



BTS TPW24-B-4A/M System User Guide

Customer Document

Version 1.1

Last Update: 23 September 2011

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1. Product Overview

The purpose of this document, *System User Guide*, is to allow service personnel to install and configure the TruePath wireless broadband system. This system is designed to offer network services and connectivity that meet or exceed the WiMAX standard Internet services.

Key system features are: support for 2.4GHz radio frequencies, a fully integrated web-based device management and billing gateway, and a software configurable wireless physical layer that allows adjustment of the transmit/receive frames, frequency, and power to work and function with the adjustment of just a few parameters.

1.1 Package Contents

The system is designed for easy installation and use right out of the box.

1.1.1 Embedded Device (Base Station or Client Station)

The package contains (1) embedded device: Base Station (Figure 1) shown below.

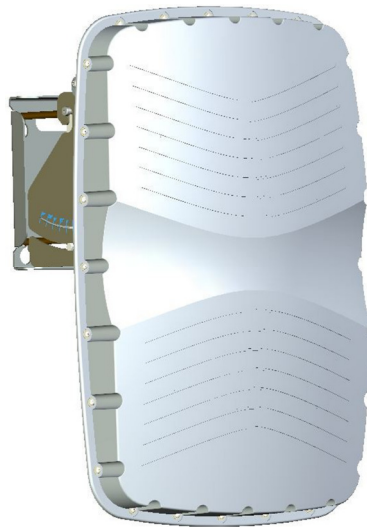


Figure 1 - Base Station

Other items included in the package are:

Power Over Ethernet (PoE) Adapter (TPW-PS-001US)
Ethernet Cable w/ Weatherproof Connector
User Guide CD

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1.2 System Requirements

Managing the system is done primarily through client shell services such as SSH and telnet. Below is a list of system requirements needed to manage the system:

Microsoft Windows (XP, Vista, 7), Linux, MAC OS X
 Clients: telnet, SSH

1.3 Hardware

Both the base station and client station are enclosed in weatherproof mechanical enclosures. The units have no moving parts and can be installed in a variety of locations including building roofs and eaves, and mobile phone towers. Each unit is equipped with internal antennas that are optimized for use in the 2.4GHz frequency bands. Optionally, the base station may be ordered/configured to use external ports if external antennas are desired.

1.3.1 Base Station

The base station enclosure consists of a single integrated unit. For standard operation, only power and data need be connected for the unit to function as down in Figure 2.

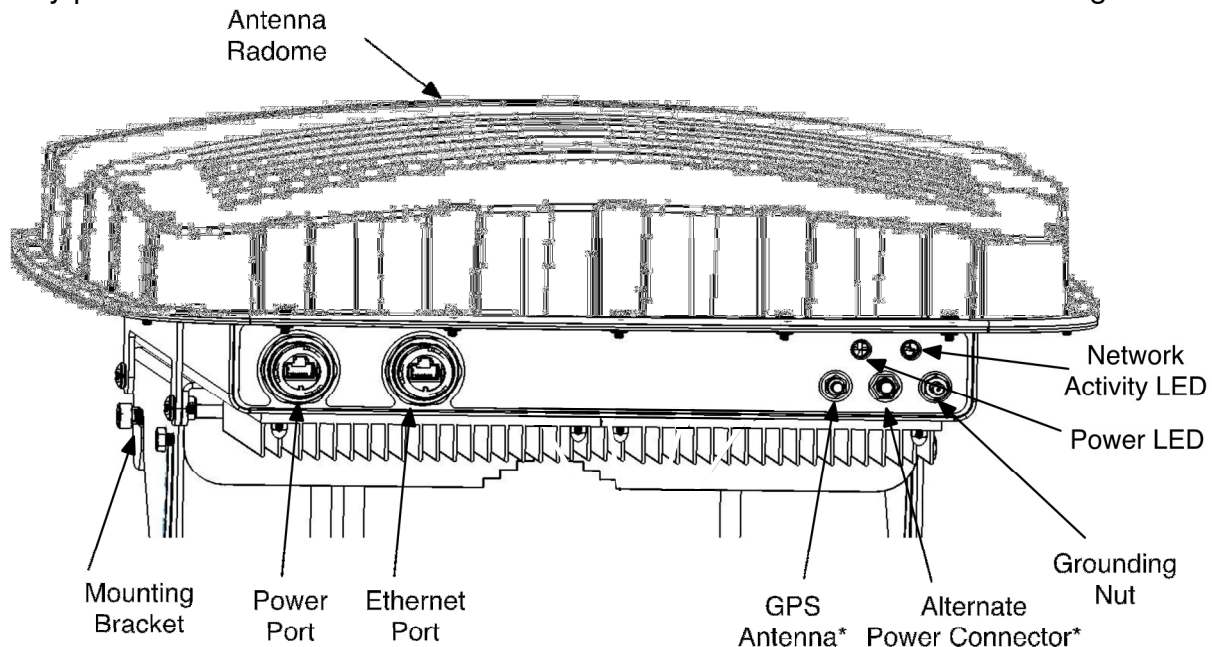


Figure 2 - Base Station Hardware

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The remaining connectors and their function are summarized in Table 1 below.

Connector/Feature	Type
Mounting Bracket	Custom bracket that wraps around a pole.
Power Port	RJ-45 connector w/ external weatherproof enclosure.
Ethernet Port	RJ-45 connector w/ external weatherproof enclosure.
External Antenna Ports (1-4)	N-type RF connectors
Grounding Nut	Nut/bolt
Alternate Power Connector	n/a
GPS Antenna	SMA female connector used to connect to external GPS antenna.
Power LED	High-intensity single color (green) LED
Network Activity LED	High-intensity single color (orange) LED

Table 1 - Base Station External Connectors / Features

In a multi-sector installation, a GPS is required for transmit and receive synchronization. Installation of this device is covered in later sections of this document. Likewise, to aid with lightning protection, the unit is equipped with a grounding nut.

A separate power port is used to allow the addition of high power amplifiers for use in enterprise-class applications. Additionally, there are two high intensity LEDs that allow network support personnel the ability to see if the unit is functioning properly from the ground level.

Finally, a custom-mounting bracket is included for pole applications. This and other installation techniques are covered in later sections of this document.

2. Installation

To install the system, first the Internet Service Provider (ISP) needs to procure tower space for base station sectors and connect them to an Internet backhaul provider. Next, the back office consists of a webserver/payment gateway hosted by a 3rd party provider, while a radius/User manager, network management system (NMS) client and server are needed to support, provision, and configure the network. Finally, an embedded client is installed at the target facility.

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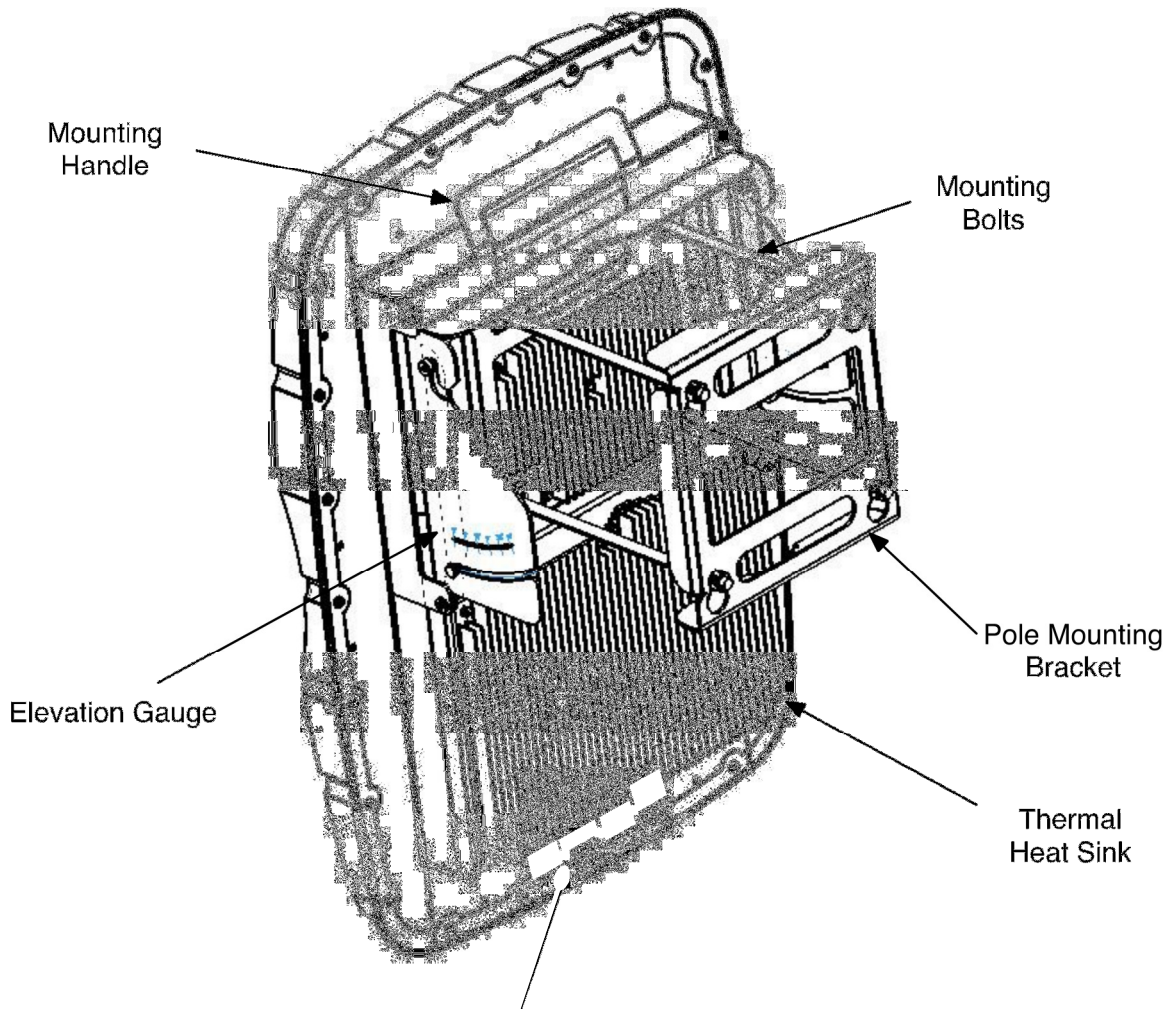
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2.1 Hardware Installation

The following sections describe various hardware installation features for both the client and base stations.

2.1.1 Mounting a Base Station

Several features are included with the base station mounting hardware to make installation easier as illustrated in Figure 3 below. First, when climbing up a tower, the mount features a handle for the installer to carry or fasten the unit. Second, an elevation gauge aids installations where the pole is already calibrated. Third, the pole-mounting bracket is adjustable to allow anchoring of the unit to poles with different diameters. Finally, the external connectors are placed at the bottom of the unit to limit weather exposure.

**BTS TPW24-B-4A/M
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2011**Figure 3 - Mounting a Base Station**

The finned thermal heat sink allows the unit to dissipate enough heat such that no additional environmental controls are needed.

2.1.2 Connecting a Base Station

As mentioned in previous sections, power and an Ethernet data connection are needed to activate the base station. To accomplish this, two weatherized RJ-45 connectors and cables should be plugged into the base station chassis and twisted to lock into place (as shown in Figure 4). Additionally, weather sealing tape should be wrapped around the connectors to provide another sealing layer (especially in humid or rainy environments).

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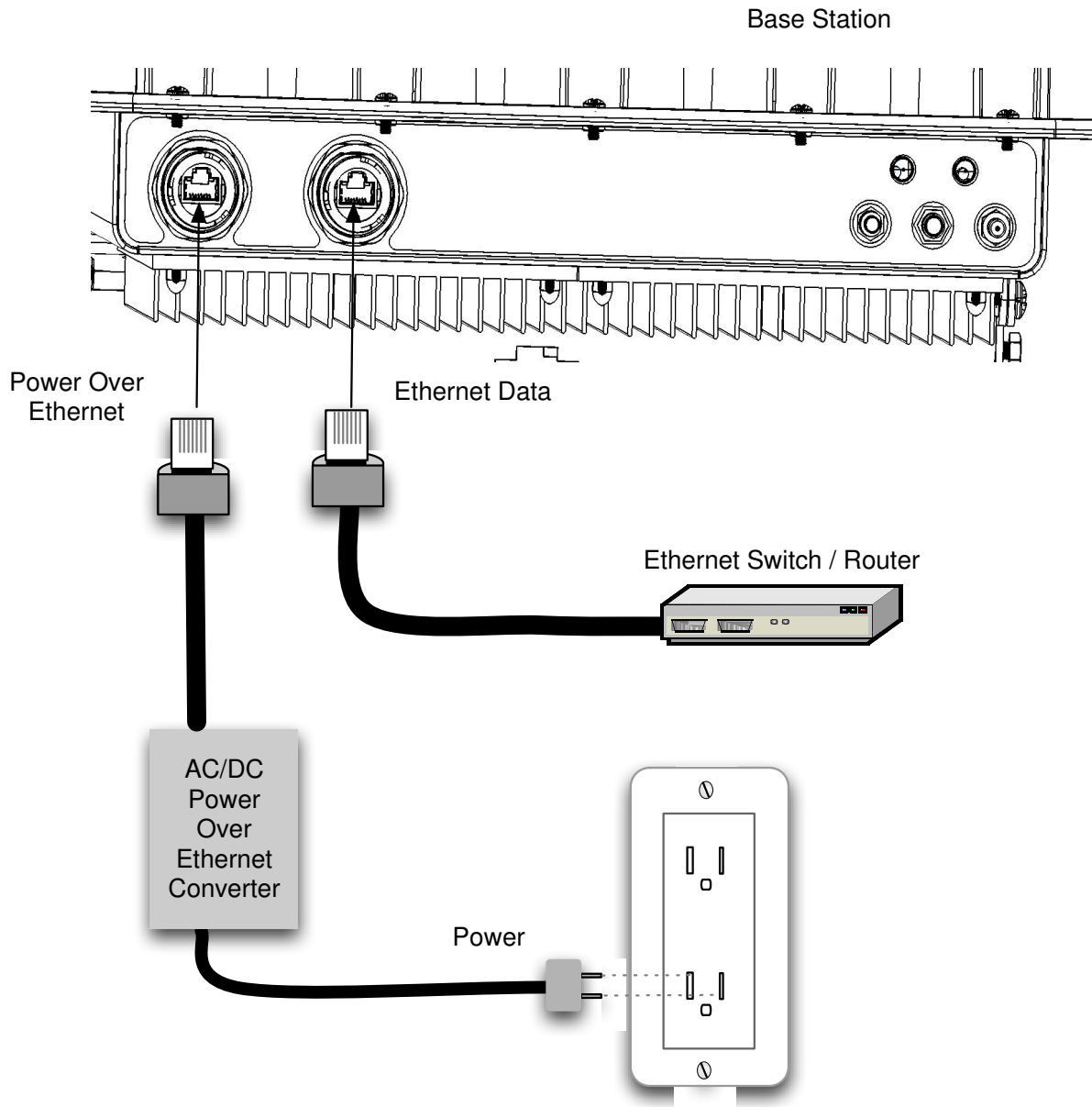
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Figure 4 - Connecting a Base Station

In either case, the Ethernet data line is terminated at an Ethernet switch or router and the power cable is plugged into the house power supply.

2.1.3 Single-Band Configuration (2.4 GHz)

The *TPW24-B-4A/M* is outfitted with a set of internal antennas designed to operate in the 2.4GHz radio frequency channels (software configurable). Figure 5 shows the base

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station configured with the internal 2.4GHz patch antennas, located under the radome (front view).



Figure 5 - Single Band BTS (Front View)

To configure the radio frequency and channel bandwidth, the system is equipped with a command line interface. This and other operational configuration parameters are discussed in the following sections.

3. Command Line Interface (CLI)

After the base station and/or client are connected to power and Ethernet, the system should initially be connected to a computer. NOTE: the Ethernet port is equipped with auto MDI-X rollover capability.

The default IP address configured as factory default is:

192.168.0.20

3.1 Connecting/First-Time Login

The default user name and password is:

Username: admin
Password: admin

These can be changed from the CLI interface after initial login. It is important to note that this account can change all aspects of the management system; therefore the admin password should be changed immediately to avoid a security breach.

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The *TPW24-B-4A/M* has the capability to be configured as either a network bridge or router. The following (2) sections provide some background of the configuration options and capabilities of the system.

3.1.1 Network Role

Each network mode is listed and described in Table 2 below.

Network Mode	Description
Router	IP packets are routed (Layer 3) between wired and wireless interfaces. Lower layer broadcast packets are dropped at each interface. Multicast packets can be configured to forward across.
Bridged	Configures the unit as a transparent Layer 2 Ethernet bridge. All packets (unicast, multicast, and broadcast) are forwarded between the wireless and wired interfaces (subject to ACL and firewall rules).

Table 2 - Network Modes

There is an option to disable specific interfaces. Please use this with extreme caution. Once disabled, no traffic will be accepted or passed from the interface (LAN/WAN).

3.1.2 Bridge Role

As mentioned in the previous section, bridge mode configures the unit as a transparent Layer 2 Ethernet bridge. All packets (unicast, multicast, and broadcast) are forwarded between the wireless and wired interfaces (subject to ACL and firewall rules).

The bridged mode management interface is either configured via static IP settings or via a DHCP server. Unless, reserved IP address lease tables are used, DHCP is not recommended, as the provisioned IP address is not guaranteed.

The settings and descriptions are listed in Table 3 below.

Network Settings (Static)	Description
IP Address	IP address used for device management. 192.168.0.20 is the default IP loaded at the factory.
Netmask	Dotted decimal representation of 4 binary octets that determine which part of address is the network and that of the host (the mask). For example, 255.255.255.0 is the most common mask used.
Gateway IP	Represents the address to send non-local data to. The local network means any network that is configured on the device (i.e.

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bridge IP network). In bridge mode, this IP address must be in the same space as the bridge IP network.

Table 3 - Network Settings (Static)

In bridge network role, the gateway IP address also shows up in the static route table (covered in a later section).

3.1.2.1 Common Network Settings

In addition to addressing, there are several network settings that are commonly configured in bridge network role. These include spanning tree protocol and IP aliasing. A list and description of each is in Table 4.

Network Settings (Common)	Description
Spanning Tree Protocol (STP)	IEEE 802.1d protocol that works on bridged interfaces to find the shortest path between to stations. Also, detects and blocks loops by preventing the same hardware/MAC address from being accepted from a port that it has transmitted the same address from.

Table 4 - Network Settings (Common)

3.1.3 Router Role

IP packets are routed (Layer 3) between wired and wireless interfaces. Lower layer broadcast packets are dropped at each interface.

Below (Table 5) is a list of settings and descriptions that are specific to the wireless LAN (WLAN) interface when the device is configured in a router role.

Network Settings	Description
IP Address	IP address used for device management. It is accessible from the wireless LAN (WLAN) interface.
Netmask	Dotted decimal representation of 4 binary octets that determine which part of address is the network and that of the host (the mask). For example, 255.255.255.0 is the most common mask used.

Table 5 - WLAN Network Settings

3.1.4 Static Routes

In both routed and static network modes, static routes can be entered to provide entries to the gateway interfaces for the networks served by the network interfaces (ROUTED,

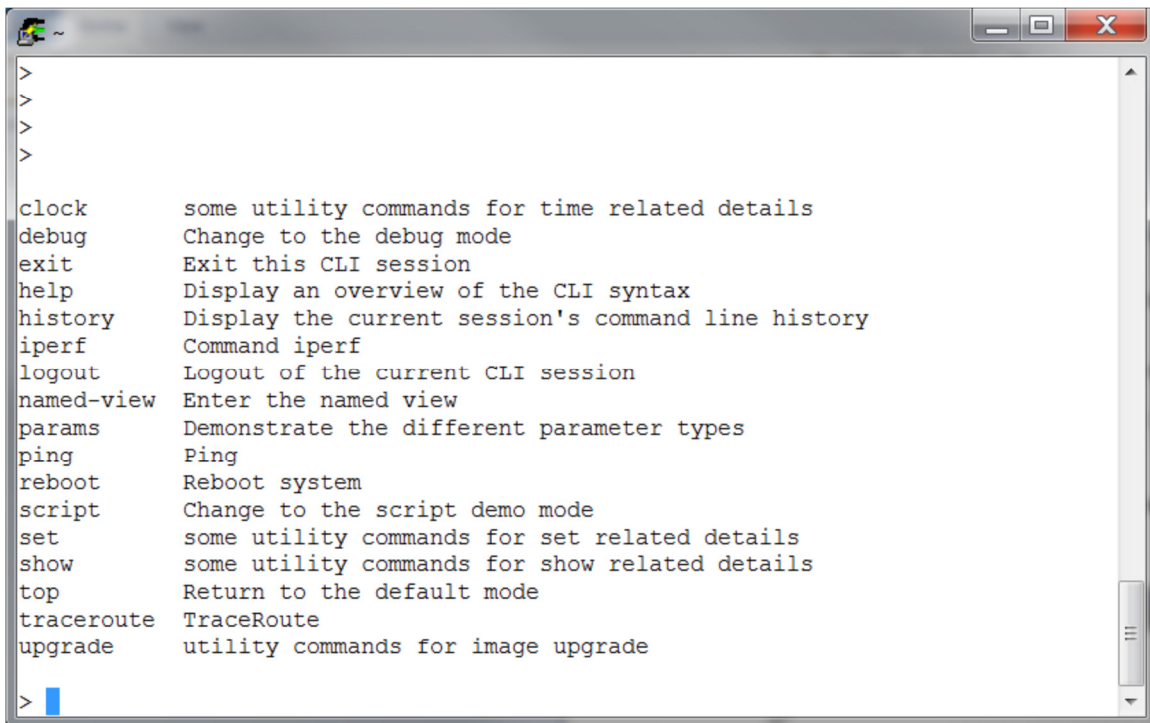
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or BRIDGED). In bridging mode, there should only be one gateway IP address to point to networks outside of the management IP network space. As a router, the gateway IP address points to the location that services the destination network.

3.1.5 Embedded CLI

The command line interface is a structured (hierarchical XML configuration) customer user interface. It is equipped with features that are typically found on carrier-class systems. This includes help, command completion, and option range/bounds checking. Similarly, the interface is serviced by a secure sockets shell server and is fully integrated with the Linux authentication subsystem.

Additionally, the CLI is equipped to support look up tables to allow the CLI to be customized to make commands easier to read- while maintaining the underlying software interface. Figure 6 shows some of the available root level commands.



```
>
>
>
>

clock      some utility commands for time related details
debug      Change to the debug mode
exit       Exit this CLI session
help       Display an overview of the CLI syntax
history    Display the current session's command line history
iperf      Command iperf
logout     Logout of the current CLI session
named-view Enter the named view
params     Demonstrate the different parameter types
ping       Ping
reboot     Reboot system
script     Change to the script demo mode
set        some utility commands for set related details
show       some utility commands for show related details
top        Return to the default mode
traceroute TraceRoute
upgrade    utility commands for image upgrade

> |
```

Figure 6 - Embedded CLI

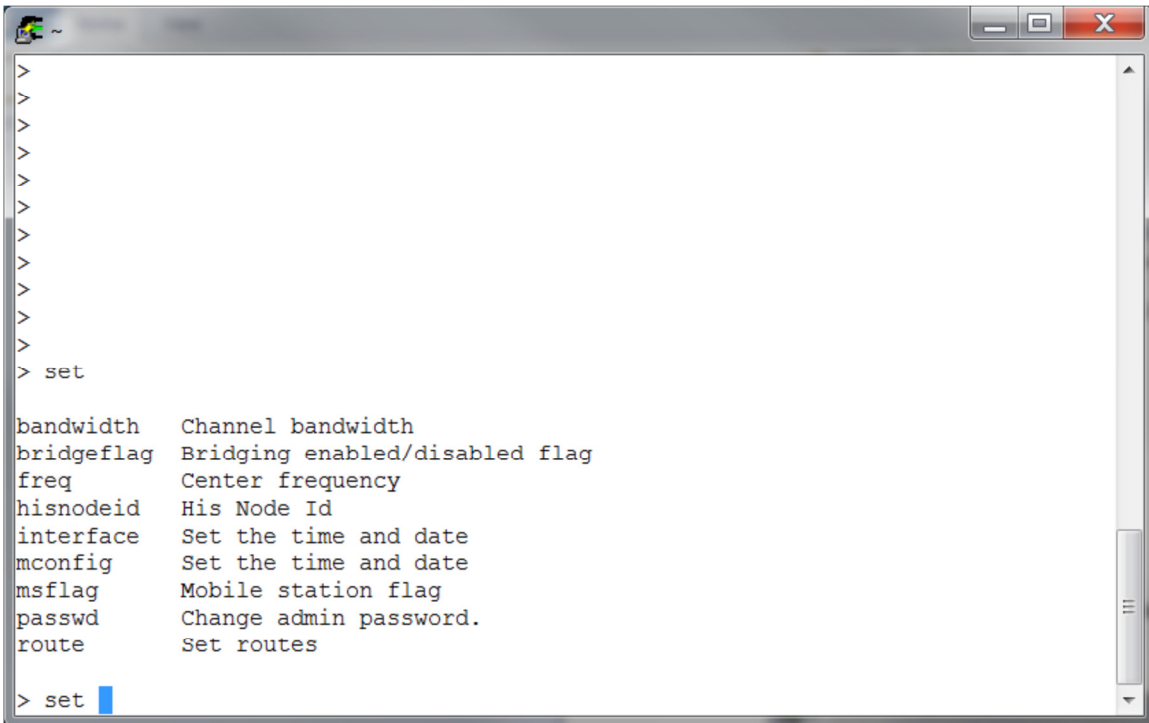
Basic level connectivity utilities are included such as support for IPerf and ping. The user can initiate help by pressing the 'TAB' key or by typing a '?' at any level of the command, including options.

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3.1.5.1 Set

The 'set' command (from the top level) is the primary configuration command. It can be used to configure system, network, and radio parameters. Changes to the configuration are automatically saved to the flash. This has the potential to cause certain parameters to be out of sync as they only take effect at boot time. These parameters have a warning message displayed, as the information is committed. Alternatively, a transaction-based configuration system is available in the software package.



```

>
>
>
>
>
>
>
>
>
>
>
> set

bandwidth   Channel bandwidth
bridgeflag  Bridging enabled/disabled flag
freq        Center frequency
hisnodeid   His Node Id
interface   Set the time and date
mconfig     Set the time and date
msflag      Mobile station flag
passwd      Change admin password.
route       Set routes

> set
  
```

Figure 7 - Embedded CLI Set Command Options

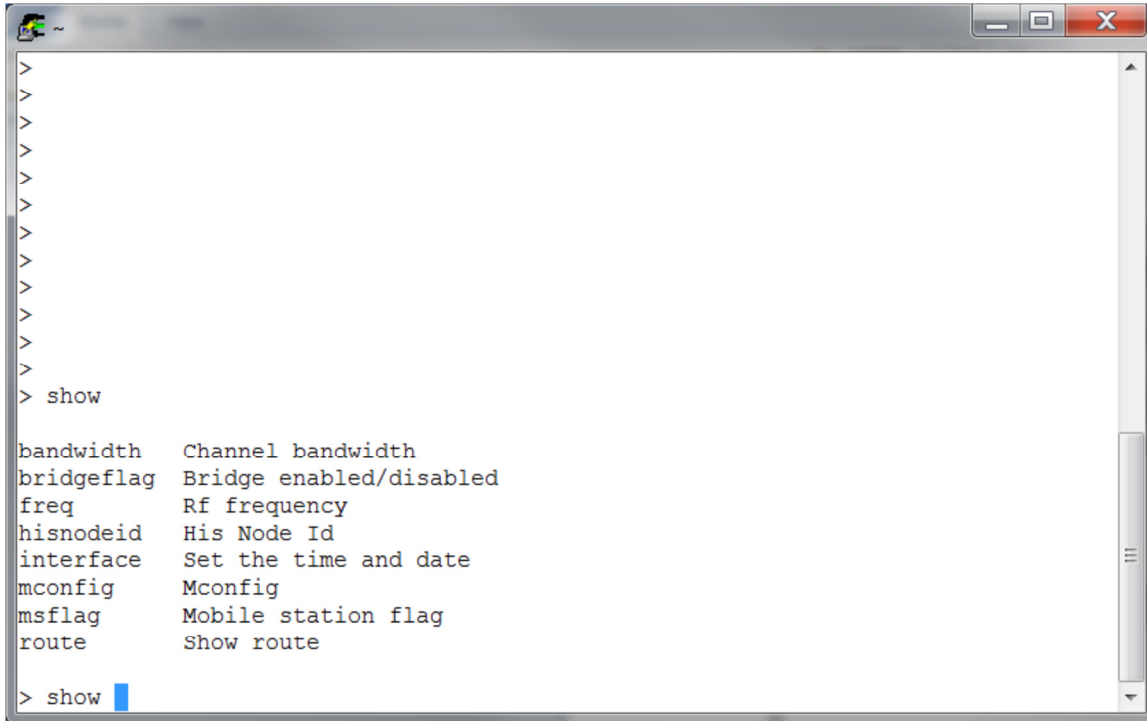
Concurrency to flash objects is handled through flash page locks. Most of the radio parameters require a reset after setting. This keeps the overall flash write rate very low.

3.1.5.2 Show

Each of the configuration options that are available in the 'set' command is also available as 'show' commands as shown in the figure below.

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A screenshot of a terminal window with a grey border and standard Windows-style window controls. The terminal text is as follows:

```
>
>
>
>
>
>
>
>
>
>
>
> show
bandwidth  Channel bandwidth
bridgeflag Bridge enabled/disabled
freq       Rf frequency
hisnodeid  His Node Id
interface  Set the time and date
mconfig    Mconfig
msflag     Mobile station flag
route      Show route
> show
```

Figure 8 - Embedded CLI Show Command Options

3.2 TruePath Wireless GUI

The TruePath Wireless GUI manages real-time airtlink performance. This is a specialized Visual Studio Application that utilizes a socket interface directly in the MAC loadable kernel driver. It is designed for a single point-to-point stream of either a base station or client view of the airtlink. Current plot metrics include SNR, modulation, bit rate, and constellation plots. Additional text-based metrics are available for SNR, internal hardware temperature, and number of points received per second.

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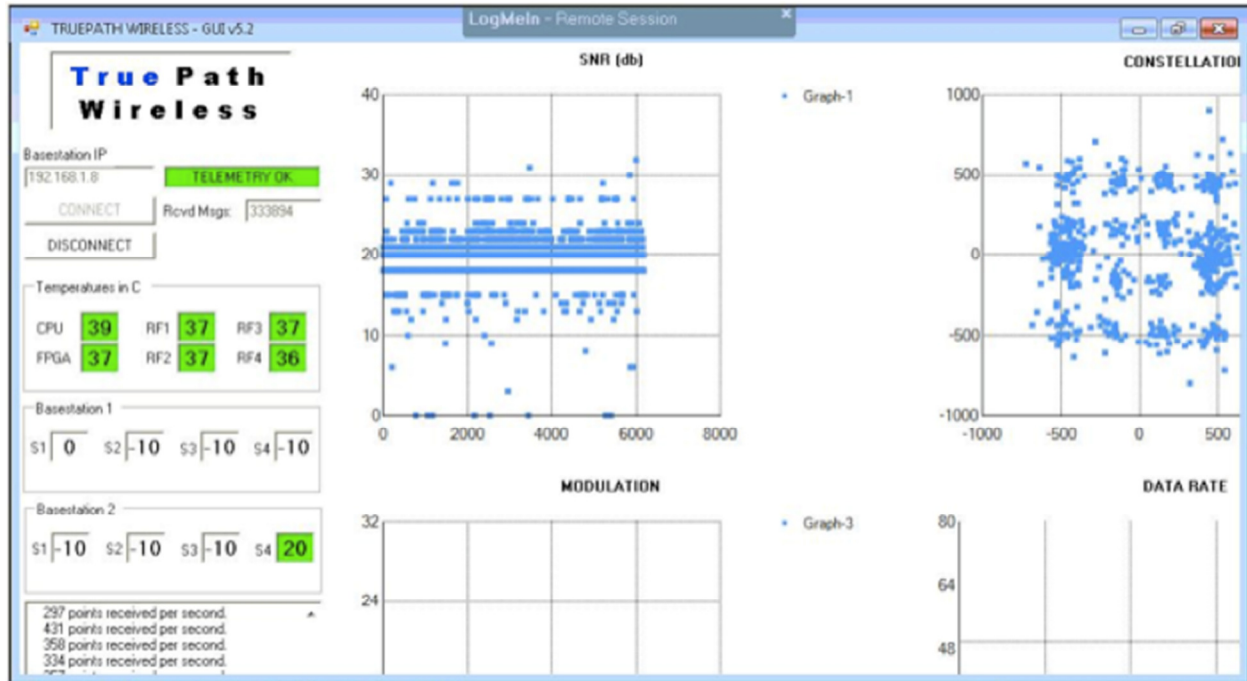
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Figure 9 - GUI Display

This tool is used to correlate bandwidth/throughput events with any measured airlink deficiencies.

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APPENDIX A: Specifications

Base Station (BTS TPW24-B-4A/M)

Dimensions	27" H x 19" W x 6" D
Weight (estimated)	BTS 19 lbs.; Mount Bracket 12 lbs.; PSU 5 lbs.
Ports	1 10/100/1000 Ethernet Port 1 Power Port 1 Alternate Power Port* 1 GPS Antenna Port* 1 Grounding Lug
LEDs	1 Power 1 Network Activity
Wireless Security	WEP, WPA, WPA2
Radio Frequency Band	2.4 GHz
Power	48VDC, 50 Watts
Operating Temperature	-45C to 55C
Storage Temperature	-45C to 80C

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APPENDIX B: FCC Interference Statement

Federal Communication Commission Interface Statement

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or experience radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE: FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.



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APPENDIX C: Support/Contact Information

TruePath Wireless Support

TruePath Wireless Support Engineers are located in the U.S. and are dedicated to helping customers resolve issues as quickly as possible. Please email all issues and requests to:

Email: support@truepathwireless.com



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