the menu items that are included in your product.

The Configuration View tab includes the following panels:

- Complete View---General status information
- Router Synchronization---Make router configurations consistent with each other
- Inventory---List of routers in the database.
- Router Identity---Identity and location information
- Device and IP---Interface and network address information
- Wireless---Information on wireless signal characteristics
- DHCP Server---Status of the on-board DHCP server
- Time---Time configuration and Network Time Protocol (NTP) server information
- Packet Filtering Predefined Rules---Rules currently defined, listed by router and protocol type
  - Customized Rules---Special filtering rules
  - Deny Rules---Rules to deny access
- VLAN---VLAN configuration information
- VLAN Information---Provides status information and lists the type of VLAN
- Rate Limiting---Information status, caps, and triggers for rate limiting
- QoS---Information on Quality of service (QoS) settings
- QoS ESSID Parameters---Information on QoS settings defined for specific ESSIDs
- Static IP Client---Information on clients that are configured with static IP addresses
- P2P Blocking---Information on blocking of communications between clients in specified subnets
- Backhaul Routing---Information on neighboring Border Gateway Protocol (BGP) routers that are one Layer 3 hop away
- Multi-ESSID---Information on secondary ESSID and multiple BSSIDs
- Router Access Control---Information on access restrictions for packet filtering
- Multi-Subnet---Source and destination information for multi-subnet roaming
  - Gateway List---Gateway information for multi-subnet roaming
  - Additional Subnets---Subnets available for roaming
- Voice---Information on voice parameters
- Security---Information on security settings
- SNMP users--List of current SNMP users
- SNMP--List of configured SNMP trap destinations
Configuration View Actions

You can perform all of the following actions from the Configuration View panels:

- View configuration information
- Search in a configuration view panel
- Print the configuration view list
- Export the configuration view list
- View alarms or events for selected routers
- Customize the configuration view columns
- Add a device
- Delete routers
- Synchronize routers
- Customize the configuration view columns

View configuration information
1. Open the web interface and choose Configuration View.
2. Choose the desired panel from the side menu.

Search in a configuration view panel
1. Click Search to open the Search window.
2. Choose an item to match from the pull-down list.
3. Choose the matching criterion from the pull-down list.
4. Enter the text to match. To match additional items:
   a. Click More and choose additional criteria. You can continue to request more items by clicking More repeatedly.
   b. Select a radio button to match any one of the criteria (OR match) or all of the criteria (AND match).
5. Click Search.
   The window opens to display the matching items.

Print the configuration view list
1. Click Print to open a window containing a print-formatted version of the list.
2. Click Print.

Export the configuration view list
1. Click Export.
   A pop-up window prompts you to open or save the view information in csv (comma-separated) format.
2. Click Save, browse for a file location, enter the file name, and click Save.
**View alarms or events for selected routers**

- Select the routers, and click View Alarms or View Events.

The Events or Alarms panel opens to show the list for the selected routers.

**Customize the configuration view columns**

1. Click **Customize Columns** to open the Customize Columns window.

2. Select columns from the Available Columns list and use the right-facing arrows to move the selected columns to the Displayed Columns area.

3. To order the columns, use the upward and downward facing arrows.

4. Click **Apply**.
Updating the Device Database

You can add devices and synchronize the device database from any of the Configuration View panels. Use the buttons at the top of the panel.

Add a device
1. Open the Configuration View panel and choose Add Gateway.
2. Click Add Gateway to open the Discover New Gateway window.
3. Enter values as described in Table 15.

**TABLE 15 Gateway Settings for Adding to the Device Database**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP Address</td>
<td>Enter the IP address of the gateway.</td>
</tr>
<tr>
<td>Mesh ID</td>
<td>Enter and confirm the 16-character code that identifies the area of the managed routers. Each managed router must be configured with the same wireless routing domain ID.</td>
</tr>
<tr>
<td>Router Authentication Key</td>
<td>Enter and confirm 16-character ASCII authentication key for communication between the router and Tropos Control.</td>
</tr>
<tr>
<td>Confirm Router Authentication Key</td>
<td></td>
</tr>
<tr>
<td>Management Station IP Address</td>
<td>Enter the IP address of the Tropos Control server in the Management Station IP Address field, or select from the drop down menu.</td>
</tr>
<tr>
<td>Save to File</td>
<td>Select to save the discovery parameters in the /&lt;installdirectory&gt;/ems/conf/server/discover_devices.txt file.</td>
</tr>
</tbody>
</table>

4. Click **Add Gateway**.

Tropos Control searches and discovers the indicated gateway, along with all the nodes in its cluster. When the discovery process is complete, the gateways are added to the Configuration View panels.

**Delete routers**

1. Select one or more routers, and click **Delete Routers**.
2. Click **OK** to confirm.

The selected routers are removed from the Tropos Control database.

**Synchronize routers**

The Synchronize Routers option writes the configuration information in the selected routers to the Tropos Control database. Synchronization occurs automatically every 5 minutes. Use the Synchronize Routers button to perform an immediate update or if a previous update was unsuccessful. You can synchronize up to 10 routers at one time.

1. Select the routers in the table.
2. Click **Synchronize Routers**.
3. A pop-up message explains that the routers will be synchronized. Click **OK** to acknowledge the message.

The information in the Tropos Control database is updated to match the information in the selected routers. When the update is completed, any new information is reflected in the Configuration View panels.
View Events or Alarms
1. Select the routers in the table.
2. Click View Events or View Alarms to open the Events or Alarms page for the selected routers. See “Viewing Fault Information” on page 49 for more information.

Provision
1. Select the routers in the table.
2. Click Provision to open the Provisioning pages for the selected routers. See “Provisioning” on page 68 for more information.

Show Map
1. Select the routers in the table.
2. Click Show Map to open a Google Maps window that shows the selected routers. See “Viewing Geographic Maps” on page 27 for more information.

Creating Custom Views

You can save lists that match search criteria by creating custom views.

Create view
1. Open the Configuration View tab.
2. Open the view for which you want to create the child view.
3. Click the Add Child View link.

4. Enter the view name.
5. Choose an item to match from the pull-down list.
6. Choose the matching criterion from the pull-down list.
7. Enter the text to match.
8. To match additional items:
   a. Click More and choose additional criteria. You can continue to request more items by clicking More repeatedly.
   b. Select a radio button to match any one of the criteria (OR match) or all of the criteria (AND match).

9. To preview the results, click Preview Results.
   The matching list is presented at the bottom of the window.

10. To save the view, click Add Child View.
    The new view is listed as a sub-item on the side menu.

Modify view
1. Click Edit View Criteria.
2. Make changes as desired.
3. Click Apply/Edit View Criteria.

Delete view
1. Click Remove View.
2. Click OK to confirm.

**Configuring Gateways for Multi-Subnet Roaming**

Multi-subnet roaming refers to the ability of client stations to retain links to the wireless network when they move from one router subnet to another. To support multi-subnet roaming, each gateway must store the IP address of all the gateways in the roaming domain.

During multi-subnet roaming, the client’s traffic is routed through its home gateway (the gateway to which it was originally associated). If the home gateway loses its uplink while an associated client is roaming, the client will lose connectivity, unless a redundant gateway is operational in the same home subnet and included in the multi-subnet roaming list. To restore connectivity, the old gateway must become available again or the client must obtain an IP address from the new gateway.

To support multi-subnet roaming, you can configure Tropos Control to automatically distribute the gateway list to all the gateways in the managed network. The distributed gateway list includes all the gateways in the Tropos Control database. See “Multi-Subnet Roaming” on page 110.
Use the web interface to view the current multi-subnet roaming information and status and to update all gateways with the latest gateway information. The information is presented in the following panels.

**Multi-Subnet**

This panel lists all the interconnections between gateways and subnets. To access this panel, open the Configuration View tab and choose **Multi-Subnet**.

Perform the following actions from this panel. To abort an operation before completion, click **Abort**. When the operation is complete, the window opens and prompts you to export the file.

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update Gateway List</td>
<td>Send the current, complete Gateway List to all gateways.</td>
</tr>
<tr>
<td>Clear Gateway List</td>
<td>Remove the gateway list from all gateways. This action disables multi-subnet roaming.</td>
</tr>
<tr>
<td>Show Current Tunnels</td>
<td>Obtain the current multi-subnet roaming tunnels from the gateways. When you click this button the window reopens to show progress.</td>
</tr>
<tr>
<td>Show Current Status</td>
<td>Show the status any current configuration jobs, such as Update Gateway List or Clear Gateway List.</td>
</tr>
<tr>
<td>Show Configuration Summary</td>
<td>Show a summary of the current multi-subnet roaming configuration in a new window.</td>
</tr>
</tbody>
</table>
Gateway List

This panel displays the current gateway list. To access this panel, open the Configuration View tab, choose Multi-Subnet, and then choose Gateway List.

Perform the following actions from this panel:

- Export Result to File—Send the information for the items with selected check boxes to a CSV file.
- Provision—Open the Multi-Subnet Roaming provisioning form to provision the routers in the list, as described in “Multi-Subnet Roaming” on page 110.
Provisioning refers to the process of configuring Tropos routers to operate in the wireless network. Tropos Control supports XML-based provisioning through the web interface to assure that configurations are consistent across the network. This chapter explains how to provision devices.

Chapter contents:
- About Provisioning Operations
- Provisioning Routers Using Web Forms
- Provisioning Routers From a File
- Provisioning Forms
- Other Provisioning Operations
- Auditing Provisioning Jobs
About Provisioning Operations

The web interface supports the following types of provisioning:

- Provisioning from Forms---Use the web interface forms to specify the configuration parameters to provision ("Provisioning Routers Using Web Forms" on page 74).
- Provisioning from Files---Provision router identity or client black list/white list using information stored in files ("Provisioning Routers From a File" on page 76).
- Administrative Operations---Perform a variety of router administration tasks ("Other Provisioning Operations" on page 123).

⚠️ Caution
It is possible for conflicts to arise in applying provisioning changes if multiple administrators are logged in and performing provisioning operations as the same time.

Each provisioning operation involves the tasks listed in Table 16.

### TABLE 16 Provisioning Tasks

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Router selection</td>
<td>Choose the routers that will receive the new configuration values (&quot;Select routers to provision&quot; on page 70).</td>
</tr>
<tr>
<td>2</td>
<td>Configuration</td>
<td>Specify any of the following changes to be made:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Configure values and store them on the Tropos Control server. See &quot;Configure router parameters&quot; on page 75.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specify the type of file provisioning and the source file. See &quot;Specify the type of provisioning and the source file.&quot; on page 77.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Choose an administrative task. See &quot;Other Provisioning Operations&quot; on page 123.</td>
</tr>
<tr>
<td>3</td>
<td>Schedule the provisioning job</td>
<td>Send the stored configuration values or file to the designated routers (&quot;Schedule the provisioning job&quot; on page 72).</td>
</tr>
<tr>
<td>4</td>
<td>Commit</td>
<td>Activate the new configuration values on the designated routers (&quot;Commit the provisioning job&quot; on page 73).</td>
</tr>
</tbody>
</table>
Select routers to provision

1. Open the Provisioning tab (Figure 16) and choose the panel for the type of provisioning that you plan to implement.

FIGURE 16 Provisioning Tab

2. Click Select Devices.
A selection window opens.

3. Select the routers that you want to provision in the Available Routers list, and click the right-facing arrow to move them to the Selected Routers area. You can use the links near the bottom of the screen to select or sort the groups of routers in the list, or use the double arrows to move the entire list.

   **Note**  
   Choose only the routers that you want to provision with the same new parameter settings. Only the settings that you specify as part of the provisioning process must be the same; all other settings can be different.

4. You can also select a **golden** router by highlighting the router and then clicking one of the arrows adjacent to the Golden Router field. The golden router parameter values are the values that are displayed when you open the individual provisioning forms. If you do not explicitly choose a golden router, the first router in the list is automatically designated as golden.

   **Note**  
   The golden router is provisioned only if it is selected. If it is not selected, its values are displayed but it is not included in the provisioning operation.
5. **Click Apply.**

The Provision from Form or Provision from Files panel reopens to show the number of selected routers and information about the golden router.

You can now configure parameters on provisioning forms, specify provisioning files, or perform other administrative operations. See “Provisioning Routers Using Web Forms” on page 74, “Provisioning Routers From a File” on page 76, or “Other Provisioning Operations” on page 123.

**Note**

To clear the list of selected routers, click **Clear Routers.**

---

**Schedule the provisioning job**

1. Open the Provisioning tab and choose the panel for the type of provisioning that you plan to implement.

2. Enter a name for the provisioning job, or keep the default name assigned by the system. The default name incorporates the date and time.

3. Specify the number of retries before the provisioning action is deemed to have failed and the time interval between retries. Provisioning actions may fail if the router cannot be reached or is not in a state to accept the configuration changes.
4. Choose **Provision Now** to begin the provisioning activity immediately, or choose **Provision At**, click to open the calendar, and select a date and time.

![Calendar Image]

At the specified time, the new parameter values are sent to the designated routers. You can now view the provisioning job list and commit the new values.

**Commit the provisioning job**

1. Open the Provisioning tab.
2. Choose **Provision Job List** from the side menu to open the Provision Job list.

![Provision Job List Image]

3. Select checkboxes for the jobs that you want to commit.
4. Confirm that provisioning was successful for the selected jobs (Status column).
5. Click **Commit**.

The Provision from Form panel reopens to show that the requested commit command is to commit the stored data to the routers.

![Provision Form Image]

6. Click **Provisioning** to commit the values that have been successfully provisioned on the selected routers.
The provisioning process is now complete.

**Provisioning Routers Using Web Forms**

This section describes how to provision routers using the Provision from Form panel in the web interface (Figure 17).

**FIGURE 17 Provisioning from Form Panel**

![Provisioning from Form Panel](image)

**Provisioning from Forms - Tasks**

Perform these tasks in the specified order to provision routers using web forms:

1. **Select routers to provision** (on page 70)
2. **Configure router parameters** (on page 75)
3. **Schedule the provisioning job** (on page 72)
4. **Commit the provisioning job** (on page 73)
Configure router parameters

1. Open the Provisioning tab and select the routers to provision (“Select routers to provision” on page 70).

2. Choose one of the provisioning forms listed under Device Settings or Service Settings in the side menu.

3. The selected form opens, as in this Time form example. Configuration parameters from the golden router are displayed.

4. Select checkboxes for each field that you want to provision, and modify the field value as desired. See “Provisioning Forms” on page 78 for descriptions of the parameters on each form.

   \[\text{\textbf{Note}}\]
   \[\text{The fields with checkboxes selected are the ones that will be provisioned on the selected routers. All other values will be ignored. If you modify a field value, the checkbox for that field is automatically selected.}\]

5. Click Submit to save the values on the Tropos Control EMS server.

You can now schedule the provisioning job (“Schedule the provisioning job” on page 72).
Provisioning Routers From a File

This section describes how to provision routers using the Provision from Files panel in the web interface (Figure 18).

FIGURE 18  Provisioning from Files Panel

You can provision the following types of information from a file:

- **Router identity**---Identify the router for the managed network, applying basic identity and location information.
  
The file must begin with the following line and conform to this format:
  
  #uniqueid,display name,latitude,longitude,location,contact
  
  Example:
  
  #uniqueid,display name,latitude,longitude,location,contact
  
  35036,Gateway,37.3935,-122.033,Sunnyvale CA 94085,www.company.com

- **Black list or white list**---Identify clients that are permitted or denied access to the Tropos network.
  
  — ACL Block---Refuse association to the devices with specified MAC addresses.
  
  — ACL Allow---Permit the devices with specifies MAC addresses to associate.
  
  The following black list/white list provisioning operations are supported:
  
  — Apply---Upload a file with MAC addresses to the selected router or routers.
  
  — Retrieve---Copy a file with MAC addresses from the selected router or routers to the Tropos Control server, storing the file in the cell configuration directory in the Tropos Control installation directory.
  
  The black list or white list file must consist of a list of MAC addresses, one per line.
Example:

00:11:22:33:44:55
aa:bb:cc:dd:ee:ff

- **Static IP addresses**—Add routers with static IP address assignments.
  
The file must begin with the following line and conform to this format:
  
  #uniqueid,wiredip,wiredmask,wlan0ip,wlan0mask,wlan1ip,wlan1mask,
  defaultgw
  
  Example:
  
  #uniqueid,wiredip,wiredmask,wlan0ip,wlan0mask,wlan1ip,wlan1mask,
  defaultgw
  19040,172.20.125.95,255.255.255.0,172.20.125.96,255.255.255.0,,
  172.20.125.254
  18505,,172.20.125.105,255.255.255.0,,

**Provisioning from Files - Tasks**

Perform these tasks in order to provision routers from files:

1. **Select routers to provision** (on page 70)
2. **Specify the type of provisioning and the source file.** (on page 77)
3. **Schedule the provisioning job** (on page 72)
4. **Commit the provisioning job** (on page 73)

**Specify the type of provisioning and the source file.**

1. Open the Provisioning tab and select the routers to provision (“**Select routers to provision**” on page 70).
2. Select the type of provisioning:
   
   For router identity:
   
   — Choose **Using Router Identity CSV** file from the provisioning type pull-down list.
   
   For black list/ white list:
   
   — Choose **Using Black List or White List file** from the provisioning type pull-down list.
   
   — Choose whether to provision the list to the routers or retrieve the list from the routers.
   
   — Choose whether the clients in the list will be allowed to access the network or blocked from accessing the network.
   
   For static provisioning:
   
   — Choose **Using Router Static IP** file from the provisioning type pull-down list.
   
3. Choose whether to select the file from your local file server or the Tropos Control server, and browse to locate and open the file.
4. Click **Provision**.

**Provisioning Forms**

The following notes apply to use of the provisioning forms in the web interface:

- Fields marked as unique can be provisioned only to one router at a time.
- Fields marked with a version apply only to routers with the indicated software release.
- Fields that do not apply to the selected routers are grayed out (such as gateway-only fields if only nodes are selected for provisioning).
- Only the fields that have a check box selected are included in the provisioning job. When you enter or modify a value, the associated check box is automatically selected.

This section lists the available provisioning forms and fields:

**Device Settings**
- Router Identity Page
- IP and VLAN Page
- Wireless Page
- Client Access
- DHCP Server
- SNMP
- Time

**Service Settings**
- DHCP Clients
- Static IP Client
- Packet Filtering
- P2P Blocking
- Multi-Subnet Roaming
- Backhaul Routing
- Rate Limiting
- QoS
- Voice

**Administration**
- Software
- Security
Router Identity Page

The Router Identity page (Figure 19) contains information on the physical identity and location of the router. Table 17 describes the parameters on the page.

**FIGURE 19  Router Identity**

![Router Identity](image)

**TABLE 17 Router Identity Settings**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router Mode</td>
<td>Gateway</td>
<td>Node</td>
</tr>
<tr>
<td>Model number</td>
<td>TroposRouter</td>
<td>Identifies the router (text string).</td>
</tr>
<tr>
<td>Name</td>
<td>TroposRouter</td>
<td>Identifies the router (text string).</td>
</tr>
<tr>
<td>Location</td>
<td>Sunnyvale</td>
<td>Identifies the location where the router is installed.</td>
</tr>
<tr>
<td>Contact</td>
<td>---</td>
<td>Identifies the person responsible for the router.</td>
</tr>
</tbody>
</table>

*Note: The router name is not displayed in the wireless client utility on the client's PC. The router is identified only by MAC address.*
### TABLE 17 Router Identity Settings (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitude</td>
<td>-180.000000 - 180.000000; 0</td>
<td>Represents the global longitudinal position of the router (fields are in the format +/- dddd.dddddddd, with up to 8 digits permitted to the right of the decimal point).</td>
</tr>
<tr>
<td>Latitude</td>
<td>-90.000000 - 90.000000; 0</td>
<td>Represents the global latitudinal position of the router (fields are in the format +/- dddd.dddddddd, with up to 8 digits permitted to the right of the decimal point).</td>
</tr>
<tr>
<td>Location Services</td>
<td>Enabled</td>
<td>If enabled, allows router location information to be sent to a client using a special XML call.</td>
</tr>
<tr>
<td>Banner</td>
<td>Enabled</td>
<td>Optional text that is displayed above the information bar. See Figure 5 on page 21. Allows you to specify the use characteristics for the router, as required by NERC-CIP. The maximum length is 128 characters and special characters such as @, &amp;, &lt;, &gt; are not supported.</td>
</tr>
</tbody>
</table>

**Note:** The `Enabled` and `Disabled` states for Location Services and Banner are not specified in the table.
IP and VLAN Page

The IP and VLAN Configuration page (Figure 20) lists network parameters for the router. Table 18 describes all parameters on the page.

**FIGURE 20  IP and VLAN (Excerpt)**

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Static</td>
<td></td>
</tr>
<tr>
<td>LAN/Backhaul IP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAN/Backhaul Mask</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLAN0 Wireless IP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLAN0 Wireless Mask</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLAN1 Wireless IP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLAN1 Wireless Mask</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain Name Server</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backhaul Check IP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1: For pre-T1 Mobile Node, use Configurator to change the settings.
2: Up to 3 dns server addresses (separated by comma) can be configured.

**VLAN Configuration**

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLANs</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Management VLAN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**VLAN IP Mapping**

<table>
<thead>
<tr>
<th>VLAN ID</th>
<th>VLAN Name</th>
<th>IP</th>
<th>Mask</th>
<th>Default Gateway</th>
<th>DHCP Server</th>
</tr>
</thead>
</table>

Add
### TABLE 18 IP and VLAN Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td><strong>DHCP</strong></td>
<td>Static Method used to obtain the device IP address (static or DHCP).</td>
</tr>
<tr>
<td>LAN/Backhaul IP Address</td>
<td>--</td>
<td>IP address of the LAN/backhaul interface (x.x.x.x/n format). This field is grayed out if Mode is set to DHCP.</td>
</tr>
<tr>
<td>LAN/Backhaul Mask</td>
<td>--</td>
<td>Subnet mask of the LAN/backhaul interface (x.x.x.x/n format). This field is active only if Mode is Static.</td>
</tr>
<tr>
<td>WLAN0 Wireless IP</td>
<td>--</td>
<td>IP address of the wlan0 interface (x.x.x.x/n format). This field is grayed out if Mode is set to DHCP.</td>
</tr>
<tr>
<td>WLAN0 Wireless Mask</td>
<td>--</td>
<td>Subnet mask of the wlan0 interface (x.x.x.x/n format). This field is active only if Mode is Static.</td>
</tr>
<tr>
<td>WLAN1 Wireless IP</td>
<td>--</td>
<td>IP address of the wlan1 interface (x.x.x.x/n format). This field is grayed out if Mode is set to DHCP.</td>
</tr>
<tr>
<td>WLAN1 Wireless Mask</td>
<td>--</td>
<td>Subnet mask of the wlan1 interface (x.x.x.x/n format). This field is active only if Mode is Static.</td>
</tr>
<tr>
<td>Default Gateway</td>
<td>--</td>
<td>IP address of the default network device (not the device). This field is active only if Mode is Static.</td>
</tr>
<tr>
<td>Domain Name Servers</td>
<td>--</td>
<td>Specifies the name of a DNS server on the network (up to three servers are supported).</td>
</tr>
<tr>
<td>Backhaul Check</td>
<td><strong>Disabled</strong></td>
<td>IP address of a device to be used to verify backhaul connectivity.</td>
</tr>
<tr>
<td>Backhaul Check IP</td>
<td><strong>Enabled</strong></td>
<td>IP address of a device to be used to verify backhaul connectivity.</td>
</tr>
</tbody>
</table>

**VLAN Configuration**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLANs</td>
<td><strong>Disabled</strong></td>
<td><strong>Enabled</strong> Indication of whether VLANs are enabled.</td>
</tr>
<tr>
<td>Management VLAN</td>
<td><strong>Enabled</strong></td>
<td>VLAN ID of the management VLAN.</td>
</tr>
</tbody>
</table>

**VLAN IP Mapping**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN IP Mapping</td>
<td>--</td>
<td>VLAN ID of the management VLAN.</td>
</tr>
<tr>
<td>VLAN ID</td>
<td>--</td>
<td>Numeric identifier for the VLAN.</td>
</tr>
</tbody>
</table>

**Note:** Do not assign four-digit VLAN IDs in mixed environments (networks that have some routers running Release 7.1 software and some routers running Release 6.7 software).

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN Name</td>
<td>--</td>
<td>Text name to identify the VLAN.</td>
</tr>
</tbody>
</table>
TABLE 18 IP and VLAN Page Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP/Mask</td>
<td></td>
<td>IP address and subnet mask of the VLAN interface (x.x.x.x/n format).</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The IP/Mask, Default Gateway, and DHCP Server fields are active only if Mode is static.</td>
</tr>
<tr>
<td>Default Gateway</td>
<td></td>
<td>IP address of the default network routing gateway.</td>
</tr>
<tr>
<td>DHCP Server</td>
<td></td>
<td>IP address of the server that supplies DHCP service for the VLAN.</td>
</tr>
</tbody>
</table>

**Wired Client Interface Configuration**

<table>
<thead>
<tr>
<th>Wired Clients</th>
<th>Disabled</th>
<th>Enabled</th>
<th>Indication of whether wired clients are supported on the Management/Wired Interface.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wired Clients Interface Mode</td>
<td>DHCP</td>
<td>Static</td>
<td>Method used to obtain the IP address of the wired clients (static or DHCP). This field is active only if Wired Clients is enabled.</td>
</tr>
<tr>
<td>Wired Clients IP/Mask</td>
<td>--</td>
<td></td>
<td>Subnet for wired clients, specified by IP address and subnet mask (x.x.x.x/n format). This field is active only if Wired Clients is enabled and Wired Clients Interface Mode is Static.</td>
</tr>
<tr>
<td>VLAN Mode</td>
<td>Access</td>
<td>Trunk</td>
<td>Type of VLAN support for wired clients. Trunk mode: Permits separate VLAN assignment for each wired interface. Access mode: Permits assignment of one VLAN for all wired interfaces.</td>
</tr>
<tr>
<td>Access VLAN</td>
<td></td>
<td></td>
<td>For access mode only, select the VLAN for all wired clients.</td>
</tr>
</tbody>
</table>

**Wired Client Interface VLAN Mapping List**

<table>
<thead>
<tr>
<th>VLAN Name</th>
<th>--</th>
<th>For trunk mode only: Select the VLAN name.</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN Name</td>
<td>--</td>
<td>For trunk mode only: Enter the IP address/mask, and click <strong>Add</strong>. Repeat to assign additional VLANs. Click <strong>Remove</strong> to delete an entry.</td>
</tr>
</tbody>
</table>

**Device Settings**

| PoE | Off, 12V, 24V, 48V | Setting for PoE power output. Off indicates that PoE power output is not available. |
### TABLE 18 IP and VLAN Page Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PoE Port</td>
<td>None, LAN, Mgmt, LAN &amp; Mgmt</td>
<td>Port for PoE power output.</td>
<td></td>
</tr>
<tr>
<td>LAN/Backhaul Interface Speed/Duplex</td>
<td>Auto</td>
<td>Characteristics of this interface. Auto: Rate automatically negotiated with other devices 100base Tx-FD: 100 Mbit transmission, full-duplex setting 100base Tx-HD: 100 Mbit transmission, half-duplex setting 10base T-FD: 10 Mbit transmission, full-duplex setting 10base T-H: 10 Mbit transmission, half-duplex setting</td>
<td></td>
</tr>
<tr>
<td>Management/Wired Interface Speed/Duplex</td>
<td>Auto</td>
<td>Characteristics of this interface. Auto: Rate automatically negotiated with other devices 100base Tx-FD: 100 Mbit transmission, full-duplex setting 100base Tx-HD: 100 Mbit transmission, half-duplex setting 10base T-FD: 10 Mbit transmission, full-duplex setting 10base T-H: 10 Mbit transmission, half-duplex setting</td>
<td></td>
</tr>
<tr>
<td>LAN/Backhaul Interface MTU</td>
<td>--</td>
<td>Largest packet size (Maximum Transmission Unit) transmitted over this interface. (bytes)</td>
<td></td>
</tr>
<tr>
<td>Management/Wired Interface MTU</td>
<td>--</td>
<td>Largest packet size (Maximum Transmission Unit) transmitted over this interface. (bytes)</td>
<td></td>
</tr>
</tbody>
</table>

**Advanced Settings**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backhaul Capacity</td>
<td>0-30 25 for one-radio gateways and 30 for two-radio gateways</td>
<td>Maximum capacity that the gateway can support. Typically depends on the capacity of the link from the gateway to the capacity injection layer. Nodes usually prefer a gateway with higher backhaul capacity.</td>
</tr>
<tr>
<td>Layer 2 Emulation</td>
<td>Enabled</td>
<td>Indication of whether the network works with wireless devices that operate at Layer 2 of the OSI hierarchy. If enabled, the network appears as a wireless bridge or access point to upstream wired Layer 2 devices.</td>
</tr>
<tr>
<td>DRSets Priority</td>
<td>1-10, 2</td>
<td>Priority, or relative willingness, of the gateway to be a designated device (DR).</td>
</tr>
<tr>
<td>Subnet DRSets Size</td>
<td>1-40, 10</td>
<td>Total number of gateways included in the set of DRs for intra-subnet roaming. Make sure that all gateways in the subnet have the same Subnet DRSets size configured.</td>
</tr>
</tbody>
</table>
TABLE 18 IP and VLAN Page Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHCP Release Packets</td>
<td>Allow</td>
<td>Drop</td>
</tr>
<tr>
<td>Backhaul Check Failure Threshold (Consecutive Pings)</td>
<td>3 – 999999, 18</td>
<td>Number of failed ICMP ping messages that constitutes failure of the backhaul link.</td>
</tr>
<tr>
<td>Backhaul Check Restore Threshold (Consecutive Pings)</td>
<td>1 – 999999, 3</td>
<td>Number of successful ICMP ping messages that causes restoration of the backhaul link.</td>
</tr>
</tbody>
</table>
Wireless Page

The Wireless page (Figure 22 and Figure 22) lists parameters required to configure radio frequency (RF) communications in the Tropos wireless network. Table 19 describes all parameters on the page.

FIGURE 21 Wireless Configuration (Top)
FIGURE 22  Wireless Configuration (Bottom)

<table>
<thead>
<tr>
<th>Rate and Power Configuration</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4 GHz Mesh Control Transmit Rate</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>5.8 GHz Mesh Control Transmit Rate</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>4.9 GHz Mesh Control Transmit Rate</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>2.4 GHz Power Curve</td>
<td>off</td>
<td></td>
</tr>
<tr>
<td>5.8 GHz Power Curve</td>
<td>off</td>
<td></td>
</tr>
<tr>
<td>4.9 GHz Power Curve</td>
<td>off</td>
<td></td>
</tr>
<tr>
<td>2.4 GHz Mesh Unicast Transmit Rate</td>
<td>Fixed (Mesh Control Tx Rate)</td>
<td></td>
</tr>
<tr>
<td>5.8 GHz Mesh Unicast Transmit Rate</td>
<td>Fixed (Mesh Control Tx Rate)</td>
<td></td>
</tr>
<tr>
<td>4.9 GHz Mesh Unicast Transmit Rate</td>
<td>Fixed (Mesh Control Tx Rate)</td>
<td></td>
</tr>
<tr>
<td>2.4 GHz Transmit Power Attenuation (0-15dB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.8 GHz Transmit Power Attenuation (0-15dB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.9 GHz Transmit Power Attenuation (0-15dB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Attenuation for 2.4 GHz</td>
<td>3 dB</td>
<td></td>
</tr>
<tr>
<td>Additional Attenuation for 5.8 GHz</td>
<td>3 dB</td>
<td></td>
</tr>
<tr>
<td>Additional Attenuation for 4.9 GHz</td>
<td>3 dB</td>
<td></td>
</tr>
<tr>
<td>2.4 GHz Additional Client Transmit Power Attenuation (0-15dB)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advanced Settings</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Mesh Links to Downstream Routers on 2.4 GHz Interface</td>
<td></td>
<td>pro 7.1.1</td>
</tr>
<tr>
<td>Support Mesh Links to Downstream Routers on 5.8 GHz Interface</td>
<td></td>
<td>pro 7.1.1</td>
</tr>
<tr>
<td>Support Mesh Links to Downstream Routers on 4.9 GHz Interface</td>
<td></td>
<td>pro 7.1.1</td>
</tr>
<tr>
<td>Support Mesh Links to Upstream Routers on 2.4 GHz Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support Mesh Links to Upstream Routers on 5.8 GHz Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support Mesh Links to Upstream Routers on 4.9 GHz Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 GHz RTS Threshold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.8 GHz RTS Threshold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.9 GHz RTS Threshold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 GHz Maximum Link Distance</td>
<td>4.2 km (max delay: 48us)</td>
<td></td>
</tr>
<tr>
<td>5.8 Maximum Link Distance</td>
<td>4.2 km (max delay: 48us)</td>
<td></td>
</tr>
<tr>
<td>4.9 Maximum Link Distance</td>
<td>4.2 km (max delay: 48us)</td>
<td></td>
</tr>
<tr>
<td>Transmit Diversity (2.4 GHz)</td>
<td>On</td>
<td></td>
</tr>
<tr>
<td>Evil Twin Detection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DoS Detected Threshold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Node Forced Standalone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Path Quality Watermark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Path Quality Watermark</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 19 Wireless Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesh ID</td>
<td>---</td>
<td>16-character code that must be the same for all routers in your network. To support multi-subnet roaming, the Mesh ID must be the same for all networks in the roaming domain, so when you first access the Configuration Utility, you are prompted to change the value.</td>
</tr>
<tr>
<td>Confirm Mesh ID</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Channel Configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto Channel</td>
<td>Enabled</td>
<td>Disabled</td>
</tr>
<tr>
<td>(entry for each wire-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less interface)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel List</td>
<td>2.4 GHz: 1, 6, 11</td>
<td>Available channels for auto channel. Active only if Auto Channel is enabled.</td>
</tr>
<tr>
<td>(entry for each wire-</td>
<td>5.8 GHz: 149, 153, 157,</td>
<td></td>
</tr>
<tr>
<td>less interface)</td>
<td>161, 165</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.4 GHz: 100, 104,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>108,112,116</td>
<td></td>
</tr>
<tr>
<td>Channel</td>
<td>2.4 GHz: 1, 2, 3, 4, 5, 6,</td>
<td>Operating channel. Active only if Auto Channel is disabled.</td>
</tr>
<tr>
<td>(entry for each wire-</td>
<td>7, 8, 9, 10, 11, auto</td>
<td></td>
</tr>
<tr>
<td>less interface)</td>
<td>5.8 GHz: 149, 153, 157,</td>
<td>The default channel for the 5.4 GHz band is determined automatically based on the calibration (country) code.</td>
</tr>
<tr>
<td></td>
<td>161, and 165</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.4 GHz: 100, 104,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>108, 112, 116</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.9 GHz: 9220, 9620</td>
<td></td>
</tr>
<tr>
<td>Maintenance Window</td>
<td>---</td>
<td>Date and time at which the gateway begins a channel scan. Active only if channel is auto.</td>
</tr>
<tr>
<td>Maintenance Interval</td>
<td>0-30, 0</td>
<td>Frequency (days) at which the gateway performs the channel scan. Active only if channel is auto.</td>
</tr>
<tr>
<td><strong>Rate and Power Configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesh Control</td>
<td>Auto</td>
<td>Fixed (Mesh Control Tx Rate)</td>
</tr>
<tr>
<td>Transmit Rate (entry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for each wireless</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interface)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 7 •

PowerCurve on Off

Implementation of adjustments for efficient network resource utilization. Choosing on activates the following parameter changes and restrictions:

- Mesh unicast transmit rate is automatically set to auto.
- Power attenuation settings apply only to router-router control traffic. You can continue to assign data rates for mesh control transmission.

Turning power curve adjustments off results in the following change:

- Power attenuation settings apply to all data and control traffic.

**Mesh Unicast Transmit Rate**

**Auto** | Fixed (Mesh Control Tx Rate)

Bit rate for data traffic between routers. See PowerCurve description for additional information. This field is active only if PowerCurve is disabled.

**Transmit Power Attenuation**

0-15 dB 0 dB

This is a global power attenuation that applies to all traffic.

**Additional Attenuation for 802.11 Beacons and Management Frames**

0-15 dB 0 dB

Additional attenuation added on top of the Maximum Power Attenuation and applied to 802.11 beacons and management traffic.

**Additional Client Transmit Power Attenuation**

0-15 dB

Determines the reduction in power transmitted by the router radio. Applies only to client links.

The total client attenuation is Transmit Power Attenuation + Additional Client Transmit Power Attenuation

**Advanced Settings**

**Support Mesh Links to Downstream Routers**

Enabled | Disabled

Indication of whether downstream meshing is enabled for each radio. We recommend that you enable this field to support downstream meshing for all applications.

### TABLE 19 Wireless Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| PowerCurve | On | Off | Implementation of adjustments for efficient network resource utilization. Choosing on activates the following parameter changes and restrictions:  
- Mesh unicast transmit rate is automatically set to auto.  
- Power attenuation settings apply only to router-router control traffic. You can continue to assign data rates for mesh control transmission.  
Turning power curve adjustments off results in the following change:  
- Power attenuation settings apply to all data and control traffic. |
| Mesh Unicast Transmit Rate | Auto | Fixed (Mesh Control Tx Rate) | Bit rate for data traffic between routers. See PowerCurve description for additional information. This field is active only if PowerCurve is disabled. |
| Transmit Power Attenuation | 0-15 dB | 0 dB | This is a global power attenuation that applies to all traffic. |
| Additional Attenuation for 802.11 Beacons and Management Frames | 0-15 dB | 0 dB | Additional attenuation added on top of the Maximum Power Attenuation and applied to 802.11 beacons and management traffic. |
| Additional Client Transmit Power Attenuation | 0-15 dB | | Determines the reduction in power transmitted by the router radio. Applies only to client links. The total client attenuation is Transmit Power Attenuation + Additional Client Transmit Power Attenuation |

**Support Mesh Links to Downstream Routers**

Enabled | Disabled | Indication of whether downstream meshing is enabled for each radio. We recommend that you enable this field to support downstream meshing for all applications. |
### Table 19 Wireless Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| Support Mesh Links to Upstream Routers (entry for each wireless interface, node only) | *Enabled* | Indication of whether downstream meshing is enabled for each radio. We recommend that you enable this field for all except 4.9 GHz public safety applications. For 4.9 GHz public safety applications, choose the following settings:  
  - *Enabled*—for 802.11b/g interface, static and mobile nodes  
  - *Disabled*—for 802.11a interface (4.9 GHz), static and mobile nodes. |
| RTS Threshold (entry for each wireless interface) | 2346 bytes | Indicates the packet size for collision protection. When the request to send (RTS) packet size is larger than the threshold, collision protection is provided.  
Each protected packet is preceded by an RTS (Request To Send) frame. Default 2346 is recommended except in congested environments, in which a setting between 500 and 1500 may improve reliability. Due to overhead and possible loss in throughput, settings below 500 are not recommended. |
| Maximum Link Distance (entry for each wireless interface) | 5 - 20, 4.2 | Maximum distance permitted for a single wireless link (km). Increase this value to avoid excessive timeouts in areas where links between routers are long. |
| Transmit Diversity (2.4 GHz) (802.11b/g interface only; not supported on 6310 and 6320 routers) | *auto*, main, aux | Antenna selection for transmission:  
  - *Auto* – automatically pick the Tx (transmit) antenna (automatic transmit diversity)  
  - *Main* – use the main antenna only for transmit  
  - *Aux* – use the auxiliary antenna only for transmit  
  
**Note:** The router receives wireless signals on both antennas. |
| Evil Twin Detection                              | *Enabled* | Indication of whether unauthorized devices that advertise an ESSID used by the Tropos mesh are detected. If an evil twin is detected, an SNMP inform is sent to Tropos Control EMS, which reports the event. |
**Chapter 7**

**Tropos Control EMS User Guide**

**DoS Detect Threshold**

0 - 10,000

Number of management frames that are acceptable to be sent within 5 seconds.

If this number is exceeded, a DoS attack is assumed and an SNMP inform is sent to Tropos Control EMS, which reports on the activity. The default value of 0 disables the feature.

The following will trigger the DoS feature and send an SNMP inform to Tropos Control EMS:

- The number of management frames set in the DOS threshold is exceeded.
- A broadcast deauthentication packet is detected.
- A spoofing MAC address of a router is detected.

*Note:* The appropriate DoS threshold depends upon network conditions. If the threshold is too high, you might miss notification of a DoS attack; if the threshold is too low, unnecessary SNMP informs might be generated. For example, in a busy network with crowded channels, a threshold in the range of 500 or more may be appropriate.

**Mobile Node Forced Standalone (mobile node only)**

Enabled | Disabled

When enabled, the mobile node is forced to stay in standalone mode when the path quality falls out of the range indicated in the watermark settings.

For example, if the watermark levels are 40 and 60 and path quality of the mobile node falls to 30, then the mobile node is forced to stay in standalone mode until path quality reaches 60 level.

**Low Path Quality Watermark (mobile node only)**

--

Path quality level (1-80) that forces the mobile node to standalone mode.

**High Path Quality Watermark (mobile node only)**

--

Path quality level (1-100) that, if reached, causes the mobile node to leave standalone mode.

---

**TABLE 19 Wireless Page Parameters**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoS Detect Threshold</td>
<td>0 - 10,000</td>
<td>Number of management frames that are acceptable to be sent within 5 seconds. If this number is exceeded, a DoS attack is assumed and an SNMP inform is sent to Tropos Control EMS, which reports on the activity. The default value of 0 disables the feature. The following will trigger the DoS feature and send an SNMP inform to Tropos Control EMS: • The number of management frames set in the DOS threshold is exceeded. • A broadcast deauthentication packet is detected. • A spoofing MAC address of a router is detected. <em>Note:</em> The appropriate DoS threshold depends upon network conditions. If the threshold is too high, you might miss notification of a DoS attack; if the threshold is too low, unnecessary SNMP informs might be generated. For example, in a busy network with crowded channels, a threshold in the range of 500 or more may be appropriate.</td>
</tr>
<tr>
<td>Mobile Node Forced Standalone (mobile node only)</td>
<td>Enabled</td>
<td>Disabled</td>
</tr>
<tr>
<td>Low Path Quality Watermark (mobile node only)</td>
<td>--</td>
<td>Path quality level (1-80) that forces the mobile node to standalone mode.</td>
</tr>
<tr>
<td>High Path Quality Watermark (mobile node only)</td>
<td>--</td>
<td>Path quality level (1-100) that, if reached, causes the mobile node to leave standalone mode.</td>
</tr>
</tbody>
</table>
Client Access

The settings on the Client Access Configuration page (Figure 23) allow you to configure SSIDs, authentication, and other settings that control client access to the wireless network.

Table 20 describes the settings on the page.

**TABLE 20 Client Access Page Parameters**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-ESSID</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 20 Client Access Page Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSID</td>
<td>---</td>
<td>Enter a name that uniquely identifies the network on which the router is operating.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> To fully support SSID-based VLANs, configure the same VLAN ID and SSID-VLAN mappings on each router in the network.</td>
</tr>
<tr>
<td>Hidden</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Authentication</td>
<td>Open WEP, WPA1-PSK, WPA1-1x, WPA2-PSK AES only, WPA1&amp;2-PSK AES only, WPA2-PSK, WPA1&amp;2-PSK, WPA1-1X AES only, WPA1&amp;2-1X AES only, WPA2-1X, WPA1&amp;2-1X</td>
<td>Select the authentication method.</td>
</tr>
<tr>
<td>PSK Passphrase</td>
<td>---</td>
<td>Enter a passphrase, if you choose one of the WPA-PSK options.</td>
</tr>
<tr>
<td>PSK Passphrase</td>
<td></td>
<td><strong>Confirm PSK Passphrase</strong></td>
</tr>
<tr>
<td>BSSID Index (MAC Address)</td>
<td>0-15, 0</td>
<td>Indicates the BSSID index used for this secondary ESSID.</td>
</tr>
<tr>
<td>Primary ESSID Preferred</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>VLAN</td>
<td>---</td>
<td>Choose the VLAN for this SSID.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> To fully support SSID-based VLANs, configure the same VLAN ID and SSID-VLAN mappings on each router in the network.</td>
</tr>
<tr>
<td>2.4 GHz</td>
<td>---</td>
<td>Wireless interfaces for this SSID.</td>
</tr>
<tr>
<td>5.8 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.9 GHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Tropos Control EMS User Guide

### Standalone SSID

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSID</td>
<td>---</td>
<td>Use this entry to configure a single SSID. Enter a name that uniquely identifies the network on which the router is operating. Choose an authentication type and enter a PSK passphrase, as described above in this table.</td>
</tr>
</tbody>
</table>

### Authentication

- Open
- WEP
- WPA1-PSK
- WPA1-1x
- WPA2-PSK AES only
- WPA1&2-PSK AES only
- WPA2-PSK
- WPA1&2-PSK
- WPA1-1X AES only
- WPA1&2-1X AES only
- WPA2-1X
- WPA1&2-1X

Select the authentication method.

### PSK Passphrase

- Enter a passphrase, if you choose one of the WPA-PSK options.

### WEP Configuration

<table>
<thead>
<tr>
<th>WEP Type (entry for each wireless interface)</th>
<th>Hex64bit</th>
<th>Hex128bit</th>
<th>ASCII64bit</th>
<th>ASCII128bit</th>
</tr>
</thead>
</table>

Choose the type of WEP key:
- Hex64bit—Hexadecimal string with 64-bit encryption key (40-bit encryption plus 24-bit initialization number)
- Hex128bit—Hexadecimal string with 104-bit encryption key (40-bit encryption plus 24-bit initialization number)
- ASCII64bit—ASCII string with 64-bit encryption key (40-bit encryption plus 24-bit initialization number)
- ASCII128bit—ASCII string with 104-bit encryption key (40-bit encryption plus 24-bit initialization number)
### Chapter 7

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**TABLE 20 Client Access Page Parameters (continued)**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| WEP Key (entry for each wireless interface) | --- | Enter the encryption key, which is required for each WEP type. The format depends on the WEP type:  
  • Hex64bit—Enter 5 hexadecimal characters  
  • Hex128bit—Enter 5 hexadecimal characters  
  • ASCII64bit—Enter 10 ASCII characters  
  • ASCII128bit—Enter 26 ASCII characters

**Note:** After you create a key, use it to program all client devices and routers on the wireless network.

<table>
<thead>
<tr>
<th><strong>RADIUS</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RADIUS Server</td>
<td>---</td>
<td>Enter the IP address of the RADIUS server that authenticates user requests for network access, if WPA1-1X or WPA2-1X (or both) are selected as an authentication type.</td>
</tr>
<tr>
<td>RADIUS Authentication Port</td>
<td>1812</td>
<td>Enter the port on the RADIUS server to be used for client authentication requests, if WPA1-1X or WPA2-1X (or both) are selected as an authentication type.</td>
</tr>
<tr>
<td>RADIUS Secret Confirm RADIUS Secret</td>
<td>mysecret</td>
<td>Enter a shared secret code to verify the connection between the RADIUS server and the router, if WPA1-1X or WPA2-1X (or both) are selected as an authentication type.</td>
</tr>
<tr>
<td>RADIUS Accounting Server</td>
<td>0.0.0.0</td>
<td>Enter the IP address of the RADIUS accounting server, if RADIUS accounting services are used to log client activity. An IP address of 0.0.0.0 disables this feature.</td>
</tr>
<tr>
<td>RADIUS Accounting Port</td>
<td>1813</td>
<td>Enter the port on the accounting server to be used for RADIUS accounting requests, if RADIUS accounting services are used to log client activity.</td>
</tr>
<tr>
<td>RADIUS Accounting Secret Confirm RADIUS Accounting Secret</td>
<td>---</td>
<td>Enter the shared secret code to verify the connection between the accounting server and the router, if RADIUS accounting services are used to log client activity.</td>
</tr>
<tr>
<td>RADIUS Accounting Interval</td>
<td>900</td>
<td>Enter an interval (seconds) between RADIUS accounting updates, if RADIUS accounting services are used to log client activity. An interval of 0 disables interim updates.</td>
</tr>
</tbody>
</table>
### TABLE 20 Client Access Page Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay RADIUS Accounting Start for Authentication and IP</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>IPSec for RADIUS</td>
<td>Disabled</td>
<td>Enabled</td>
</tr>
<tr>
<td>IPSec Tunnel Endpoint</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>IPSec Preshared Key Confirm IPSec Preshared Key</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Advanced Settings

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| Client Access Rule | Deny | Allow | Choose the type of rule:  
  • Deny—Clients in the list are denied access; all others are permitted to associate.  
  • Allow—Only the clients in the list are permitted to associate. |
| 802.11b Support | Disabled | Short Preamble | Long Preamble | Mixed | Choose a value according to whether the router must operate with older 802.11b devices that require a long preamble in the 802.11 frame format.  
  • Short Preamble is more efficient, but incompatible with some older 802.11 devices.  
  • Long Preamble ensures compatibility with most early models of wireless clients.  
  • Mixed allows 802.11b clients using short or long preamble to associate.  
  • Disabled prevents all 802.11b clients from associating with the router. |

**Note:** This setting does not apply to mobile routers.

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beacon Interval (entry for each wireless interface)</td>
<td>250 (802.11b/g) 100 (801.11a/n)</td>
<td>Choose the time interval between the transmission of 802.11 beacons by the router (ms).</td>
</tr>
<tr>
<td>Beacon Rate (entry for each wireless interface)</td>
<td>11 (802.11b/g) 6 (801.11a/n)</td>
<td>Enter the rate at which the router transmits 802.11 beacons (Mbps).</td>
</tr>
</tbody>
</table>
DHCP Server

The DHCP Server page (Figure 24) lists DHCP parameter settings for routers. Table 21 lists all parameters on the page along with an explanation of the purpose of each and how it should be interpreted and used.

FIGURE 24  DHCP Server

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP to VLAN Mapping</td>
<td></td>
<td>To create or edit IP to VLAN mappings, enter the VLAN ID and the subnet (x.x.x.x/n format). Click <strong>Add</strong> after each addition.</td>
</tr>
<tr>
<td>Note: Before you create IP to VLAN mappings, enable and define VLANs on the IP and VLAN page. See “IP and VLAN Page” on page 81.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DHCP Server

The DHCP Server page (Figure 24) lists DHCP parameter settings for routers. Table 21 lists all parameters on the page along with an explanation of the purpose of each and how it should be interpreted and used.
TABLE 21 DHCP Server Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| Network address translation| Enabled | Choose whether to enable Network Address Translation (NAT) for IP address assignment. Enable NAT if either of these conditions apply:  
• You want to use internal addressing within your wireless network.  
• The network has a single gateway that represents all internal clients to the external network.  
**Note:** When you enable NAT, the internal DHCP server on the gateway is automatically enabled. |
| DHCP Server On Board      | Enable | Indicates whether the DHCP server is enabled on the router.                  |
| DHCP Relay To             | --     | Specifies the IP address of the DHCP server that receives the relayed DHCP requests. |
| Starting Address          | --     | Specifies the first IP address in the address range for the Tropos gateway. |
| Ending Address            | --     | Specifies the last IP address in the address range for the Tropos gateway DHCP server; the address range should be large enough to accommodate all routers and users on the network. |
| Netmask                   | --     | Specifies the subnet mask for the IP addresses provided by the DHCP server.   |
| Domain Name Server        | --     | Specifies the IP address of the DNS server that supplies name resolution for the DHCP server. |
| DHCP Server Lease Time    | --     | Specifies the time in seconds before the IP address expires and must be renewed (it is recommended that you assign lease times of at least 12 hours, or 43200 seconds). |
| WINS Servers              | --     | Specifies the IP address of a Windows name server to be passed on to DHCP clients. |
| MAC Address Filter        | Enabled | Indicates whether MAC address filtering is enabled.                          |

**SNMP**

The SNMP page (Figure 25) lists the SNMP community for the router and specifies where to send SNMP informs. To use Tropos Control to manage the router, you must register Tropos Control to allow SNMP access to the router and to receive SNMP informs. This allows access to the SNMP MIBs and use of Tropos Control. In addition, registering the IP address allows SNMP
informs to be sent to that address. You can configure multiple IP addresses if you want other addresses to have SNMP access and the ability to receive informs.

Table 22 lists the settings on the page along with an explanation of the purpose of each and how they should be interpreted.

**Note**
*Tropos Control does not support encrypted traps.*
TABLE 22 SNMP Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, <strong>Default</strong></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trap Destinations</td>
<td>--</td>
<td>IP address and SNMP community of the server that receives SNMP traps.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>These settings are for SNMPv2 traps, which apply only to routers running pre-Release 7.5 software.</td>
</tr>
<tr>
<td>SNMP User Table</td>
<td>--</td>
<td>SNMP user information:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Security User Name - SNMP user</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Auth Type - MD5, SHA1, or No Authentication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Auth Key - for the authentication protocol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Priv Type - AES, DES, or none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Priv Key - Privacy key for the privacy type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>These settings are for SNMPv3 and apply only to routers running Release 7.5 and later software.</td>
</tr>
<tr>
<td>SNMPv3 Trap Destinations</td>
<td>--</td>
<td>Name, target IP address, and user name for each SNMP trap destination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>These settings are for SNMPv3 and apply only to routers running Release 7.5 and later software.</td>
</tr>
<tr>
<td>SNMP Enable Management</td>
<td>Enabled</td>
<td><strong>Disabled</strong></td>
</tr>
<tr>
<td>Servers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowed Management</td>
<td>--</td>
<td>IP address of each Tropos Control server that is allowed to manage this device.</td>
</tr>
<tr>
<td>Servers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Time**

The time page (Figure 26) contains settings for Network Time Protocol (NTP) servers used to synchronize time on the router, and may also be used to set the time manually. Table 23 lists parameters and tasks on the page.
FIGURE 26  Time Page

Time

Golden Device: (default value comes from the device)
Name: CS-NET-entrance-cell  Type: node  ID: 19134  IP: 172.20.125.64

<table>
<thead>
<tr>
<th>Field</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTP Server</td>
<td>---</td>
<td>Indicates the IP address or domain name of an NTP server. If NTP is used, at least one server must be specified; specify up to three servers by entering comma-separated IP addresses or host names.</td>
</tr>
<tr>
<td>Time Zone</td>
<td>UTC</td>
<td>Presents a list of time zones.</td>
</tr>
<tr>
<td>Set Router Time</td>
<td>---</td>
<td>Permits manual setting of the date and time using the pull-down lists. Manual time changes take effect immediately. Click to open a calendar and select a date and time.</td>
</tr>
</tbody>
</table>

Note: Universal Time (UTC) is the same as Greenwich Mean Time.
DHCP Clients

The DHCP MAC Filter/Reservation page (Figure 27) contains parameters to configure the internal DHCP server of the Tropos gateway in order to limit assignment of IP addresses to wireless clients. Table 24 lists the settings on the page, which can be opened by clicking **DHCP Clients** on the side menu.

FIGURE 27  DHCP Clients

![DHCP Clients](image)

TABLE 24 DHCP Clients Page Settings

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC</td>
<td>---</td>
<td>Specifies the MAC address of the client to be accepted. Click <strong>Add</strong> to include this entry in the list.</td>
</tr>
</tbody>
</table>
Static IP Client

The Static IP Client Configuration page (Figure 28) contains settings for clients that require static IP addresses rather than DHCP-supplied addresses. The Static IP Client Configuration page also provides the ability to configure static IP addresses for clients behind customer premise equipment (CPE), such as Wireless-to-Ethernet bridges. Table 25 lists the parameters on the page.

**Note**
If you use auto-detection, you must enable it on all the gateways and nodes in the wireless routing domain (WRD). If the WRD is changed in Tropos Control, all gateways and nodes must be deleted from the Tropos Control using the Configuration View.

**Note**
For static IP clients, you must add the client entries on all gateways in the wireless routing domain in order for the clients to be able to roam across the full domain.
FIGURE 28 Static IP Clients Page

TABLE 25 Static IP Client Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Detect Static Clients</td>
<td>Enabled</td>
<td>If enabled, allows the router to automatically detect the presence of static IP clients and permit them to be routed, even though their addresses are not explicitly entered. If security is an issue and you do not want to route clients that are not explicitly recognized, you can disable this feature.</td>
</tr>
<tr>
<td>Client MAC Address</td>
<td>---</td>
<td>Specifies the MAC address of the client to be added to the Static IP list.</td>
</tr>
<tr>
<td>Static IP Address</td>
<td>---</td>
<td>Specifies the IP address of the client to be added to the Static IP list.</td>
</tr>
<tr>
<td>CPE MAC Address</td>
<td>---</td>
<td>Specifies the MAC address of any customer premise equipment (CPE), in addition to the MAC and IP addresses of the client connected to the CPE.</td>
</tr>
<tr>
<td>Client MAC Address</td>
<td>---</td>
<td>Specifies the MAC address of the client to be added to the Static IP list.</td>
</tr>
<tr>
<td>Static IP Address</td>
<td>---</td>
<td>Specifies the IP address of the client to be added to the Static IP list.</td>
</tr>
</tbody>
</table>
Packet Filtering

Packet Filtering (Figure 29) determines the types of packets forwarded or rejected by the router. Forwarding applies to packets that pass through the router, not those that begin or terminate at the router. Usage for the Packet Filter Forwarding page differs according to whether the default packet filter forwarding policy is Permitted or Denied (see Table 26).

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE MAC Address</td>
<td>---</td>
<td>Specifies the MAC address of any customer premise equipment (CPE), in addition to the MAC and IP addresses of the client connected to the CPE.</td>
</tr>
<tr>
<td>VLAN Name</td>
<td>---</td>
<td>Specifies the VLAN for the wired client.</td>
</tr>
</tbody>
</table>
FIGURE 29  Packet Filtering

Packet Filtering

0 Gateways 1 Nodes 0 MobileNodes are selected  Adjust Selection

Golden Device: (default value comes from the device)
Name: LuckyLake  Type: node  ID: 00041  IP: 172.20.125.225

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packet Forwarding</td>
<td>Allowed</td>
<td></td>
</tr>
</tbody>
</table>

- **Predefined Forwarding Rules**
  - This table takes effect only when packet forwarding is enabled.
  - Enabled  Protocol Type  Permit to/from the address

- **Customized Forwarding Rules**
  - This table takes effect only when packet forwarding is disabled.
  - Name  Protocol Type  Source IP  Source Mask  Source Port  Destination IP  Destination Mask  Destination Port
  - Add

- **Packet Forwarding Deny Rules**
  - This table takes effect only when packet forwarding is allowed.
  - Name  Protocol Type  Source IP  Source Mask  Source Port  Destination IP  Destination Mask  Destination Port
  - Add

*1: Protocol should be a number or tcp/udp.
### TABLE 26 Packet Filtering Page Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, <strong>Default</strong></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packet Forwarding</td>
<td><strong>Allowed</strong></td>
<td>If enabled, allows all packets except those explicitly blocked. If disabled, blocks all packets except those explicitly permitted.</td>
</tr>
</tbody>
</table>
| Predefined Forwarding Rules   | --                | Indicates whether this protocol has a forwarding rule applied. The following information applies to each rule:  
• Enabled—Indicates whether the rule is active.  
• Protocol Type—Indicates the protocol to which the filtering applies. See Table 27.  
• Permit to/from the address—Specifies the IP address or subnet to which the filtering applies. (Format a.b.c.d). |
| Customized Forwarding Rules   | --                | Indicates whether a custom forwarding rule is applied. The following information applies to each rule:  
• Name—Custom name for the filtering rule.  
• Protocol—Protocol to be filtered.  
• Source IP—IP address of the packet source.  
• Source Mask (bits)—Subnet mask for the packet source.  
• Source Port—Port for the packet source.  
• Destination IP—IP address of the packet termination point.  
• Destination Mask (bits)—Number of mask bits for the IP address where the packet will terminate.  
• Destination Port—Port where the packet will be received. |
### TABLE 26 Packet Filtering Page Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packet Forwarding Deny Rules</td>
<td>--</td>
<td>Indicates whether a deny rule is applied. The following information applies to each rule:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Name---Custom name for the filtering rule.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Protocol---Protocol to be filtered.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Source IP---IP address of the packet source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Source Mask (bits)---Subnet mask for the packet source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Source Port---Port for the packet source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Destination IP---IP address of the packet termination point.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Destination Mask (bits)---Number of maskbits for the IP address where the packet will terminate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Destination Port---Port where the packet will be received.</td>
</tr>
</tbody>
</table>

### TABLE 27 Packet Forwarding - Standard Permit Rules

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHCP (Dynamic Host Configuration Protocol)</td>
<td>UDP ports 67/68</td>
</tr>
<tr>
<td>DNS (Domain and Host Name Service)</td>
<td>UDP ports 42/53</td>
</tr>
<tr>
<td>Cisco (Cisco VPN 3000 Concentrator Series)</td>
<td>UDP ports 500/10000</td>
</tr>
<tr>
<td>ICMP (Ping and Traceroute)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>HTTPS (Secure HTTP)</td>
<td>TCP port 443</td>
</tr>
<tr>
<td>SSH (Secure Shell)</td>
<td>TCP port 22</td>
</tr>
<tr>
<td>IPSec (Internet Protocol Security)</td>
<td>protocol 50 UDP port 500</td>
</tr>
<tr>
<td>POP3 (Post Office Protocol 3)</td>
<td>TCP port 110</td>
</tr>
<tr>
<td>HTTP (hypertext transfer protocol)</td>
<td>TCP port 80</td>
</tr>
<tr>
<td>SMTP (simple mail transfer protocol)</td>
<td>TCP port 25</td>
</tr>
<tr>
<td>Telnet</td>
<td>TCP port 23</td>
</tr>
<tr>
<td>SNMP</td>
<td>TCP port 161 and 162</td>
</tr>
</tbody>
</table>
**Caution**
If DHCP is disabled, client devices and Tropos nodes cannot obtain the DHCP lease required for operation. If HTTPS is disabled, all HTTPS traffic will be dropped.

**P2P Blocking**

Use the Peer-to-Peer Blocking page (Figure 30) to block clients in the same subnet or in different subnet (VLANs) from communicating with each other. Table 28 lists parameters on the page.

**FIGURE 30  Peer-to-Peer Blocking Configuration Page**

**TABLE 28 Peer-to-Peer Blocking Parameters**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>---</td>
<td>Text name for the peer-to-peer block rule</td>
</tr>
<tr>
<td>Peer1 IP</td>
<td>any</td>
<td>IP address of one of the peers</td>
</tr>
<tr>
<td>Peer1 Mask</td>
<td>any</td>
<td>Subnet mask that applies to the first peer IP address</td>
</tr>
<tr>
<td></td>
<td>(bits)</td>
<td>(bits)</td>
</tr>
<tr>
<td>Peer2 IP</td>
<td>any</td>
<td>IP address of the second peer</td>
</tr>
<tr>
<td>Peer2 Mask</td>
<td>any</td>
<td>Subnet mask that applies to the second peer IP address</td>
</tr>
<tr>
<td></td>
<td>(bits)</td>
<td>(bits)</td>
</tr>
</tbody>
</table>
Multi-Subnet Roaming

The Multi-Subnet Roaming page (Figure 20) identifies the list of gateways available for roaming across multiple subnets. Table 29 lists parameters on the page.

**Note**
During multi-subnet roaming, the client’s traffic is routed through its home gateway (to which it was originally associated). If the home gateway loses its uplink while an associated client is roaming, the client will lose connectivity. To restore connectivity, the old gateway must become available again or the client must obtain an IP address from the new gateway.

**FIGURE 31  Multi-Subnet Roaming Page**

**TABLE 29 Multi-Subnet Roaming Page Parameters**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway IP</td>
<td>__</td>
<td>Specifies the IP address of a gateway to make available for roaming.</td>
</tr>
<tr>
<td>Mask</td>
<td>__</td>
<td>Specifies the subnet mask for the gateway.</td>
</tr>
<tr>
<td>Subnet Route</td>
<td>__</td>
<td>Specifies the subnet of a mobile node or downstream interface associated with the subnet of this gateway.</td>
</tr>
<tr>
<td>Subnet Mask</td>
<td>__</td>
<td>Specifies the subnet mask of a mobile node or downstream interface associated with the subnet of this gateway.</td>
</tr>
<tr>
<td>Add/Delete</td>
<td>__</td>
<td>Adds an entry to the list or deletes one from the list.</td>
</tr>
</tbody>
</table>
Backhaul Routing

The Backhaul Routing page (Figure 20) permits selection of advanced routing protocols such as Border Gateway Protocol (BGP) to support backhaul traffic. The Tropos gateway establishes BGP sessions with configured neighbors and exchanges routes for all multi-subnet roaming clients. The clients’ upstream traffic is sent directly to the neighbor without requiring tunneling between the home and foreign subnets.

Table 29 lists parameters on the page.

**FIGURE 32  Backhaul Routing Page**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backhaul Routing Type</td>
<td>Disabled</td>
<td>Specifies whether gateway-to-gateway tunnels are automatically set up for multi-subnet roaming.</td>
</tr>
<tr>
<td>Neighbor Name</td>
<td>---</td>
<td>Specifies the name of an Internet or IP router that will serve as a BGP neighbor.</td>
</tr>
<tr>
<td>Neighbor IP</td>
<td>---</td>
<td>Specifies the IP address of the neighbor.</td>
</tr>
<tr>
<td>Local AS Number</td>
<td>---</td>
<td>Identifies the assigned local autonomous system (AS) number for the BGP neighbor.</td>
</tr>
<tr>
<td>Remote AS Number</td>
<td>---</td>
<td>Identifies the assigned remote autonomous system (AS) number for the BGP neighbor.</td>
</tr>
</tbody>
</table>
Rate Limiting

Rate Limiting page (Figure 33) contains settings to limit the bandwidth available to individual clients. Rate limiting provides the joint benefits of limiting the impact of denial of service (DoS) attacks and users who consume too much bandwidth. Users can exceed bandwidth in brief bursts, but if they send more than the permitted amount of data (trigger) in a specified period of time, they are temporarily subjected to rate limits.

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote AS Number</td>
<td>---</td>
<td>Identifies the assigned remote autonomous system (AS) number for the BGP neighbor.</td>
</tr>
<tr>
<td>Service/VLAN ID</td>
<td>---</td>
<td>Specifies the VLAN that is served by the BGP neighbor. If VLANs are disabled, leave the Service/ VLAN ID field blank, or enter 0.</td>
</tr>
</tbody>
</table>
FIGURE 33  Rate Limiting Page

Rate Limiting

0 Gateways 0 Nodes 0 MobileNodes are selected  Adjust Selection
Please select routers to provision

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airtime Congestion Control</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

This enforces a selective cap on anyone who exchanges too much data for too long. The caps are per association, so multiple IP addresses behind the same bridge share a cap. Bits count 802.11 frame length, not just IP datagrams.

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput Rate Limiting</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

Throughput Rate Limiting Multiplicators

Only the first multiplier matched is used. This multiplier is for egregious usage (both trigger and selective cap). Durations are unmodified.

<table>
<thead>
<tr>
<th>SSID</th>
<th>2.4GHz</th>
<th>5.8GHz</th>
<th>4.9GHz</th>
<th>Multiplier</th>
</tr>
</thead>
</table>

QoS Subnet Differentiated Service Classes

Only the first multiplier matched is used. This multiplier is for egregious usage (both trigger and selective cap). Durations are unmodified.

<table>
<thead>
<tr>
<th>IP</th>
<th>Mask</th>
<th>Multiplier</th>
</tr>
</thead>
</table>

Submit  Reset
<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airtime Congestion Control</td>
<td>Enabled</td>
<td>Disabled</td>
</tr>
<tr>
<td>Downstream Trigger (kbits)</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Upstream Trigger (kbits)</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Trigger Time (seconds)</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Downstream Cap (kbits/sec)</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Upstream Cap (kbits/sec)</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Minimum Cap Duration (seconds)</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>ESSID</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Wireless Interface</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
| Multiplier                    | .2 - 10, 1 |         | Rate limiting multiplier that applies to the To client cap and From client cap fields; traffic to and from the subnet is restricted to the client caps times the multiplier. Examples:  
  • Multiplier 0: No traffic permitted to or from the subnet  
  • Multiplier 2: Rate limit for the subnet is equal to two times the To client cap and From client cap settings |
| IP                            | ---     |         | IP address of the subnet to which a rate limiting multiplier applies. |
| Mask                          | ---     |         | Subnet mask for the subnet to which a rate limiting multiplier applies. |
QoS

Quality of Service (QoS) refers to a set of methods for assigning preferential access to network bandwidth based on pre-defined rules. QoS rules can assure that traffic for certain functional organizations is always accommodated or that certain applications and users are given higher priority. Tropos implements QoS by way of policies that reserve network bandwidth or assign priorities for packet forwarding. Figure 34 shows the page, and Table 32 describes the page settings.

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
</table>
| Multiplier | .2 - 10, 1     | Rate limiting multiplier that applies to the To client cap and From client cap fields; traffic to and from the subnet is restricted to the client caps times the multiplier. Examples:  
• Multiplier 0: No traffic permitted to or from the subnet  
• Multiplier 2: Rate limit for the subnet is equal to two times the To client cap and From client cap settings |
FIGURE 34  QoS Page

TABLE 32 QoS Page

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSID</td>
<td>---</td>
<td>Displays the currently configured ESSIDs.</td>
</tr>
<tr>
<td>2.4 GHz</td>
<td>---</td>
<td>Displays the wireless interfaces on the router.</td>
</tr>
<tr>
<td>5.8 GHz</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>4.9 GHz</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 32 QoS Page (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QoS Class</td>
<td>---</td>
<td>Class of service for the specified ESSID.</td>
</tr>
<tr>
<td>Note:</td>
<td></td>
<td>This setting applies only to upstream traffic. To apply a class of service to downstream traffic, you must use an off-mesh device to pre-mark traffic in the downstream direction (using 802.1p or DSCP).</td>
</tr>
<tr>
<td>Max Clients</td>
<td>---</td>
<td>Indicates the maximum number of wireless clients that can connect to this ESSID simultaneously. This constraint is in addition to the constraint that limits each radio to 50 clients total, regardless of the ESSID.</td>
</tr>
<tr>
<td>Downstream Quality Selection</td>
<td>DSCP</td>
<td>Quality of traffic flows from the gateway's wired interface to wireless clients. If 802.1p is chosen but traffic does not have 802.1p tags because VLAN (trunking) is not enabled, then all traffic is treated as Silver traffic.</td>
</tr>
<tr>
<td>Note:</td>
<td></td>
<td>802.1p is a layer 2 header, while DSCP is part of the layer 3 IP datagram.</td>
</tr>
<tr>
<td>DSCP for Bronze</td>
<td>24 (Bronze)</td>
<td>DSCP assigned to upstream traffic when remarking is enabled. The value is chosen by the ESSID of the client for upstream traffic. If Downstream Quality Selection is set to DSCP, these values classify traffic headed from a gateway's wired interface to the wireless client.</td>
</tr>
<tr>
<td>DSCP for Silver</td>
<td>0 (Silver)</td>
<td></td>
</tr>
<tr>
<td>DSCP for Gold</td>
<td>32 (Gold)</td>
<td></td>
</tr>
<tr>
<td>802.1p Priority N to</td>
<td>Bronze</td>
<td>Silver</td>
</tr>
<tr>
<td>Bronze to...</td>
<td>802.1p priority 0-7, 802.1p priority 0</td>
<td>Determination of 802.1p traffic marking from the gateway's wired interface. The marking requires VLAN (trunking) to be enabled.</td>
</tr>
<tr>
<td>Silver to...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gold to...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voice to...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wired Sub-Interface Priority</td>
<td>Bronze</td>
<td>Silver</td>
</tr>
</tbody>
</table>
Voice

Use the Voice page (Figure 35) to improve QoS for voice over IP (VoIP) traffic. Table 33 lists the parameters on the page.

FIGURE 35  Voice Page

TABLE 33 Voice Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice Service</td>
<td>Enabled</td>
<td>Enables the voice QoS features. You must enable this field and store changes to display all the rest of the fields on the Voice page.</td>
</tr>
</tbody>
</table>
### TABLE 33 Voice Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice Percentage of Available Airtime</td>
<td>1-100; 50</td>
<td>Limits the amount of bandwidth available for prioritized voice traffic (0-100).</td>
</tr>
<tr>
<td>WMM Classification</td>
<td>Enabled</td>
<td>Dis-abled</td>
</tr>
<tr>
<td>Heuristic classification</td>
<td>Disabled</td>
<td>Enabled</td>
</tr>
<tr>
<td>DSCP values to recognize as voice (Decimal)</td>
<td>46</td>
<td>Specifies the incoming DSCP values that are recognized as voice traffic. Use comma-separated entries for multiple DSCP values.</td>
</tr>
<tr>
<td>Maximum per-call packet rate (pps)</td>
<td>100</td>
<td>Limits the packet rate (packets per second) that can be used for an individual voice call.</td>
</tr>
<tr>
<td>Maximum per-call bandwidth (kbps)</td>
<td>150</td>
<td>Limits the bandwidth (kbps) that can be used for an individual call.</td>
</tr>
<tr>
<td>Remarking</td>
<td>Enabled</td>
<td>Dis-abled</td>
</tr>
<tr>
<td>DSCP value to remark to (Decimal)</td>
<td>46</td>
<td>Specifies the reassigned DSCP value, if remarking is enabled.</td>
</tr>
</tbody>
</table>
| Fast Handoff Optimization                  | Pre-Fetch Only | Packet Snoop Only | Indicates the optimization method to reduce the time required for handoff when clients move from one router to another in the same ESS:  
  • Pre-Fetch Only---Perform ARP resolution upon receipt of a qualified probe request.  
  • Packet Snoop Only---Determine client IP address by inspecting the packets coming from the client.  
  • Pre-Fetch and Packet Snoop---Perform pre-fetch and packet snoop.  
  • None---Do not use either handoff optimization method. |
| IP Prefix                                  | ---           | Identifies the IP addresses and netmasks (format a.b.c.d/n) of any voice gateways that are used exclusively for voice traffic. |
Software

Use the Software page (Figure 36) to enable auto-recovery for the router and select backward compatibility options. Table 34 lists the parameters on the page.

**FIGURE 36  Software Page**

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Recovery</td>
<td>Enabled</td>
<td>Enables the auto-recovery feature. Auto recovery helps the router recover from failure during bootup.</td>
</tr>
<tr>
<td>Backward Compatibility</td>
<td>All Releases</td>
<td>Indicates the mix of router software releases in the network. If Release 7.1 is used throughout the network, select the 7.1 and later option. If you have 6.7 software on some routers, you must select the 6.7 and later option. The All Releases option is most compatible in a mixed release network, however, it is not as secure as the other choices.</td>
</tr>
</tbody>
</table>

Security

Use the Security page (Figure 36) to enable auto-recovery for the router and select backward compatibility options. Table 34 lists the parameters on the page.
FIGURE 37  Security Page

Security

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router-EMS Authentication Key</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirm Router-EMS Authentication Key</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared Port Status</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Infrared Access Code</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirm Infrared Access Code</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Configurator Access

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configurator Access Control</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

Allowed IP Subnets for Configurator Access

<table>
<thead>
<tr>
<th>IP</th>
<th>Netmask</th>
</tr>
</thead>
</table>

FIPS

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIPS Mode</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

* FIPS Mode should not be provisioned on 3210 and 5210 routers.

Submit  Reset

The field can only be provisioned to the routers with the specified version and above or specified pre-release versions.

TABLE 35  Software Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router-EMS Authentication Key</td>
<td>16 ASCII characters</td>
<td>Specifies the key that is used to authenticate communications between devices and Tropos Control. Enter and confirm the key.</td>
</tr>
<tr>
<td>Confirm Router-EMS Authentication Key</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared Port Status</td>
<td>Enabled/Disabled</td>
<td>Enables or disabled access to the router by way of an infrared remote device.</td>
</tr>
</tbody>
</table>
### TABLE 35 Software Parameters (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>Range, Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrared Access Code Confirm Infrared Access Code</td>
<td>---</td>
<td>Specifies the security code for using the infrared remote device.</td>
</tr>
<tr>
<td>Configurator Access Control</td>
<td>Enabled</td>
<td>Enables or disables access to the router Configuration utility.</td>
</tr>
<tr>
<td>Allowed IP Subnets for Configurator Access</td>
<td>---</td>
<td>Restricts access to the Configuration utility to the specified subnet. Click Add to add multiple subnets.</td>
</tr>
<tr>
<td>FIPS Mode</td>
<td>Enabled</td>
<td>Enables FIPS mode (FIPS 140-2) on the router (Release 7.3 and later routers only). See “Configuring FIPS Mode” on page 150.</td>
</tr>
</tbody>
</table>
Other Provisioning Operations

This section describes how to use the Administer Routers panel (Figure 38) to perform the provisioning functions described in Table 36.

FIGURE 38 Administer Routers Panel
### TABLE 36 Other Provisioning Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
<th>Commit Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commit the stored data in routers</td>
<td>Activates the changes that have been provisioned on the selected routers.</td>
<td></td>
</tr>
<tr>
<td>Rollback the stored data in routers</td>
<td>Cancels the application of provisioned data that has not yet been committed. Provisioned data is saved in stored profiles on each router. During commit, the data is written to committed profiles. If a rollback operation is sent before commit, the provisioned data are lost.</td>
<td></td>
</tr>
<tr>
<td>Reboot routers</td>
<td>Restart the hardware and software on the selected routers.</td>
<td></td>
</tr>
<tr>
<td>Restart routers</td>
<td>Restart the software on the selected routers.</td>
<td></td>
</tr>
<tr>
<td>Install an uploaded software image on routers</td>
<td>Install the uploaded software image on the selected routers.</td>
<td></td>
</tr>
<tr>
<td>Change the administrative password on the routers</td>
<td>Change the password used to administer the selected routers.</td>
<td>Yes</td>
</tr>
<tr>
<td>Save configuration as known good profile</td>
<td>Store the configuration on the selected routers, identifying it as the last known good profile.</td>
<td></td>
</tr>
<tr>
<td>Restore the configuration to the last saved known good profile</td>
<td>Change the configuration on the selected routers to the last good profile that was saved.</td>
<td>Yes</td>
</tr>
<tr>
<td>Save the minimum profile</td>
<td>Store the minimum profile on the selected routers.</td>
<td></td>
</tr>
<tr>
<td>Restore the configuration to the last save minimum profile</td>
<td>Change the configuration on the selected routers to the last minimum profile that was saved.</td>
<td>Yes</td>
</tr>
<tr>
<td>Restore the configuration to factory defaults</td>
<td>Change the configuration on the selected routers to the factory defaults.</td>
<td>Yes</td>
</tr>
<tr>
<td>Upload admin public key</td>
<td>Upload a public key to restrict access to the router command line interface (CLI).</td>
<td></td>
</tr>
<tr>
<td>Upload Profile</td>
<td>Upload a configuration profile to the specified routers. You can select a profile from the Tropos Control server or from your local computer.</td>
<td></td>
</tr>
<tr>
<td>Enable/Disable Client Statistics</td>
<td>Enable or disable the collection of client statistics on the specified routers.</td>
<td></td>
</tr>
</tbody>
</table>
Provisioning Tasks - Administration

Perform these tasks in the specified order to complete the operations listed in Table 36:

1. Select routers to provision (on page 70)
2. Schedule the provisioning job (on page 72)
3. Set up and commit the provisioning job (on page 75)

Set up and commit the provisioning job

1. Open the Administer Routers panel under the Provisioning tab and select the routers to provision (“Select routers to provision” on page 70).
2. Choose the command from the pull-down list.

3. For some commands, additional settings are presented in the lower right area of the panel, as in this example of the rebooting command.

4. Complete any additional settings, as described in Table 36.
5. Click Provision.

The job instructions are sent to the selected routers.
Some operations must be committed after provisioning. The operations that require commit are indicated in the menu and also listed in Table 36.

6. To commit any required changes, select **Commit the stored data in routers** from the pull-down list and click **Provision**.

The changes are activated on the selected routers.

**Auditing Provisioning Jobs**

This section describes how to track and audit provisioning jobs:

- **Use the Provision Job List**---Check on the status of jobs and link to other status information.
- **Use the Provisioning Result panel**---Check on the results of provisioning jobs and link to other result information.

**Use the Provision Job List**

1. Choose **Provisioning > Provision Job List** to open the list (Figure 39).

**FIGURE 39 Provision Job List**

2. Choose from the options list in Table 37.

**TABLE 37 Provision Job List Operations**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check job status</td>
<td>View the Status column, and click the underlined link to open a window that contains additional details about the job.</td>
</tr>
<tr>
<td>View job results</td>
<td>Click the underlined ID link or select the checkbox for a job and click <strong>View Provision Result</strong>.</td>
</tr>
<tr>
<td>Open the provision panel for the selected job</td>
<td>Click the underlined job name or select the checkbox for a job and click <strong>View Provision Detail</strong>.</td>
</tr>
</tbody>
</table>
Use the Provisioning Result panel

1. Choose **Provisioning > Provision Result** to open the list (**Figure 40**).

**FIGURE 40  Provision Results**

2. Choose from the options list in **Table 38**.

### Table 37: Provision Job List Operations (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a new job based on the current</td>
<td>Select the job to modify, and click <strong>Redo</strong>. A new panel opens to allow you to modify or remove settings. For example:</td>
</tr>
<tr>
<td></td>
<td>After you modify the settings, click <strong>Provision</strong> to restart the provisioning process.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This option is useful if an existing job failed and you want to make changes before resubmitting it or if you want to apply the same settings to provision other routers.</td>
</tr>
<tr>
<td>Cancel a scheduled job</td>
<td>Select checkboxes for the jobs you want to cancel, and click <strong>Stop</strong>. Click <strong>OK</strong> to confirm.</td>
</tr>
<tr>
<td>Commit a job</td>
<td>Select a checkbox for the job that you want to commit, and click <strong>Commit</strong>. Click <strong>Provision</strong> on the panel that opens.</td>
</tr>
<tr>
<td>Control which jobs are listed.</td>
<td>Use either or both of the following controls:</td>
</tr>
<tr>
<td></td>
<td>• Choose from the pull-down list at the top of the panel to select the number of jobs to display on each page.</td>
</tr>
<tr>
<td></td>
<td>• Enter the job name and click <strong>Filter</strong>.</td>
</tr>
</tbody>
</table>

### Table 37: Provision Job List Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a new job based on the current</td>
<td>Select the job to modify, and click <strong>Redo</strong>. A new panel opens to allow you to modify or remove settings. For example: After you modify the settings, click <strong>Provision</strong> to restart the provisioning process. <strong>Note:</strong> This option is useful if an existing job failed and you want to make changes before resubmitting it or if you want to apply the same settings to provision other routers.</td>
</tr>
<tr>
<td>Cancel a scheduled job</td>
<td>Select checkboxes for the jobs you want to cancel, and click <strong>Stop</strong>. Click <strong>OK</strong> to confirm.</td>
</tr>
<tr>
<td>Commit a job</td>
<td>Select a checkbox for the job that you want to commit, and click <strong>Commit</strong>. Click <strong>Provision</strong> on the panel that opens.</td>
</tr>
<tr>
<td>Control which jobs are listed.</td>
<td>Use either or both of the following controls:</td>
</tr>
<tr>
<td></td>
<td>• Choose from the pull-down list at the top of the panel to select the number of jobs to display on each page.</td>
</tr>
<tr>
<td></td>
<td>• Enter the job name and click <strong>Filter</strong>.</td>
</tr>
<tr>
<td>Operation</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>View result information</td>
<td>Examine the Time, Status, and Reason columns for information about the specific job.</td>
</tr>
<tr>
<td>Open the provision panel for the selected job</td>
<td>Click the underlined job name.</td>
</tr>
<tr>
<td>View details for the selected router</td>
<td>Click the underlined device name to open a window with details about the selected router.</td>
</tr>
<tr>
<td>Control which jobs are listed.</td>
<td>Use any of the following controls:</td>
</tr>
<tr>
<td></td>
<td>• Choose from the pull-down list at the top of the panel to select the number of jobs to display on each page.</td>
</tr>
<tr>
<td></td>
<td>• Click Show All to show all the provision results that are in the database.</td>
</tr>
<tr>
<td>Commit a job</td>
<td>Select a checkbox for the job that you want to commit, and click Commit.</td>
</tr>
<tr>
<td></td>
<td>Click Provision on the panel that opens.</td>
</tr>
</tbody>
</table>
8 Performing Administrative Tasks

This chapter describes how to use the web interface to manage router inventory, upgrade router software, and generate diagnostic information to assist Tropos Customer Support in troubleshooting Tropos Control problems.

Chapter contents:
- Generating Diagnostic Information.
- Upgrading Router Software.
- Tracking Router Inventory
- Backing Up Router Configurations
- Restoring Router Configurations
- Supporting RADIUS Authentication
- Managing Administrative Users
- Using Router Auto Discovery
- Viewing the User Audit Log
- Configuring Banner Text
Generating Diagnostic Information

If the Tropos Control server has operational problems, you can use the Tech Support tab to generate a diagnostic file that you can send to Tropos Customer Support for analysis.

Generate diagnostic files

1. Open the Administration tab and click Tech Support.
2. Click Collect Techdump.
   The file is generated and listed in the panel.
3. Click the underlined file name. Browse to select a location, and click Save.
4. When requested, email the file to support@tropos.com.

If the web interface is not available, you can generate the techdump file from the command line. Go to the support directory in the Tropos Control installation directory, and execute the techdump.sh script. The script automatically generates the diagnostic tar file, which you can then send to Tropos Customer Support:

```
cd /<installdirectory>/ems/support
./techdump.sh
Average disk space required : 58M
Available disk space : 107583M
+
| This command collects information from your server to send to
| customer support. When this process is complete, there will be a file
| in /<installdirectory>/ems/support called:
| techsupport_200708201045.tar.gz
| Please send all files to your support staff.
+
/<installdirectory>/ems/support
Cleaning old files (if any) :
Done.
```
Upgrading Router Software

Use the following router software upgrade panels under the Administration tab to install new router software and manage the upgrade process:

- Add Schedule---Schedule router upgrades. For instructions, see “Schedule router software upgrades” on page 131.
- Status---Check the status of a specific upgrade job. For instructions, see “Check upgrade job status” on page 133.
- History---Check the status of all upgrade jobs. For instructions, see “View upgrade job history” on page 133.
- Add Image---Upload router software images to the Tropos Control server. For instructions, see “Upload a software image” on page 134.

Schedule router software upgrades

1. Open the Administration tab and click **Router Software Update**.

   The Add Schedule panel (Figure 41) opens.

---

**FIGURE 41  Add Schedule Panel**

Add Schedule

[Table showing router software versions and device counts]

 Submit  Reset
2. Enter a name to identify the upgrade job.

3. Choose **Upload Now** or click the Calendar icon and select a date and time to schedule the upload.

4. Select the number of times to retry the upgrade process if the initial attempt fails.

5. Enter the user name and password for administrative access to the router or routers targeted for upgrade.

6. Select a software image from the pull-down list. If the software image you want to use is not in the list, click **Add Image**, and follow the instructions in “Upload a software image” on page 134.

7. To choose the routers to be upgraded, click the **Select Device** link.

8. Use the arrows and links to highlight the desired routers and move them to the Selected Routers area. Links are also available to sort the list for easier viewing. The single-headed arrows move only the selected routers, while the double headed arrows move all routers in the list.

9. Click **Apply** to save the list and return to the Add Schedule panel.

10. Click **Submit** to schedule the process of loading the new software on the selected routers.
11. The Status page opens to display the status of the scheduled job. The display is refreshed every few seconds. You can click the underlined wireless IP link to display detailed information about a router in the list.

![Status page](image)

12. When the scheduled job is complete and the software is loaded on the router, an Install button is displayed on the Status panel. Click **Install** to install the new image on the router or routers.

**Check upgrade job status**
1. Open the Administration tab and click **Router Software Update > Status**.
   The Status panel opens. The panel refreshes every few seconds to show the current job status.

   - **Note**
   
   *The Status panel opens automatically when you submit an upgrade job.*

2. Use the controls at the top of the panel to choose the number entries to display and to navigate from page to page. Click a column header to sort according to that column. Clicking the column header again changes the sort order.

**View upgrade job history**
1. Open the Administration tab and click **Router Software Update > History**.
   The History panel opens. The panel refreshes every few seconds to show the current job status.

   ![History panel](image)

2. Use the controls at the top of the panel to choose the number entries to display and to navigate from page to page. Click a column header to sort according to that column. Clicking the column header again changes the sort order.

3. To open the status panel for a specific job, click the underlined job link.
Upload a software image

1. Open the Administration tab and click **Router Software Update > Add Image**.

   The panel opens to show a list of uploaded images.

   ![Add Image](image)

2. Click **Browse** to locate the new image, and then click **Open** in the Browse window to select the image.

3. Click **Upload**.

   The image is copied to the Tropos Control server and becomes available in the Select Image pull-down list on the Add Schedule panel. For instructions on scheduling an upgrade using the image, see “Schedule router software upgrades” on page 131.

Tracking Router Inventory

To manage the inventory of routers in your network, open the Tropos Control web interface Administration tab, and click **Inventory Tracking to open the Inventory Tracking panel** (Figure 42).

**FIGURE 42  Inventory Tracking Panel**

<table>
<thead>
<tr>
<th>Summary of Result</th>
<th>Upload Inventory (Serial Number) Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of routers in inventory</td>
<td>15</td>
</tr>
<tr>
<td>Total number of routers found</td>
<td>14</td>
</tr>
<tr>
<td>Total number of routers never found</td>
<td>1</td>
</tr>
<tr>
<td>Total number of mystery routers found</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Delete</th>
<th>Export</th>
<th>Showing all routers from the inventory</th>
<th>Page Length (entries per page)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 of 5 of 15</td>
</tr>
<tr>
<td>□</td>
<td></td>
<td>Serial Number</td>
<td>IP Address</td>
</tr>
<tr>
<td>□</td>
<td></td>
<td>19040</td>
<td>172.20.125.95</td>
</tr>
<tr>
<td>□</td>
<td></td>
<td>19125</td>
<td>172.20.125.98</td>
</tr>
<tr>
<td>□</td>
<td></td>
<td>19134</td>
<td>172.20.125.94</td>
</tr>
<tr>
<td>□</td>
<td></td>
<td>19153</td>
<td>172.20.125.80</td>
</tr>
<tr>
<td>□</td>
<td></td>
<td>19173</td>
<td>172.20.125.83</td>
</tr>
</tbody>
</table>

The upper part of the Inventory Tracking panel lists the information in Table 39. All the routers in inventory are listed below the summary area, along with the information listed in Table 40.
The following inventory-related functions are supported on this panel:
- **Verify inventory**
- **Upload an inventory file**
- **Export the inventory list**
- **Delete routers from inventory**

**Verify inventory**

1. Open the Administration tab and click *Inventory Tracking*.
2. Click *Inventory Check*.

Tropos Control compares the inventory contents with the list of most recently discovered routers and presents the results in the table on the panel.
Upload an inventory file

1. Create a text file in which each row contains the serial number of a router, as in this example:
   
   19967
   35435
   14563
   50310

2. Open the Administration tab and click **Inventory Tracking**.
3. Click **Upload Inventory (Serial Number) File**.
4. Browse to find locate the inventory file, and click **Open**.
   The file is uploaded and the inventory is added to the list. Discovery and other monitoring and management functions are automatically activated.

Export the inventory list

1. Open the Administration tab and click **Inventory Tracking**.
2. Select checkboxes for the routers you want to include in the export, and click **Export**.
3. Browse to find choose a save location, and click **Save**.
   The file is saved in csv format.

Delete routers from inventory

You can remove routers from the inventory list. This action does not remove the routers from the Tropos Control database. Use the map menu options as described under “Delete node, mobile node, or fixed node” on page 47.

1. Open the Administration tab and click **Inventory Tracking**.
2. Select checkboxes for the routers you want to remove, and click **Delete**.

Back Up Router Configurations

Follow the steps in the section to back up router configuration profiles on the Tropos Control server. You can schedule daily backups, perform a manual backup, or export backed up configuration profile. Daily backups include all routers.

- **Set up automatic daily backups**—Set up the system to back up the configuration profiles of all managed routers once per day.
- **Perform a manual backup**—Backup the configuration profiles of selected routers on demand.
- **Export a backed up configuration profile**—Export a backed up configuration file to a location of your choice.
- **View the Backup Events list**—Monitor the status of backup operations.
Set up automatic daily backups

1. Open the Administration tab and click **Router Backup.**
   
The Router Backup panel (Figure 41) opens.

2. Select **Enable daily backup at** and enter the time in HH:MM format.
3. Enter the number of days to keep the backup.
4. Click **Submit.**
   
The daily backup job is scheduled. Every day, the configuration profiles for all routers are backed up at the specified time.

Perform a manual backup

1. Open the Administration tab and click **Router Backup.**
2. Click the underlined **routers are selected** link to choose the routers to include in the backup.
A selection window opens.

3. Select the routers that you want to back up Available Routers list, and click the right-facing arrow to move them to the Selected Routers area. You can use the links near the bottom of the screen to select or sort the groups of routers in the list, or use the double arrows to move the entire list.

4. Click Apply.

The panel reopens to show the number of selected routers.

5. Enter a prefix to identify the backup job. Date and time information is automatically appended to the prefix.

6. Click Backup Now.

The selected router configurations are backed up, and the Backup Events list at the bottom of the panel is updated with status information.
Export a backed up configuration profile

1. Open the Administration tab and click **Router Backup**.
2. In the Export Backup area, click **Browse** to select the file to export.
3. Click an underlined link to open the Manual or Scheduled backups directory.

4. Click the link for the job that you want to export.

5. Select the item to export and click **Submit**.

6. The main panel reopens to show the file name in the Export area.

7. Click **Download** to save the file in a location of your choice.
View the Backup Events list

1. Open the Administration tab and click **Router Backup**.
   The Backup Events list is displayed at the bottom of the panel.

<table>
<thead>
<tr>
<th>ID</th>
<th>Start Time</th>
<th>End Time</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>254</td>
<td>Jan 22 2010 00:02:11</td>
<td>Jan 22 2010 00:04:13</td>
<td>Success; 29 Failure: 4</td>
</tr>
<tr>
<td>253</td>
<td>Jan 21 2010 00:02:11</td>
<td>Jan 21 2010 00:04:17</td>
<td>Success; 29 Failure: 4</td>
</tr>
<tr>
<td>252</td>
<td>Jan 20 2010 00:02:11</td>
<td>Jan 20 2010 00:04:13</td>
<td>Success; 29 Failure: 4</td>
</tr>
<tr>
<td>251</td>
<td>Jan 19 2010 00:02:19</td>
<td>Jan 19 2010 00:02:19</td>
<td>Success; 29 Failure: 4</td>
</tr>
</tbody>
</table>

2. Click an underlined link in the Status column to display details about the job.

   **Backup Task (Job 253)**
   
   **Start Time:** Jan 21 2010 00:02:11  
   **End Time:** Jan 21 2010 00:04:17

   **Summary:**
   Success: 29 Failure: 4

   **Details:**

<table>
<thead>
<tr>
<th>Device</th>
<th>Start Time</th>
<th>End Time</th>
<th>Status</th>
<th>Detail</th>
<th>FileName</th>
</tr>
</thead>
<tbody>
<tr>
<td>172.20.125.238</td>
<td>Jan 21 2010 00:03:15</td>
<td>Jan 21 2010 09:04:15</td>
<td>Failed</td>
<td>Unknown Error: java.net.SocketTimeoutException: connect timed out</td>
<td>[path] [filename]</td>
</tr>
<tr>
<td>172.20.125.128</td>
<td>Jan 21 2010 00:02:19</td>
<td>Jan 21 2010 09:02:21</td>
<td>Success</td>
<td>Downloaded</td>
<td>[path] [filename]</td>
</tr>
<tr>
<td>172.20.125.55</td>
<td>Jan 21 2010 00:02:19</td>
<td>Jan 21 2010 09:02:20</td>
<td>Success</td>
<td>Downloaded</td>
<td>[path] [filename]</td>
</tr>
<tr>
<td>172.20.125.65</td>
<td>Jan 21 2010 00:02:19</td>
<td>Jan 21 2010 09:02:20</td>
<td>Success</td>
<td>Downloaded</td>
<td>[path] [filename]</td>
</tr>
</tbody>
</table>

**Restoring Router Configurations**

Follow the steps in the section to restore router configurations that were previously backed up:

- **Restore router configuration to the same router**---Restore a previously-backed up configuration to the same router.
- **Restore router configuration to a different router**---Restore a previously-backed up configuration to a different router. This procedure is useful for restoring configurations after a router has been replaced in the field.
- **View the Restore Events list**---Monitor the status of restoration operations.
Restore router configuration to the same router

1. Open the Administration tab and click **Router Restore**.
   
The Router Restore panel (Figure 44) opens.

**FIGURE 44  Router Restore Panel**

2. Click **Browse** in the Restore Router area. Navigate to the directory containing the file, select the file, and then click **Submit**.

3. Click **Restore**.
**Restore router configuration to a different router**

1. Open the Administration tab and click **Router Restore**.
   
The Router Restore panel opens.

2. Click **Browse** in the Restore filer to selected router area. Navigate to the directory containing the file, select the file, and then click **Submit**.

3. Select the router to receive the restored file from the pull-down list.

   **Note**
   
   *The router selected for restoration should be the same type of router (gateway, node, mobile node) that was used to generate the backup file.*

4. Click **Restore**.

**View the Restore Events list**

1. Open the Administration tab and click **Router Restore**.
   
The Restore Events list is displayed at the bottom of the panel.

<table>
<thead>
<tr>
<th>ID</th>
<th>Start Time</th>
<th>End Time</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Dec 06 2003 14:44:58</td>
<td>Dec 06 2003 14:45:32</td>
<td>Success</td>
</tr>
</tbody>
</table>
2. Click an underlined link in the Status column to display details about the job.

Supporting RADIUS Authentication

You can configure the Tropos Control server to forward any authentication requests for access to the Tropos Control server to an external RADIUS server.

**Note**

*Password Authentication Protocol (PAP) is used as the authentication protocol.*

Set up RADIUS authentication for access to the Tropos Control server

1. Open the Administration tab and click **AAA Server**.
   A list of currently configured RADIUS servers is displayed.

2. Perform the following operations from this panel:
   Add a new server:
   a. Click **Add**.
   b. Enter values as described in **Table 41**.
   c. Click **Submit**.

   The panel reopens to show the new server.

Modify a server entry:
   a. Select the server and click **Modify**.
   b. Change values as described in **Table 41**.
   c. Click **Submit**.
The panel reopens to show the modified values.

Delete a server entry:

a. Select the server and click **Delete**.

b. Click **OK** to confirm.

### TABLE 41 RADIUS Server Settings

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RADIUS Server Name</td>
<td>Enter a name to identify the RADIUS server.</td>
</tr>
<tr>
<td>Server Host Name/IP</td>
<td>Enter the IP address or host name of the server.</td>
</tr>
<tr>
<td>Server Port Number</td>
<td>Enter the RADIUS server port number for authentication requests. Default: 1812</td>
</tr>
<tr>
<td>Shared Secret Key</td>
<td>Enter and confirm the code used to verify the connection between the RADIUS server and the router.</td>
</tr>
<tr>
<td>Confirm Shared Secret Key</td>
<td></td>
</tr>
<tr>
<td>Timeout</td>
<td>Enter the number of seconds after which an authentication request times out. Range: 1-30 seconds; default: 5 seconds</td>
</tr>
</tbody>
</table>

**Managing Administrative Users**

You can use the web interface to set up administrative user accounts.

**Note**

*Only the user with root privileges can set up other user accounts.*

**Manage administrative user accounts**

1. Open the Administration tab and click **AAA Server**. A list of currently configured users is displayed.

<table>
<thead>
<tr>
<th>Username</th>
<th>Full Name</th>
<th>Role</th>
<th>Authentication Server</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>root</td>
<td>Default Root User</td>
<td>root</td>
<td>Local</td>
<td>Enabled</td>
</tr>
<tr>
<td>guest</td>
<td>Default Guest User</td>
<td>readonly</td>
<td>Local</td>
<td>Disabled</td>
</tr>
<tr>
<td>test</td>
<td></td>
<td>root</td>
<td>Local</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

2. Perform the following operations from this panel:

Add a new user:

a. Click **Add**.

b. Enter values as described in Table 42.
c. Click **Submit**. The panel reopens to the list the new user.

Modify a user entry:

a. Select the user and click **Modify**.

b. Change values as described in **Table 42**.

c. Click **Submit**. The panel reopens to the list the modified values.

Delete a user:

a. Select the server and click **Delete**.

b. Click **OK** to confirm.

### TABLE 42 Administrative User Settings

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Username</td>
<td>Enter a name that identifies the user.</td>
</tr>
<tr>
<td>Full Name</td>
<td>Enter the full name of the user.</td>
</tr>
<tr>
<td>Role</td>
<td>Select a role from the pull-down list.</td>
</tr>
<tr>
<td></td>
<td>• Root—Permitted to view all information and perform all tasks that relate to the system and to the server platform.</td>
</tr>
<tr>
<td></td>
<td>• Read/Write—Permitted to view information and perform most tasks.</td>
</tr>
<tr>
<td></td>
<td>• Read Only—Permitted to view information but not make any changes to the system.</td>
</tr>
<tr>
<td>Status</td>
<td>Choose whether the user account is active (Enabled) or inactive (Disabled).</td>
</tr>
<tr>
<td>Authenticate with</td>
<td>Choose whether authentication is performed from the server using username and password, or by using a RADIUS server. If you choose Local, the password fields are activated; if you choose Remote, the Preferred Server field is activated.</td>
</tr>
<tr>
<td>Preferred Server</td>
<td>If RADIUS is chosen for the Authenticate with field, select the RADIUS server.</td>
</tr>
<tr>
<td>Password</td>
<td>If Local is chosen for the Authenticate with field, enter and confirm the password used for access.</td>
</tr>
<tr>
<td>Confirm Password</td>
<td></td>
</tr>
</tbody>
</table>

### Using Router Auto Discovery

You can set up the system to automatically discover all routers in a network from a single gateway (seed gateway). When auto discovery is configured, the Tropos Control server requests that the seed gateway obtain the list of available gateways in the network. When the list is obtained, the server contacts each gateway to obtain its local list of nodes. Auto discovery operations are run once per day.

**Note**

*If the network is composed of multiple subnets, a gateway from each subnet must be added.*
For resilience, a second gateway can be configured for each subnet. If the first (primary) gateway is not reachable, the server contacts the secondary gateway to obtain the list of routers.

**Note**
For additional information on adding routers to the Tropos Control database, see “Tracking Router Inventory” on page 134.

### Configure SNMP parameters for auto discovery

1. Open the Administration tab and choose **Auto Discovery > Configuration**. A list of currently configured seed gateways is displayed.

2. Configure parameters as listed in Table 43.

3. Click **Submit**.

#### TABLE 43 Auto Discovery Configuration

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td>Select to enable auto discovery.</td>
</tr>
<tr>
<td>SNMP Port Number</td>
<td>Enter the port number for SNMP messages (default 161).</td>
</tr>
<tr>
<td>SNMP Read Community String</td>
<td>Enter the write community string.</td>
</tr>
<tr>
<td>SNMP Write Community String</td>
<td>Enter the read community string.</td>
</tr>
<tr>
<td>SNMP Trap Port Number</td>
<td>Enter the port number for SNMP traps.</td>
</tr>
<tr>
<td>SNMP Trap Community String</td>
<td>Enter the trap community string.</td>
</tr>
</tbody>
</table>

### Set up auto discovery

1. Make sure that auto discovery is enabled, as described in the previous procedure.

2. Open the Administration tab and click **Auto Discovery > Seed List**.
A list of currently configured seed gateways is displayed.

3. Perform the following operations from this panel:

Add a new gateway:
   a. Click **Add**.
   b. Enter values as described in Table 44.
   c. Click **Submit**.
      The panel reopens to the list the new user.
   d. To rediscover the new gateway immediately, without waiting for the next daily auto discovery, click **Rediscover**.

Modify a gateway entry:
   a. Select the user and click **Modify**.
   b. Change values as described in Table 44.
   c. Click **Submit**.
      The panel reopens to the list the modified values.
   d. To rediscover the new gateway immediately, without waiting for the next daily auto discovery, click **Rediscover**.

Delete a gateway entry:
   a. Select the server and click **Delete**.
   b. Click **OK** to confirm.

**TABLE 44 Auto Discovery Settings**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed Gateway IP</td>
<td>Enter the IP address of a gateway with nodes that you want to include in the auto discovery.</td>
</tr>
<tr>
<td>Secondary Gateway IP</td>
<td>Enter the IP address of a gateway to contact if the seed gateway is not reachable.</td>
</tr>
<tr>
<td>Wireless Routing Domain ID</td>
<td>Enter and confirm the 16-character code that identifies the area of the managed routers. All managed routers must be configured with the same wireless routing domain ID.</td>
</tr>
<tr>
<td>Confirm Wireless Routing Domain ID</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 44 Auto Discovery Settings (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admin User Password</td>
<td>Enter and confirm the password required for access to the gateway.</td>
</tr>
<tr>
<td>Confirm Admin User Password</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Enter text to describe the gateway.</td>
</tr>
</tbody>
</table>
Viewing the User Audit Log

The User Audit Log page shows the history of user sessions on the Tropos Control server.

View the user audit log

1. Open the Administration tab and click **Use Audit Log**.
   
The user login history is displayed.

2. Click **Refresh Audit Log** to update the list.

Configuring Banner Text

Use the Server Configuration page to configure optional banner text that is displayed in the upper right portion of the each page, as shown in Figure 5 on page 21.

Configure banner text

1. Open the Administration tab and click **Server Configuration**.

2. Enter the banner text. The maximum length is 128 characters and special characters such as @, &, <, > are not supported.

3. Click **Submit**.
Configuring FIPS Mode

Tropos supports the Federal Information Processing Standards, version 140-2 (FIPS 140-2), which are general security standards for protection of sensitive information, required by government agencies in the U.S. and Canada.

Note
Refer to the complete security policy for detailed FIPS instructions. The security policy is distributed to Tropos FIPS customers along with router software and tamper-evident seals.

Note the following properties and restrictions:
- For FIPS 140-2 support, FIPS mode must be enabled on the Tropos Control server and the managed routers must be running Release 7.3 or later with FIPS mode enabled.
- FIPS mode is disabled by default.
- Changing to FIPS mode automatically causes the Tropos Control EMS server to restart.
- After changing to FIPS mode, you must close and then reopen your web browser.
- In FIPS mode, the Router-EMS Authentication key (not the mesh ID) is used to establish communication between the routers and the Tropos Control EMS server.
- FIPS 140-2 support includes a “zeroize” capability that automatically removes any clear text critical security parameters (CSPs) and shuts down the system.

Caution
The zeroize function should be used only in extreme cases when it is necessary to remove sensitive information. After zeroizing, the server software must be reinstalled.

Note
Tropos Control can manage both FIPS and non-FIPS enabled routers when running in FIPS disabled mode; however, in this case the management is not FIPS 140-2 compliant.

Enable FIPS mode
1. Make sure that SSH access to the router is disabled.
2. Configure the Router-EMS Authentication Key for local authentication, as described in “Security” on page 120. The password must have a minimum of eight characters. Do not configure RADIUS authentication for Tropos Control users.
3. Open the Administration tab and click Server Configuration.
4. Select Enabled from the FIPS Mode drop-down list, and click Submit.
5. FIPS is enabled, and the Tropos Control EMS server restarts. After a few minutes, close and reopen your browser and then log in. When you reopen the Server Configuration page, a **Zeroize** button is displayed.

The Zeroize button allows you to immediately secure the system in the event of a potential security problem. If you click the button, all critical security parameters stored in clear text are automatically removed from the system. This action also shuts down the Tropos Control server. Following shutdown, you must reinstall the server software.
Redundant Tropos Control Servers for Failover

This appendix describes how to configure primary and secondary Tropos Control servers so that the secondary server takes over if the primary server is not available.

- Primary and Secondary Servers
- Set Up the Primary and Secondary Servers
- Set Up the Secondary Server as Backup
- Perform Failover from the Primary to Secondary Server
- Returning to the Primary Server when it Recovers

Primary and Secondary Servers

The primary Tropos Control Server is responsible for managing the Tropos network. As part of its normal management function, the primary server maintains a current database of devices. When a secondary server is configured, the primary server automatically copies the database to the secondary server. If the primary server fails for any reason, the secondary server is able to immediately take over the management functions and discover any routers that it has not already discovered.

During failover, the secondary server can provide most management functions. An exception is that the secondary server cannot execute network performance measurements. Implementation is limited in that network performance data can run only on a single server. During normal operations, performance measurements are disabled on the secondary server. Following failover, they are enabled on the secondary server.

Set Up the Primary and Secondary Servers

Follow this process to download, install, and configure the primary and secondary servers:

1. Install Tropos Control on the primary and secondary servers, as described in Chapter 2, “Installation.” Make sure that you install the same version of Tropos Control on both servers. Also, if you are using an Oracle database, make sure to stop the primary server (by
running the command `service watchdog stop`) before installing the secondary server. After the secondary server is installed, power off the secondary server to keep it in standby mode.

2. If you are using MySQL, start both the primary and secondary servers. If you are using Oracle, start only the primary server.

3. If you are using MySQL configure each server to discover the entire network, as described in “Discovery” on page 19.

**Set Up the Secondary Server as Backup**

1. Log in to the primary server as root.

2. Install the “expect” software package on CentOS if it is not installed:

   ```bash
   [root@localhost]# yum install expect
   ```

3. Install the redundancy file by issuing the following commands in a terminal window:

   ```bash
   [root@localhost]# cd /<installdirectory>/ems/bin/redundancy
   [root@localhost]# chmod a+x *
   [root@localhost]# ./setupRedundantServer <Secondary IP Address> <Secondary root password>
   ```

   Example:

   ```bash
   [root@localhost]# ./setupRedundantServer.sh 192.168.128.194 passwd
   1 Checking for secure password-less logins to 192.168.128.194, please wait... done
   2 Querying the system for all the devices, please wait... done
   3 Finding Control Server Installations on 192.168.128.194... done
   4 Copying discover_devices.txt to 192.168.128.194:/opt/ControlServer/ems/conf/server... done
   5 Setting up crontab on 192.168.128.194... done
   6 Setting up crontab on this server... done
   [root@localhost]#
   ```

**Perform Failover from the Primary to Secondary Server**

Follow these steps to move operations to the secondary server upon service interruption or failure of the primary server:

1. Disconnect the primary server from the network. Unexpected results may arise if the primary server is still active and managing the network.

2. Issue the following commands on the secondary server to take over primary server operations:

   For Oracle database:

   ```bash
   % service watchdog restart
   ```
For MySQL database:

[root@localhost]# cd /<installdirectory>/ems/bin/redundancy
[root@localhost]# chmod a+x *
[root@localhost]# ./disableRedundancy.sh

Example:

[root@localhost redundancy]# ./disableRedundancy.sh
Disabling secure password-less logins to this server, please wait... done
Restoring crontab... done
[root@localhost redundancy]#

Make sure to provision all the gateways with the secondary server’s IP address in the SNMP page for Trap-Receiver-Registration and EMS-Registration so that the secondary server receives traps from the routers and generates alarms/notifications correctly.

Returning to the Primary Server when it Recovers

For the Oracle database, when the primary server becomes available again, first power off the secondary server to keep it in standby mode and then start the EMS watchdog service on the primary server.

For the MySQL database, when the primary server becomes available again, start the EMS watchdog service on the primary server and make sure to run the setupRedundantServer.sh script on it to enable redundancy and to keep the secondary server in standby mode.
Glossary

This glossary defines terms pertaining to wireless and networking technology.

**802.11**
IEEE wireless networking standards developed by IEEE. There are multiple versions of the 802.11 specification; Tropos Networks products conform to the 802.11b specification.

**802.1x**
IEEE standard for port-based client authentication using a central authentication server to verify client identity.

**AAA Server**
Server that provides authentication, authorization and accounting services over a network.

**Adaptive Noise Immunity (ANI)**
adaptive noise immunity (ANI).

**Address Resolution Protocol (ARP)**
Standard protocol for mapping an IP address to a hardware (MAC) address.

**Airtime Congestion Control**
Tropos Networks method of allowing networks to be operated close to their maximum capacity by detecting and averting congestion events.

**Autonomous System (AS)**
Collection of networks under a single administrative structure and with a single, well-defined routing policy.

**Advanced Encryption Standard (AES)**
Effective single-key encryption standard originally adopted by the National Institute of Standards and Technology for use by U.S. government organizations and later adopted as an industry standard.

**Backhaul**
Process of transmitting data so it can be sent over a backbone network, typically to the Internet. Tropos wireless networks provide wireless backhaul from client stations through the wireless Tropos mesh to the wired network.
Basic Service Set (BSS)
The set of all wireless client stations controlled by a single Tropos router. The BSS is identified by the BSSID, often the MAC address of the router.

Border Gateway Protocol (BGP)
Internet protocol that allows routers to share information and provides the routing mechanism for same-subnet roaming in the Tropos network.

Certificate Authority (CA)
Trusted network entity that issues digital security credentials.

Call Admission Control (CAC)
Mechanism for improving QoS for VoIP communications by causing calls to be rejected in the presence of contention.

Domain Name Service (DNS)
Standard used to convert alphanumeric Internet domain names to IP addresses.

Dynamic Host Configuration Protocol (DHCP)
Protocol used for central, dynamic management of IP addresses. A DHCP server leases DHCP addresses to individual network entities for a specified period of time. Leases can be renewed automatically when the lease period ends. DHCP assures flexibility in IP address assignment and precludes the necessity of generating and entering static IP addresses for each network entity.

Differentiated Services Code Point (DHCP)
Integer value that is included in the DS field of an IP header and which designates a specific QoS value.

Extended Service Set (ESS)
A wireless network that consists of multiple Tropos routers, each of which provides wireless service to network clients.

Extensible Authentication Protocol (EAP)
Effective authentication protocol that supports multiple authentication methods, including passwords, tokens, certificates and public-key authentication.

ESSID
Alphanumeric name that uniquely identifies the wireless network.

Federal Information Processing Standards (FIPS)
General security standards for protection of sensitive information, required by government agencies in the U.S. and Canada.
Gateway
Tropos router that connects directly to the wired network and provides backhaul for downstream Tropos nodes and clients.

Generic Route Encapsulation (GRE)
Protocol used in creating virtual private networks between clients or between clients and servers.

Global Positioning System (GPS)
Satellite navigation system used for accuracy positioning.

Hypertext Transfer Protocol (HTTP)
Protocol that manages data transfers between web browsers and servers.

Hypertext Transfer Protocol over SSL (HTTPS)
Secure version of HTTP based on Secure Sockets Layer (SSL).

Internet Control Message Protocol (ICMP)
Error and control message protocol for the Internet. ping uses ICMP echo requests and replies.

Internet Protocol (IP)
Packet routing protocol operating at the network level which associates individual addresses with network nodes.

IP address
Method of identifying a network entity as a 32-bit number, usually presented as four, period-separated 8-bit (3-digit) numbers according to the Internet Protocol specification.

Internet Protocol Security (IPSec)
Internet security protocol used in virtual private networks (VPNs).

Management Information Base (MIB)
A set of objects that can be managed by SNMP or another network management system.

Maximum Transmission Unit (MTU)
The largest packet size in bytes transmitted over the network.

Media Access Control (MAC) Address
Device-specific identifier, assigned during device manufacture, that uniquely identifies a network node. MAC address filters can be used to limit assignment of IP addresses to wireless clients.

Meshed cluster
Collection of Tropos gateways and nodes providing wireless communications services to network clients and establishing backhaul to the wired network. Clients communicate with Tropos nodes, which communicate in turn
with other nodes, and finally to Tropos gateways, which connect to the wired network.

**Mobile node**
Tropos router that is designed to be mounted in a moving vehicle.

**Netmask (subnet mask)**
The broadcast domain for a subnetwork, consisting of the subnet prefix for an IP address (example: 255.255.255.0).

**Network Address Translation (NAT)**
Method whereby nodes within a local area network can access the Internet without having a public Internet address assigned. Administrators can assign local IP addresses from their own address pool and use NAT to translate these into publicly-accessible addresses. NAT can also be used to map multiple local nodes to a single globally-accessible IP address.

**Network Mode**
Optimization level for 802.11 beacons and probe responses.

**Network Time Protocol (NTP)**
Method of synchronizing clocks on network devices.

**Node**
Tropos router that provides delivers wireless communications support for clients and provides wireless backhaul to other upstream Tropos nodes and gateways.

**Packet Success Probability (PSP)**
The probability that a transmitted packet will be received successfully.

**Ping Packet Internet Groper (ping)**
Method of troubleshooting network connections by determining whether a specific IP address is reachable and the amount of time required for the addressed device to respond.

**Post Office Protocol 3 (POP3)**
Industry standard protocol that permits users to receive email from an email server.

**Power Over Ethernet (PoE)**
Method of supplying electrical power to a device through an Ethernet network data cable. This permits devices to be powered without a separate electrical power connection.

**Predictive Wireless Routing Protocol (PWRP)**
Tropos technique for managing network routing based on self-organizing principles.
Quality of Service (QoS)
Any of a variety approaches to guaranteeing network performance for specified uses. Tropos supports QoS through bandwidth reservations and priority-based forwarding.

Remote Authentication Dial-In User Service (RADIUS)
Client/server protocol that allows organizations to store client account information in a centrally located database and call up the information as needed to verify client identity.

Request to send (RTS)
Signal sent from a transmitting device to a receiving device that requests approval to send packets. To approve, the receiving device responds with a clear to send (CTS) message.

Reverse Packet Success Probability (PSP)
The probability that a transmitted backhaul packet will be received successfully.

Roaming
The ability to move from one wireless coverage area to another without loss of service. Client initiated roaming occurs when the client detects loss of association and associates with another router. Tropos supports client initiated roaming throughout the wireless routing domain.

Router (Tropos)
Tropos Networks devices that provide the communications infrastructure for wireless mesh networks.

Secure SHell (SSH)
Secure method of accessing a remote computer.

Service Set Identifier (SSID)
Alphanumeric identifier for a network, used interchangeably with ESSID.

Secure Sockets Layer (SSL)
A common protocol for message transmission security on the Internet. Existing as a program layer between Internet's Hypertext Transfer Protocol (HTTP) and Transport Control Protocol (TCP) layers, SSL is a standard feature in Internet Explorer, Netscape, and most web server products.

Simple Mail Transfer Protocol (SMTP)
Protocol that governs transfer of email messages between email servers.

Simple Network Management Protocol (SNMP)
Protocol used for device and network management.
SNMP inform
SNMP message sent to a notification server, indicating noteworthy activity or events.

Static IP Address
Permanent IP address assigned to a node in a TCP/IP network.

Subnet
Portion of a larger network, distinguished by a subnet mask or broadcast domain.

Subnet Mask
Method of addressing subnets. For example, the subnet mask 255.255.255.0 refers to the subnet in which the first three triplets of the IP address are fixed, and the available subnet addresses use the last triplet of the IP address.

Telnet
Terminal emulation protocol for connecting to a remote computer.

Temporal Key Integrity Protocol (TKIP)
Encryption standard included in the 802.11i specification, which improves on WEP encryption by adding effective key mixing and message integrity checks.

Transmission Control Protocol/Internet Protocol (TCP/IP)
The suite of protocols on which Internet communications are based.

Transport Layer Security (TLS)
Protocol that provides security for local and Internet applications. TLS is a newer generation version of Secure Sockets Layer (SSL).

Tunneled Transport Layer Security (TTLS)
Security protocol that combines network-based certificates with token or password authentication. Often used in conjunction with EAP.

Universal Time Coordinated (UTC)
Official world time, equivalent to Greenwich Mean Time.

User Datagram Protocol (UDP)
Protocol that shares many commons attributes with TCP but without the reliability capabilities of TCP. UDP is often used for applications that can tolerate some level of error.

Virtual LAN (VLAN)
Logical grouping of client stations that enables them to function as if they are on the same subnetwork, regardless of their actual physical location.

Virtual Private Network (VPN)
Network in which remote users are securely connected over the Internet and operate as if connected locally.
Voice over IP (VoIP)
Network in which remote users are securely connected over the Internet and operate as

Wi-Fi Protected Access (WPA)
Effective wireless authentication security solution introduced by the Wi-Fi Alliance, an industry consortium. WPA is compatible with and now contained in the IEEE 802.11i specification.

Windows Name Service (WINS)
Microsoft Windows standard for converting alphanumeric Internet domain names to IP addresses.

Wired Equivalent Privacy (WEP)
Default security system for 802.11 networks.

Wireless Multimedia Extensions (WMM)
Wi-Fi Alliance standard that specifies QoS capabilities for wireless networks with wireless traffic.

Wireless Network, or Wireless Local Area Network (WLAN)
Local area network based on 802.11 wireless communications.

Wi-Fi Multimedia (WMM)
IEEE 802.11e standard used voice QoS in 802.11 networks. Also known as Wireless Multimedia Extensions (WME).
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