PureWave networks

PureWave Quantum 6600

High performance, all outdoor
Mobile WiMAX base stations

PureWave Quantum 6600 User Guide v2.1

(ING -00006-001 Rev E)

Contents

Figures

Tables

Regulatory Notice

This device complies with the FCC limits a class B digital device, pursuant to Part 15 of the FCC Rules. A complete list of regulatory certifications can be provided by PureWave upon request. 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 or more of the following measures:

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

Shielded cables and I/O cords must be used for this equipment to comply with the relevant FCC regulations.

Changes or modifications not expressly approved in writing by PureWave Networks may void the user's authority to operate this equipment.

The 2.3, 3.3 and 3.5 GHz products have the CE (European Conformity) Mark.

Note: This device must be professionally installed, and the operator and/or the licensed spectrum holder have the responsibility to comply with FCC regulations.

Note: The contention protocol MUST be turned on and used for the specified band (3.65GHz - 3.7 GHz) in the specified country or wherever FCC rules and regulations are enforced. Failure to comply makes the operation of this device illegal.

Safety Precautions

When operating or installing this equipment, please observe the following precautions to minimize the risk of danger or personnel injury:

	NEVER install equipment if there is a chance of lightning or other adverse weather conditions.
	NEVER install equipment in a wet location unless the equipment is specifically design for wet locations.
	NEVER touch un-insulated wires or terminals unless the wire has been disconnected from any equipment.
	ALWAYS use caution when installing or modifying cables.
	ALWAYS disconnect all lines and power connections before servicing or disassembling this equipment.
	ALWAYS assume that all components and assemblies are static sensitive and always follow local ESD-prevention guidelines to prevent equipment damage**.**
	For any external power supply that provides the power source for the PureWave equipment, replace any power supply fuse with the same rating or equivalent; otherwise PureWave Networks cannot not be responsible for any subsequent damage to the equipment.
	For performance and safety reasons, only power supplies listed for use with telephone equipment by a Nationally Recognized Testing Laboratory (NRTL) should be used with equipment.
	ALL wiring external to the product(s) should follow the provisions of the current edition of the National Electrical Code.
	These units contain no user serviceable components. Only authorized service personnel should service or repair these units. Use only isolated Class 2 Power Source, Rated 48V dc 5.0A Minimum.

1 Preface

1.1 About This Document

The purpose of this User Guide is to quickly familiarize the user with the PureWave Quantum 6000 family of Base stations, their initial setup, and provisioning. It is not intended to be a comprehensive reference for the product and all its capabilities, nor does it cover in depth provisioning, operation, or administration using the PureView Network Management System or the PureWave Quantum Command-Line Interface. Please refer to their respective user guides for more in-depth coverage of those tools.

Please also note that this guide does not cover the physical installation of the product, but rather assumes that the Base station has been fully installed and is ready to be powered on. Please refer to the PureWave Quantum 6600 Installation Guide for detailed professional installation guidelines.

Always refer to the current set of Release Notes for the most up to date information and a description of the current features as they relate to the PureWave system. These may be different from and supersede the information contained within this “Installation Guide”.

1.2 Symbols used in this Document

Notes, cautions and timesavers use these conventions and symbols:

	**Tip**	Means the following will help you solve a problem. The tips information might not be troubleshooting or even an action, but could be useful information.
	**Note**	Means reader take note. Notes contain helpful suggestions or references to materials not contained in this manual.
	**Caution**	Means reader be careful. In this situation, you might do something that could result equipment damage or loss of data.
	**Warning**	This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

1.3 Locating the Product Serial Number

The product identification information, serial number, and certification information are located on a label on the side panel of the Base station. Please take note of and keep this information for your records, as it is very important for warranty and support services.

1.4 Obtaining Documentation and Support

All requests for documentation and/or support should be addressed to

Technical Support Department
PureWave Networks, Inc.
2660-C Marine Way
Mountain View, CA 94043

E-mail: support@pwnets.com
Tel: 650-528-5200
Fax: 650-528-5222

2 PureWave Quantum Base Station Overview

2.1 Introduction - What is a Compact Base Station?

At PureWave, we believe that true broadband data networks must roll out in a completely different manner than the traditional, low-throughput cellular networks of yesterday. The traditional cellular network paradigm of colossal “macro” Base stations and large cell radii developed from the need for high-coverage networks to carry low-bandwidth voice and messaging traffic. However, as the demand for data-based applications has grown, networks have quickly become congested, necessitating new wireless standards designed specifically for high-speed broadband data. Furthermore, as spectrum is always a scarce and expensive resource, the need for improved frequency re-use techniques has become more important than ever.

The clear solution to this is higher-efficiency wireless standards, such as IEEE 802.16e Mobile WiMAX, and more flexible cell sizes. Where medium and high population density exists, cell sizes should be small to enable increased spectral re-use, thereby ensuring that each subscriber enjoys a sufficient amount of throughput. In such cases it may be necessary to deploy Base stations on utility poles, flag poles, rooftops, small buildings and walls. This necessitates small, pleasant form-factor Base stations that can accept a variety of antenna types, both omni-directional and directional. Such Base stations are often referred to as “Pico”. Because wired backhaul may not always be available in some such locations, it also suggests the need for wireless backhaul options.

On the other hand, in rural areas with lower population densities, it makes more economic sense to deploy fewer Base stations on higher towers or buildings and usually with higher transmit power. This is closer to the traditional cellular approach and typically involves large, expensive and power-hungry “macro” or “micro” Base stations, often with split designs requiring both indoor and tower-top electronics. Wherever indoor components are required an operator must obtain an air-conditioned shelter, which adds significantly to the continual operating expenditures of such a deployment and limits the deployment location.

PureWave has taken a revolutionary approach in the development of exclusively “Compact” Base stations. A compact Base station shares the similar form-factor and cost of a Pico Base station, but with the performance of a Macro Base station. It is a zero-footprint device that can be fully co-located with its antennas. It is the best of all worlds and can be flexibly deployed in Pico, Macro, and Micro type deployments.

Welcome to the Revolution!

2.2 PureWave Quantum at a Glance

The PureWave Quantum Family of Compact Mobile WiMAX Base Stations is PureWave's 3rd generation Base station platform and we believe it presents what is simply the most advanced and high-performing, yet cost-effective Base station solution available.

The PureWave Quantum Family of Base stations currently consists of the 2x4 (2 Transmit, 4 Receive) Quantum 1000, the 3 x 2 x 2 Quantum 2200 and the PureWave Quantum 6600 (6x6) products.

This User's Guide covers the PureWave Quantum 6600 products, with models differentiated by only the frequency variant which is represented by the two right digits. For example, the PureWave Quantum 6625 is the 2.5GHz variant, supported 2.5-2.7GHz. Otherwise they are functionally identical. In this guide we will, without loss of generality, refer primarily to the PureWave Quantum 6600 product, which is synonymous to writing PureWave Quantum 66xx. Please note that not all Quantum models are available in all markets. Please contact your sales representative for additional information and ordering options.

The PureWave Quantum Family of Base station products is fully 802.16e (Mobile WiMAX) compliant and designed to interoperate seamlessly with standard, off-the-shelf, WiMAX-certified subscriber devices. All PureWave Quantum products feature a software-defined radio (SDR) architecture that allows them to continuously evolve and take on new features as they become available. Some of the key highlights of the PureWave Quantum Family of products include the following:

- **Superior Range** – An antenna array of up to 6 antennas operated in concert creates tightly focused radio beams that extend the range of each Base station by up to 40% or boost capacity where required.
- **Spectral Re-use** – Sophisticated interference mitigation techniques coupled with advanced beamforming technology, both made possible by PureWave's multiple antenna architecture, allow for simple network deployments and for improved spectral re-use.
- **Software Defined Radio** – Protects your investment through support for over-the-air, field upgrades of existing networks as standards evolve and new features and capabilities are released.
- **Completely Weatherproof** – PureWave Quantum Base stations do not require shelter and can be installed completely outdoors. This eliminates the capital cost of building a shelter and the recurring cost of leasing or running an air-conditioned site.
- **Flexibly Mount Virtually Anywhere** – PureWave Quantum Base stations can be deployed on towers, utility poles, walls, rooftops, etc, without the need for remote RF heads.
- **ASN-GW Optional** – PureWave Quantum Base stations can operate with or without an ASN-GW, making even small deployments affordable.

PureWave Quantum Base stations can utilize virtually any off the shelf antennas, both omni-directional and sectored. However, PureWave recommends our own line of affordable, compact, multi-antenna panels designed specifically to complement the performance of our Base stations.

PureWave Quantum Base Stations can be installed indoors or outdoors, however the antennas must always be installed outdoors. Figure 1 shows a PureWave Quantum 6600 Base station co-located on a tower with a PureWave 6-Port Antenna Panel.

Figure 1: PureWave Quantum 6600 Base Station Mounted on Tower

PureWave's carrier-grade solution includes the full-featured and highly scalable PureView NMS (Network Management System), which can efficiently and powerfully provision and manage all Base station and Subscriber Stations in the access network. PureView features include automatic discovery, fault management, inventory tables, configuration, and performance management. PureView utilizes full open standard SNMP on the access network side, and employs a full-featured northbound interface for connection to virtually any existing NMS.

In addition to the PureView NMS, all PureWave Quantum Base Stations support a full-featured Command Line Interface (CLI) and an integrated Web Interface. Please refer to the PureView NMS User Guide and the CLI User Guide for in depth coverage of those applications.

2.3 A Closer Look

The PureWave Quantum 6600 Base Station is a single, weather-resistant enclosure with overall dimensions 17.5” x 16.7” x 5.3” (44cm x 42cm x 13cm). The Base station is a single self-contained unit.

Note that the PureWave Quantum 6600 Base Station has no user-serviceable components.

PureWave Quantum products employ a sophisticated and flexible hardware architecture that combines general purpose processors, and application-specific hardware. Together these components deliver the processing power required to realize the high-performance required by today’s demanding applications, while yielding the flexibility to support future functionality as needs arise.

2.3.1 Ports and Indicators

The PureWave Quantum 6600 connector panel is shown in figure 2. The product’s flexible architecture allows for a number of product variants to suite almost limitless deployment needs. The model shown includes six antenna ports, two CAT-5 Gigabit Ethernet backhaul ports, and a DC power connector. Single or Multi-Mode Fiber backhaul and AC power options are also available. As the configuration of individual Base station models varies, so will the appearance of the connector panel. All PureWave Quantum Base stations include a serial (RS-232) console port, a GPS antenna connector, a ground terminal, and three high-intensity LEDs.

Figure 2: PureWave Quantum 6600 Base Station

Note that Installation and weatherproofing must be completed by a professional installer. Please refer to the PureWave Quantum 6000 Base Station Installation Guide for detailed instructions.

The function of each Base station connector/port is described in Table 1. Note that every connector present must be terminated to ensure proper Base station operation. Please refer to the PureWave Quantum 6600 Installation Guide for comprehensive installation procedures.

Connector	Function
PWR	-48VDC power source inputs for the unit. DC power connector: LTW BB-04PMMS-LC7001 (chassis), LTW BB-04BFFA-LL7001 (mate)
GND	This M5 screw provides a ground connection point to the Base Station. It is the installer's responsibility to ensure that the unit is professionally grounded and complies with all relevant local codes.
GPS	N-type connector for mandatory external GPS antenna. 3.3V power on center pin.
ETH-1	This Gigabit Ethernet port serves as the data traffic backhaul Interface and also provides for in-band management of the Base Station. Note that this port may be physically routed directly to the operator's network equipment, or it may be daisy-chained through additional PureWave Quantum sectors by routing it to another unit's ETH-2 port. Cat-5 (RJ-45), Single-Mode Fiber (HartingPull/Han 3 A), and Multi-Mode (LC duplex) Fiber options are available for the ETH-1 port.
ETH-2	This Gigabit Ethernet port serves as an incoming daisy-chain port from a neighboring sector, and may be used for out-of-band management of the Base Station. It may also be used to connect to an external device, such as a web camera. Daisy-chained traffic is aggregated and passed through the ETH-1 port. Cat-5 (RJ-45), Single-Mode Fiber (HartingPull/Han 3 A), and Multi-Mode (LC duplex) Fiber options are available for the ETH-2 port.
CONSOLE	RJ-45 based RS-232 port for CLI control via a console. Defaults settings are 38400, 8 data bits, 1 stop bit, no parity bits, no flow control.
ANT 1-6	N-type Tx / Rx Antenna Ports.

Table 1: Base Station Connector Descriptions

The Base Station's three high-intensity LEDs are intended to be viewable from the ground for quick confirmation of the unit's operational state. Table 2 describes the function of each indicator. Note that the LEDs can be turned off by the operator using the PureView NMS, the Web Interface, or the Base Station's command-line interface.

LED	Function
STATUS	Green - BS is up and running normally. No faults detected. Blinking Red – System booting up, or system is temporarily down. Solid Red - Fault detected. Off – LEDs disabled or Power is off. Fault detected if POWER LED is Green, but STATUS LED is Off.
LINK	(Status LED for ETH-1 Gigabit Ethernet Port) Solid Green – Connected to an Ethernet switch. Blinking Green – Ethernet packet activity. Off – LEDs disabled or no Ethernet activity detected.
POWER	Green – Power is being supplied to the BS. Off – LEDs disabled or no power is being supplied to the BS.

Table 2: Base Station LED Description

2.3.2 Radio and Physical Layer Specifications

The PureWave Quantum Family of Base Stations is available in several models to support a variety of frequency bands and the regulatory requirements of a number of countries. Because several deployment-specific variables (e.g., antenna type, cable type and length, settings, etc) can affect the effective power output and other characteristics of the system, it is the customer's responsibility to assure that each deployment of this product meets applicable regulations. The PureView NMS, the Web UI, and the CLI all provide guidelines and feedback to ensure an appropriate installation.

Table 3 lists key radio-related specifications of PureWave Quantum Base Stations. Note that additional features, not listed, may be released in future software revisions.

Parameter	Specification
Frequency Bands	XX23: 2.3-2.4GHz XX25: 2.496-2.69GHz XX33: 3.3-3.4GHz XX35: 3.4-3.6GHz XX36: 3.6-3.8GHz, including 3.65GHz US
Channel Sizes	5, 7,10 MHz
Duplex Method	TDD
DL:UL Ratios	35:12, 29:18, 32:15, 26:21 (5MHz and 10MHz) 23:9, 21:12, 17:15 (7MHz)
Number of Tx/Rx Antennas	Up to 6 Tx, 6 Rx for Quantum 6600 series
Tx Power per Antenna	33dBm (RMS data power at maximum MCS level, measured at each external antenna connector of the Base Station)
Permutation	PUSC
Modulation	QPSK-1/2, QPSK-3/4 16QAM-1/2, 16QAM-3/4 64QAM-1/2, 64QAM-2/3, 64QAM-3/4, 64QAM-5/6
Data Repetition Coding	QPSK-1/2 Repetition 2, 4, 6
MAP Repetition	1, 2
Smart Antenna Capabilities	Beamforming, MIMO Matrix A, MIMO Matrix B, Cyclic Delay Diversity, MRC
Air Link Optimization	HARQ, CTC

Table 3: Radio and PHY Specifications

2.3.2.1 Receiver Sensitivity

Table 4 presents typical receiver sensitivity specs of the Quantum 6600 Base Station. Note that sensitivity will be correspondingly less on models with fewer than 6 antennas. Note that the values presented are measured over the entire channel bandwidth, as opposed to WiMAX Radio Conformance Test (RCT) type measurements, which are measured over only a fraction of the channel bandwidth.

Typical 6-Ant Rx Sensitivity		
AWGN, 10^{-6} BER, Full Band, in dBm		
UL MCS (CTC)	**5MHz**	**10MHz**
QPSK-1/2	-105.0	-102.0
QPSK-3/4	-102.0	-99.0
16QAM-1/2	-99.8	-96.8
16QAM-3/4	-96.1	-93.1
64QAM-1/2	-95.1	-92.1
64QAM-2/3	-90.9	-87.9
64QAM-3/4	-90.2	-87.2
64QAM-5/6	-87.0	-84.0

Table 4: Typical Rx Sensitivity

2.3.2.2 Computing EIRP Power

Effective Isotropic Radiated Power (EIRP) refers to the transmit power radiating out of the antenna. The accurate computation of EIRP is essential to proper network planning and to ensuring that the system meets local and regional maximum power regulations.

As indicated in Table 3, the average Tx power output at each Base Station antenna connector is 33dBm. The average EIRP per antenna is computed as follows:

Ave EIRP per Ant (in dBm) = Ave Tx Pwr per Ant + Ant Gain – Cable and Connector Loss

For example, if deployed with a 14dBi antenna connected to the Base Station with only a few feet of cable, the average EIRP per Antenna might be 33dBm + 14dBi – 1dB = 46dBm.

The total average EIRP of the Base Station with all antennas combined can then be computed as follows:

Total Ave EIRP (in dBm) = Ave EIRP per Ant + 10log (Number of Antennas)

For a 6 antenna Base Station, the example above yields Total Ave EIRP = 46dBm + 7.78dB = 53.78dBm.

Note that some regulations refer to *peak* power, which in a WiMAX system is normally as much as 10dB higher than average power. In the case of the PureWave Quantum products the peak power can be assumed to be 9dB higher than average. Therefore, Peak EIRP should be computed as follows:

Peak EIRP per Ant (in dBm) = Ave EIRP per Ant + 9dB.

Total Peak EIRP (in dBm) = Total Ave EIRP + 9dB.

For the above example, Peak EIRP per Ant = 46dBm + 9dB = 54dBm and Total Peak EIRP = 53.78dBm + 9dB = 62.78dBm. These equations are summarized in Table 5.

EIRP Metric	Formula
Ave EIRP per Ant (in dBm)	= Ave Tx Pwr per Ant + Ant Gain – Cable and Connector Loss
Total Ave EIRP (in dBm)	= Ave EIRP per Ant + 10log(Number of Antennas)
Peak EIRP per ant (in dBm)	= Ave EIRP per Ant + 9dB
Total Peak EIRP (in dBm)	= Total Ave EIRP + 9dB

Table 5: EIRP Calculations

Note that some regulations are specified for particular channel bandwidths and/or antenna beamwidth and in such cases the allowable power should be scaled accordingly. As with the previous calculations, each case is often unique. Although the PureView NMS provides guidance and limits where known regional regulations apply, it is ultimately the responsibility of the spectrum holder to assure that appropriate limits are set.

2.3.2.3 Smart Antenna Capabilities

Beamforming is a technique that combines and focuses signals to and from multiple antennas to improve both downlink and uplink performance. On the uplink, the Base Station combines signals received on its multiple antennas, resulting in substantial link budget gains that improve range and throughput. **Maximum Ratio Combining (MRC)** and **Minimum Mean-Square Error (MMSE)** are basic techniques from which more sophisticated uplink processing techniques (such as interference mitigation) are built.

On the downlink (Base Station to Subscriber Station), sophisticated digital signal processing algorithms exploit information gathered during the uplink beamforming process to concentrate the transmitted RF energy from the antenna array to the exact subscriber stations locations, improving gain, efficiency and signal to noise ratio (SNR), resulting in greater range and throughput.

MIMO Matrix A utilizes a technique called **space-time coding (STC)**, which exploits the spatial diversity of the channel to improve downlink performance. By improving data reception, it can increase range and maximize the utilization of available sector capacity.

MIMO Matrix B utilizes a technique called **spatial multiplexing (SM)**, in which multiple streams of data are simultaneously transmitted through multiple antennas and effectively separated by the receiving device. This technique can actually increase the spectral efficiency and, hence, the capacity of a system.

The effectiveness of MIMO relies upon the spatial diversity inherent within the channel as well as other factors, and therefore a given technique may be more appropriate for certain users or deployments. Fortunately, PureWave Quantum Base Stations make these decisions automatically, maximizing the efficiency of your valuable spectrum.

Cyclic Delay Diversity (CDD) is a technique employed by PureWave Quantum Base stations to allow the power of multiple antennas to be combined in transmitting a single stream of data even when MIMO or beamforming cannot be supported (e.g., when transmitting the MAP).

2.3.3 Capacity and Performance Characteristics

Table 6 summarizes key upper layer and overall performance characteristics of PureWave Quantum Base Stations. Note that some features may not be currently available, but are planned for future software releases. In addition, detailed throughput tables for each DL:UL ratios are presented in Appendix B.

Parameter	Specification
Active Users	200
Service Flows Per User	16
Peak Throughput	Aggregate: Up to 50Mbps DL: Up to 43Mbps UL: Up to 20Mbps
QoS	BE, UGS, ErtPS, nrtPS, rtPS
Convergence Sublayer	IP-CS, Eth-CS, IPv4, IPv6 Pass-Through
Security	AES-128, EAP-TLS, EAP-TTLS, PKMv2
Management	PureView NMS / EMS, Remote CLI, Web Interface, SNMP v2c, SNMPv3
Core Network Interface	R6 (NWG 1.2.2, NWG 1.3.1), Radius

Table 6: Performance Characteristics

2.3.4 Electro-Mechanical and Environmental Specifications

All PureWave Quantum Family Base Stations consist of a single, all-in-one, fully weatherproof unit that may be installed entirely outdoors or indoors, as dictated by each deployment. Please refer to the PureWave Quantum Base Station Installation Guide for detailed installation instructions and guidelines.

Table 7 lists the mechanical, electrical, and environmental properties of the PureWave Quantum 6600 Base Station.

Physical & Environmental	Specifications
Dimensions	17.5" x 16.7" x 5.3" (44cm x 42cm x 13cm)
Weight	32lbs (14.5kg) (does not include mounting hardware)
Power	-48 VDC (150 Watts Max)
Temperature	-40C to +55C (ETSI EN 300 019-1.4 Class 4.1E) Note: An available solar shield is required for ambient temperatures exceeding +45C with full sun exposure.
Humidity	5-100% non-condensing
Altitude	To 10,000 ft above sea level
Surge Protection	UL497B
Lightning Protection	Min 10kA IEC 6100-4-5 (optional via external kit)
Weatherproofing	IEC IP67
Wind Loading	160Km/hr operation, 200Km/hr survival
Lightning Protection	Min 10kA IEC 6100-4-5 (optional via external kit)
Safety and IEC IP	EN 300 019-2-2, GR487, IEC 60529
Vibration and Dust	ETSI EN 300 019-1-4 Class 4.1E

Table 7: Environmental and Mechanical Specifications

For temperatures above +45 degrees C in direct sunlight it is necessary to deploy the Base Station with the available solar shield, shown in **Figure 3**. Again, details can be found in the PureWave Quantum 6600 Base Station Installation Guide.

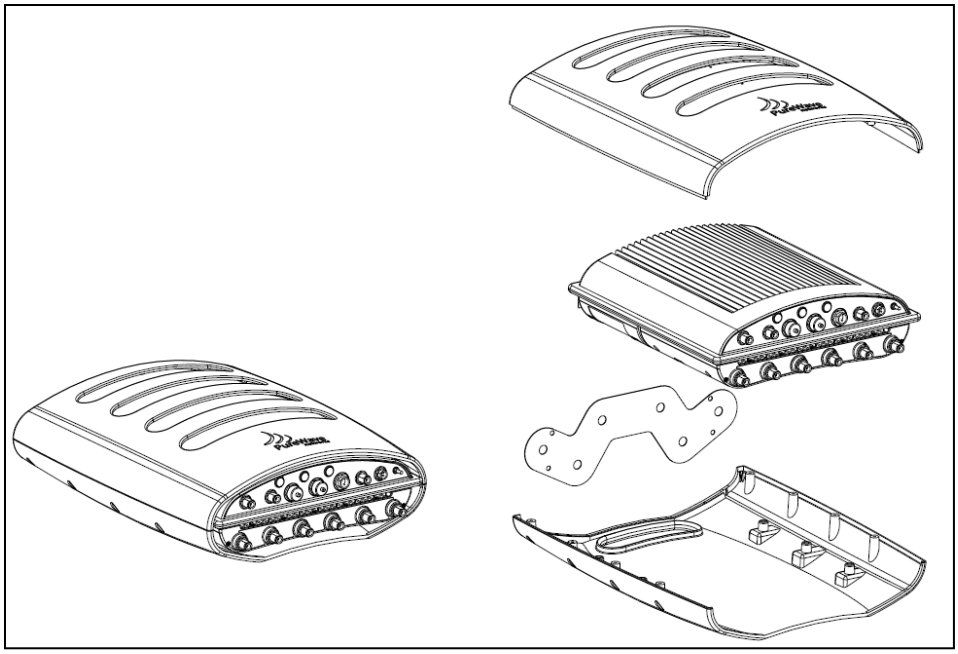

Figure 3: Quantum 6600 with Available Solar Shield

3 Quick Start Guide

This section describes how an Operator may power-up the PureWave Base Station and verify proper system initialization and configuration. There are two methods by which a PureWave Quantum Base Station may be configured and/or managed. This can be achieved via either a graphical user interface (GUI) Web Interface or a command line interface (CLI).

Each interface has the capability of configuring all parameters available in the Base Station. It is generally recommended to configure using the CLI for the first initial configuration of the Base Station or in the event that the Base Station management interface parameters are not known. PureWave thereafter recommends using the Web Interface for all configuration parameters.

Note that the Web Interface and the CLI utilize the same terminology, parameter names, etc.

3.1 Preparing and Powering Up the Base Station

Before powering on the Base Station it is critical that all of its connector panel ports be properly connected or terminated per the detailed instructions in the PureWave Quantum 6600 Installation Guide. Failure to do so may result in damage to the Base station.

The procedures in this section assume the following connections have been to the Base Station:

- Antenna's have be connected to each Base Station ANT (ANT 1 through ANT 6) ports.
- A GPS antenna is properly installed and attached to the Base Station GPS port.
- The ETH-1 port is connected to an accessible network via a router or other mechanism.
- An appropriate cable has been connected to the Console port. To connect to the Console port, the User will need the following hardware that is provided with the Base Station installation kit. These are as follows:
    - RJ45 cable.
    - DB9 male connector (Network Adapter).
    - DB9 female to DB9 female adapter.

  The adaptor should be connected to a “straight-through” serial cable. Do not use a Cisco “rollover” cable or a null modem serial cable as these are not supported. Please see the PureWave Quantum 6600 Installation Guide for more details.

  Optional: Serial to USB connector. Most laptop nowadays comes with USB connection instead of serial connection. If the PC/laptop has a DB9 serial connection then there is no requirement for a USB adapter. If not, then you will need to get serial to USB adapter to access the Base Station CLI. Plug one end of a “straight” Cat 5 Ethernet cable into the Base Station Console port and the

other end into the RJ45 to Modem adapter. Connect the other end of this Modem adapter to a DB9 serial cable and connect this DB9 serial cable to a USB adapter that connect to your laptop.

With the Base Station and all cables properly installed, power may now be applied to the Base Station.

The Base Station has no power switch so it will begin to power up immediately when a power source is attached. The POWER LED should be solid green.

3.2 Default Parameters

Table 8 lists the factory default values that are set prior to shipment. These default parameters provide the means for a User to gain access to the system.

Parameter	Factory Default
Mgmt IP Address	192.168.1.10
Mgmt IP Netmask	255.255.255.0
Mgmt Default Gateway	192.168.1.254
Hostname	quantum-bs
Admin User name	admin
admin User Password	admin123

Table 8: Base Station Management Interface and Access Default Parameters

3.3 Logging in to the CLI

The PureWave Quantum Base Station's Command Line Interface (CLI) has a standard Cisco IOS (Internetwork Operating System) look and feel to its operation. It is accessible via the Base Station Console interface using an appropriate terminal emulator, or via a Base Station ETH-1 port using either SSH or Telnet. Both methods of access will be described.

Telnet is disabled by default so may not be used for initial configuration. It is assumed that the default parameters (IP address, baud rate, etc) are still in use. If defaults have been changed then please use the current values.

Accessing the CLI via the Ethernet port requires that its IP address and related parameters be known. If the default settings have been changed and the new settings have been lost then access via the Base Station Console port will be required to reset those parameters.

3.3.1 Accessing the CLI via the Base Station Console Port

(1) Connect a computer to the Base Station Console port as detailed in section 3.1 above.

(2) Open a terminal emulation program on the computer. Suitable programs are PuTTY or HyperTerminal (Figure **4**).

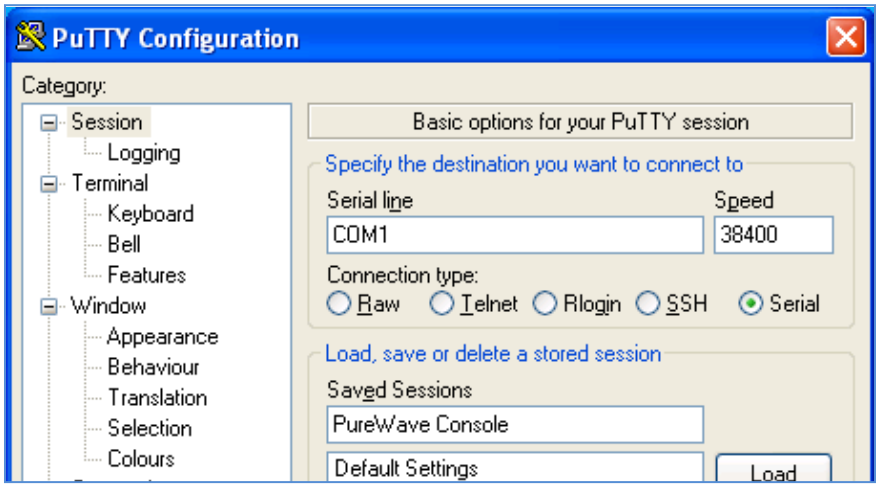

Figure 4: PuTTY Serial Port Configuration Window

Create a new connection with the serial port settings as outlined in Table 9.

Serial Console Port Settings	
Serial Line	COM1
Speed (Baud Rate)	38400
Data bits	8
Stop Bits	1
Parity	None
Flow Control	None

Table 9: Console Port Settings

(3) A login prompt will be displayed as in fFigure 5: Console Login. The default Login and Password are:

Default login: admin

Default password: admin123

Figure 5: Console Login

(4) After this login, the User will be presented at the ***hostname prompt*** (figure 6). If the Base Station is still in its default status then the hostname prompt will be ***quantum-bs***.

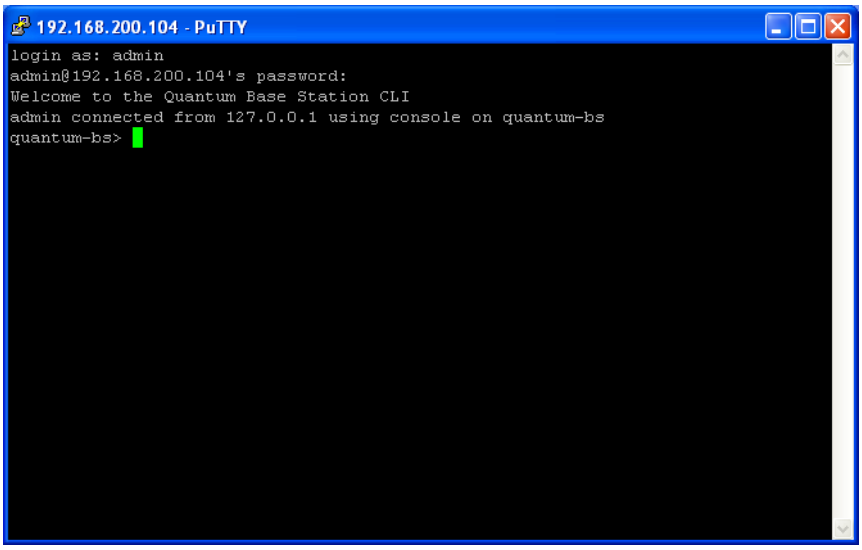

Figure 6: Console Login Default Status

3.3.2 Accessing the CLI via an Ethernet Port

(1) Connect a computer using an Ethernet connection to the Base Station ETH-1 port (either directly or via a router or network). Open an SSH client program such as PuTTY (Figure **7**:). The default port number is 22.

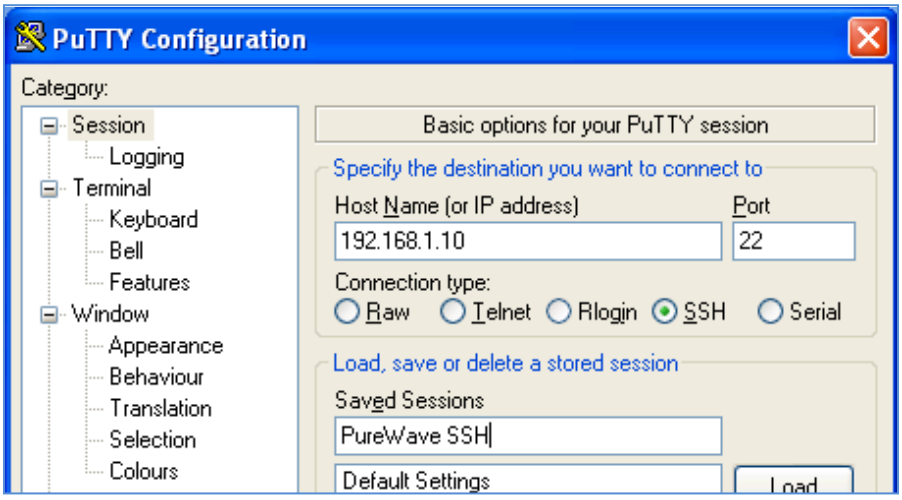

Figure 7: PuTTY SSH Client Configuration

(2) Create a new SSH profile using the default management IP values. If the defaults have been changed then please use their current values.

If the management IP settings are "unknown" then the Base Station can only be accessed via its Console port (refer to section 3.3.1). Once the Base Station has been accessed, its management IP settings can be reset using the procedure detailed in section 3.4.

(3) The default Login and Password are:

Default login: admin

Default password: admin123

3.4 Logging in to the Web GUI Interface

The PureWave Quantum Base Station's Web Interface is accessible through most major web browsers that support SSL connections. The Web Interface has been specifically tested on Internet Explorer (Version 7 and up) and Mozilla FireFox. Access via HTTP and HTTPS are both supported, however HTTPS is the default and HTTP is disabled by default.

If the current ETH-1 port IP settings have been lost then they must be reset using access via the Base Station Console CLI (see section 3.3.1). The ETH-1 management IP settings must be known if the Base Station is to be accessed via the Web GUI Interface.

(1) Connect a computer using an Ethernet connection to the Base Station ETH-1 port (either directly or via a router or network). Open an SSH client program on the computer.

(2) Open up a web browser and type in https://192.168.1.10 or http://192.168.1.10 (if HTTP has been enabled which is disabled by default) in the address field. If the default ETH-1 management IP settings have been changed then please enter the current Management IP Address of the Base Station.

If the User is presented with a "certificate error" in the browser, then just click "ignore" or "continue to web site" and proceed.

(3) The login page is displayed in Figure 8: . The default Username and Password are:

Default Username: admin

Default Password: admin123

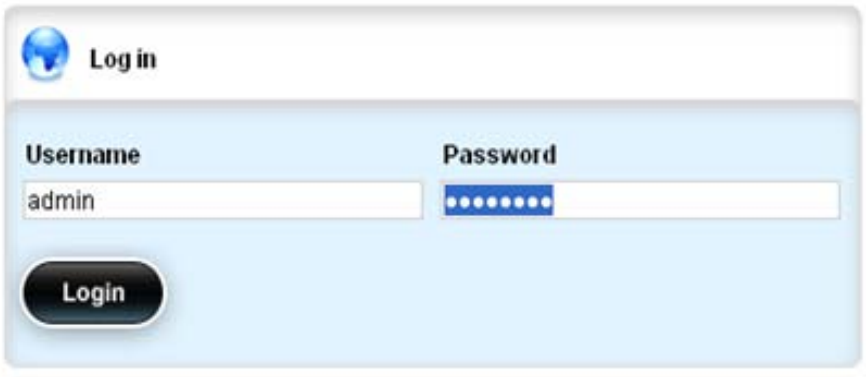

Figure 8: Web GUI Interface Login Page

(4) After login, the User will be presented at the Main Web GUI Interface Screen (figure 9). This will be the starting position for all subsequent configurations.

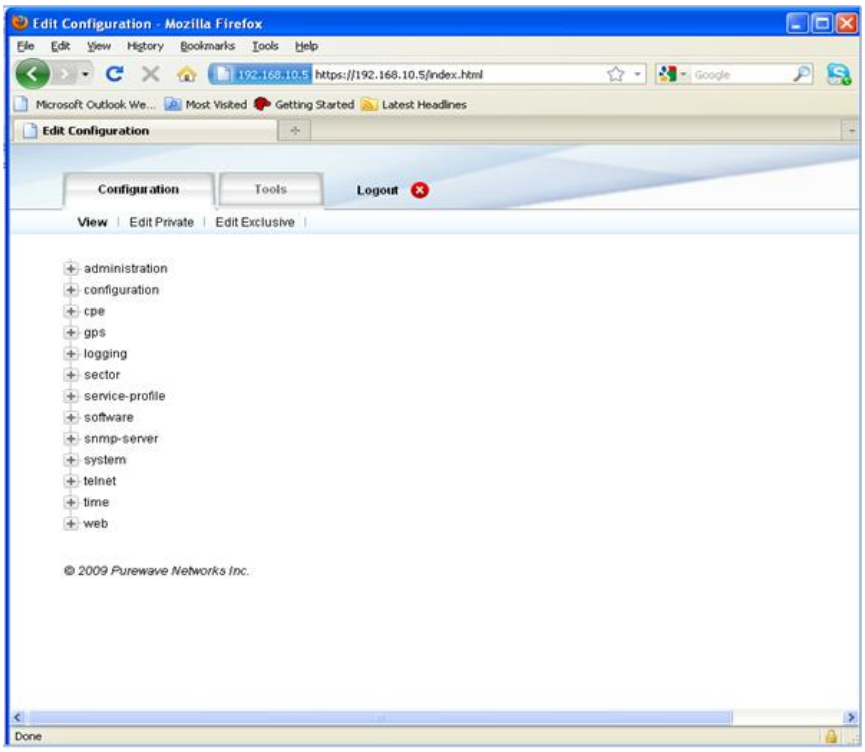

Figure 9: Main Web GUI Interface Screen

(5) The structure of the Main Web GUI Interface Screen is as follow:

- Configuration and a Tools tab across the top of the screen.
    - Underneath these Tabs there are the View or Edit modes of operation (Edit Private and Edit Exclusive).
- Configuration tree on the left-hand side of the screen which consists of the Main Menu Options. The plus sign "+" indicates that there are Main Menu Sub-Elements to each Main Menu Option. The right hand side of the screen to the right of the Main Menu Options will be blank.

(6) Once a Main Menu Option has been selected and navigated to, even if the User reverts back to the Main Web GUI Interface Screen, the previous menu option will be displayed on the right hand side of the screen (refer to figure 10). Once the screen is "refreshed", this will be cleared away.

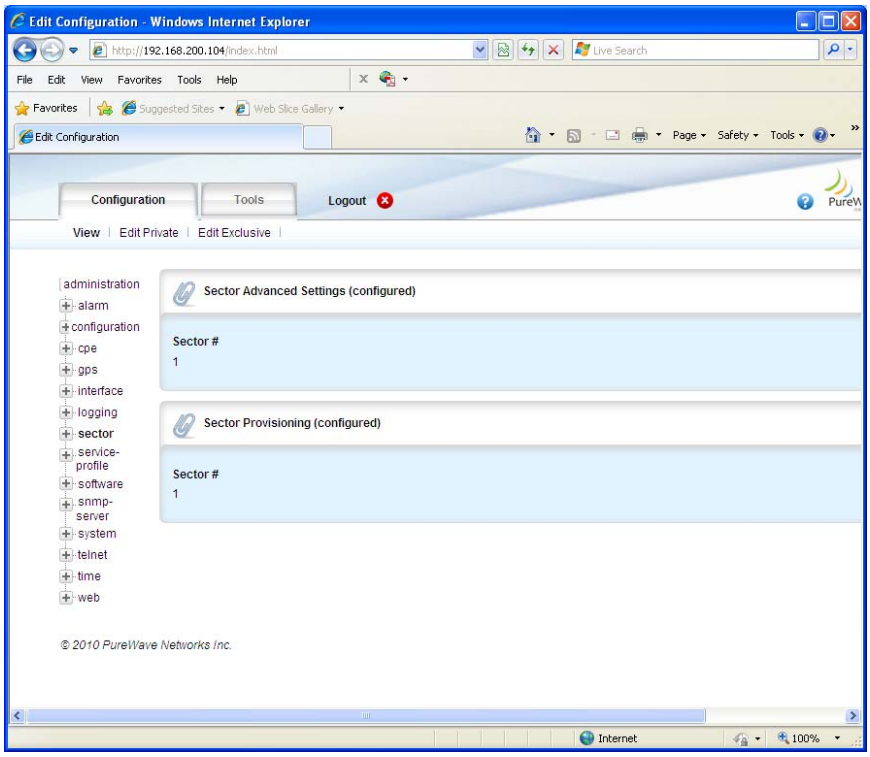

Figure 10: Main Web GUI Interface Window Refresh

To enable Base Station access via HTTP then:

(1) From the Main Web GUI Interface Screen select the ***Configuration*** Tab and then the ***web*** Main Menu Option from the down the left hand side menu (figure 11).

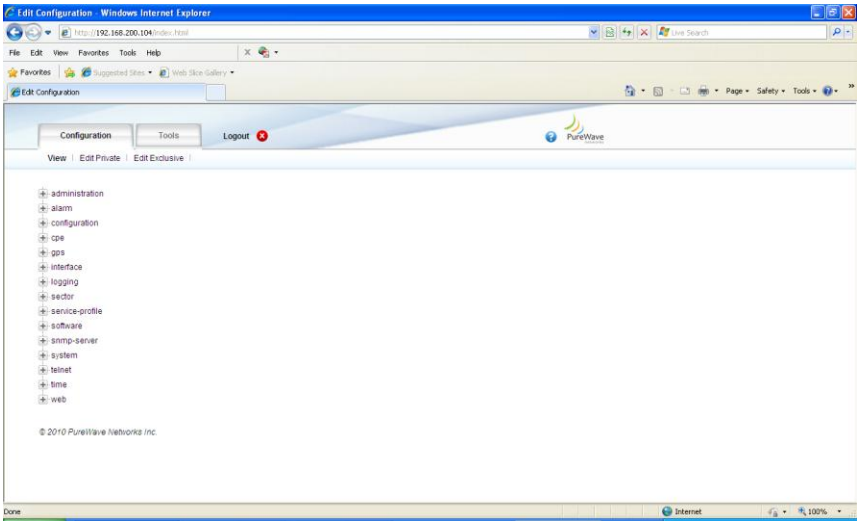

Figure 11: Web GUI Interface Web Main Menu Option

(2) A window will be displayed that provides an indication or not as to Web Server HTTP Support (figure 12).

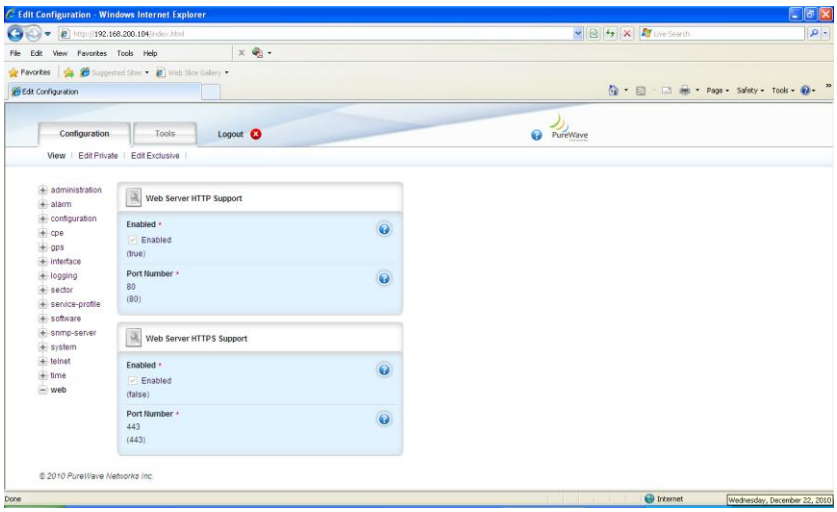

Figure 12: Web GUI Interface HTTP Support

(3) To enable first select ***Edit Private*** or ***Edit Exclusive.*** This will drop the User into the Edit mode (figure 13). The User can enable the Web Server HTTP Support by selecting the ***Enabled*** option

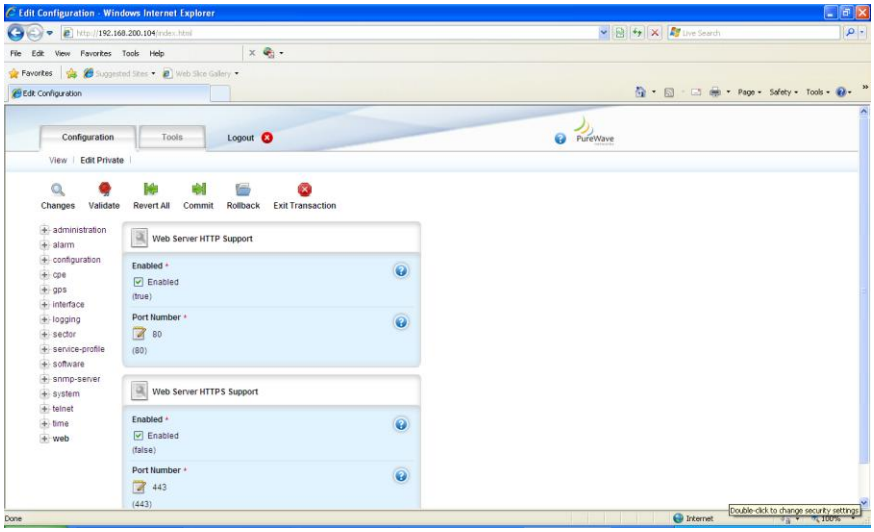

Figure 13: Web GUI Interface HTTP Support Edit Enabled

(4) The User must ***Commit*** the changes (apply the configuration in run-time). To Commit, select the ***Commit*** option. A prompt screen will appear directing the User to confirm the pending configuration changes. To proceed the User must select ***Cancel*** or ***OK***.

3.4.1 Web Interface Configuration Key Concepts

The Web GUI Interface, when the Configuration Tab has been selected, has two major modes of operation:

- ***View Mode:*** Read-only access of all parameters. This is the default mode upon initial log in (refer to figure 14).
- ***Edit Mode:*** Write access configuration of all available parameters. Within this mode there are two sub-options:
  - ***Edit Private.*** Edit Private will allow the user to configure all parameters but will not lock the configuration database, allowing for other users to make configuration changes at the same time (see Figure 15).
  - ***Edit Exclusive***. Edit Exclusive will lock the configuration database and prevent any other user from making configuration changes.

Note: System configuration changes are first made to the running configuration database in memory. This allows the opportunity for the user to test the changes first before committing. In order to make the change persistent and survive a restart, the "**Configuration-Write**" command must be used.

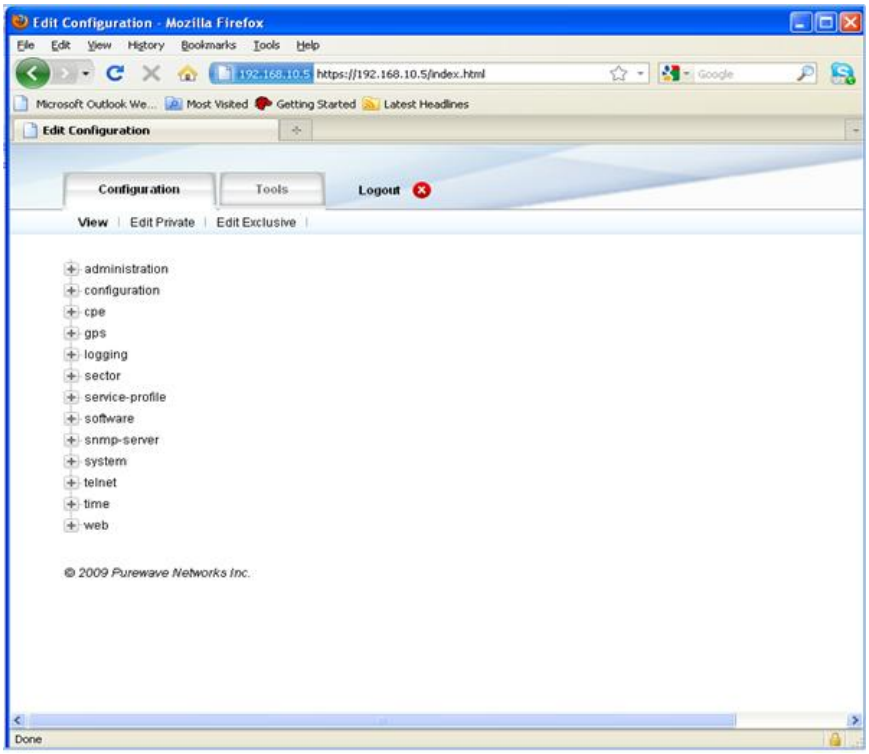

Figure 14: The Main Web GUI Interface Screen in View Mode

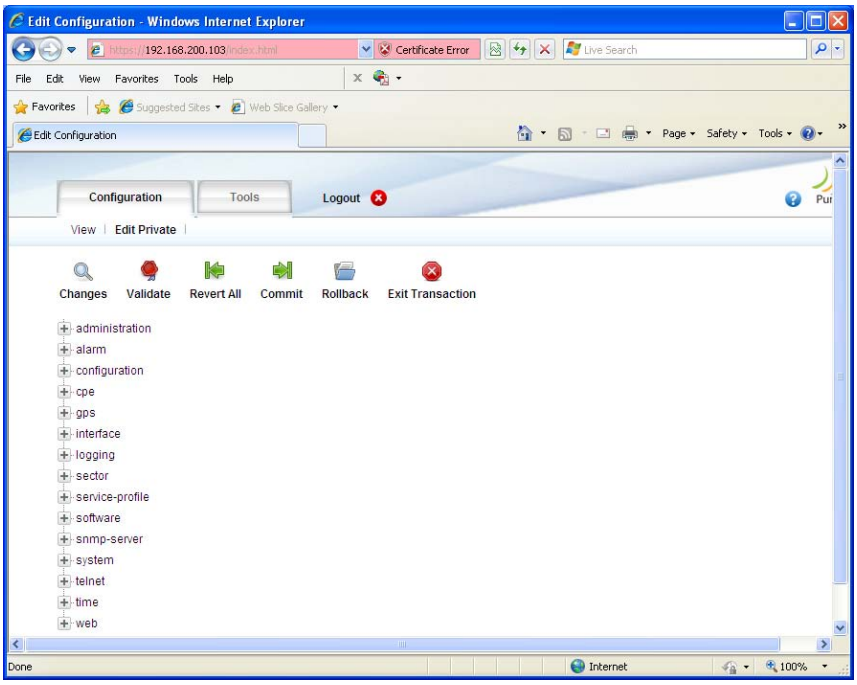

Figure 15: The Web GUI Interface Screen in Edit Private Mode

At the Main Web GUI Interface Screen, select the ***Configuration*** Tab, select the ***configuration*** Main Menu option and then ***Edit Private*** or ***Edit Exclusive.*** The User will now be in the Edit mode.

There are a number of key concepts that will be repeatedly used when the User is in the Edit mode and thus making configuration changes. These key concepts form the six Command Menu Options when the User is in the Edit mode. These are:

- ***Changes.*** This prompts the User to accept the configuration changes that have been made.
- ***Validate.*** This validates that the changes are valid and have been configured correctly.
- ***Revert All.*** This will cancel (or revert) any changes that may have been made.
- ***Commit.*** This will commit the changes to the running database.
- ***Rollback.*** This will rollback any changes to a previously saved state.
- ***Exit Transaction.*** This will exit the Edit mode.

When the User selects the ***Changes*** Command Menu Option then they are presented with the following options:

- If no configuration changes have been made, then a popup window appears stating "No configuration changes have been made". The User simply selects the ***OK*** prompt to navigate back to the Edit Mode.

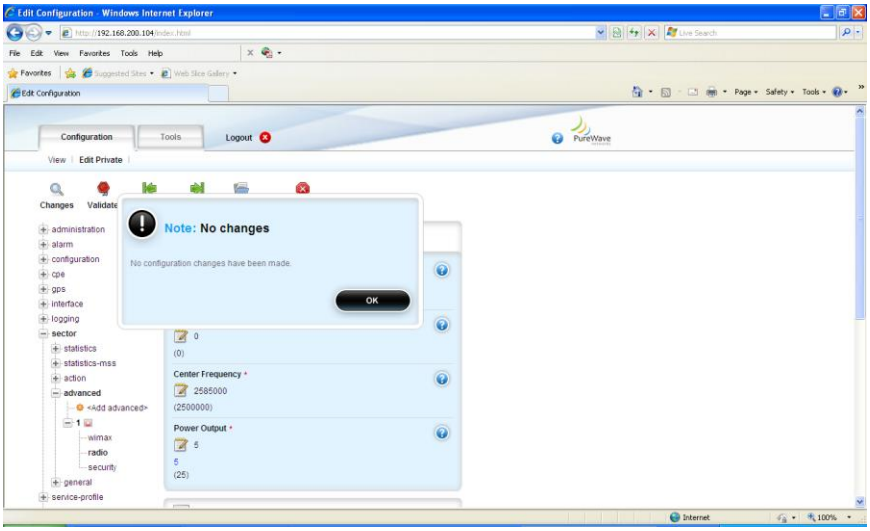

Figure 16: Configuration Changes Popup Window

- If relevant changes have been made, then a window appears. This indicates the relevant configuration file for this pending change. It indicates the relevant parameter that is in the process of being changed and the old and the new value.
- There is also an option within this window to ***Revert*** the change (refer to figure 17). If the User selects this revert option then the intended changes will be reversed and the "No configuration changes" will appear (refer to figure 16 above).

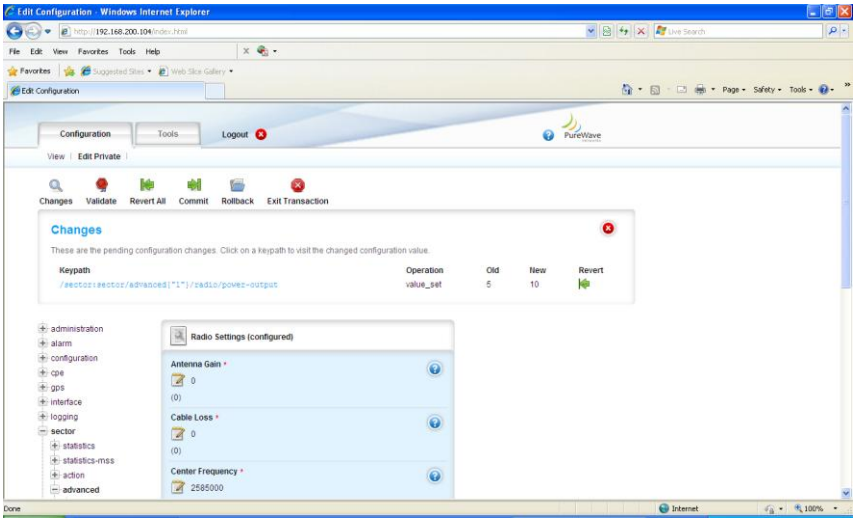

Figure 17: Revert Option

If the User has made some configuration changes and then they decide to reverse the changes then the User can select the ***Revert All*** window option. Selecting this option presents:

- If no configuration changes have been made, then a window appears stating "There is nothing to revert". The User simply selects the ***OK*** prompt to navigate back to the Edit Mode.

- If changes have been made, then a window appears stating "All your non-committed configuration changes will be reverted" (refer to figure 18). The User simply selects the ***OK*** prompt to proceed and navigate back to the Edit Mode.

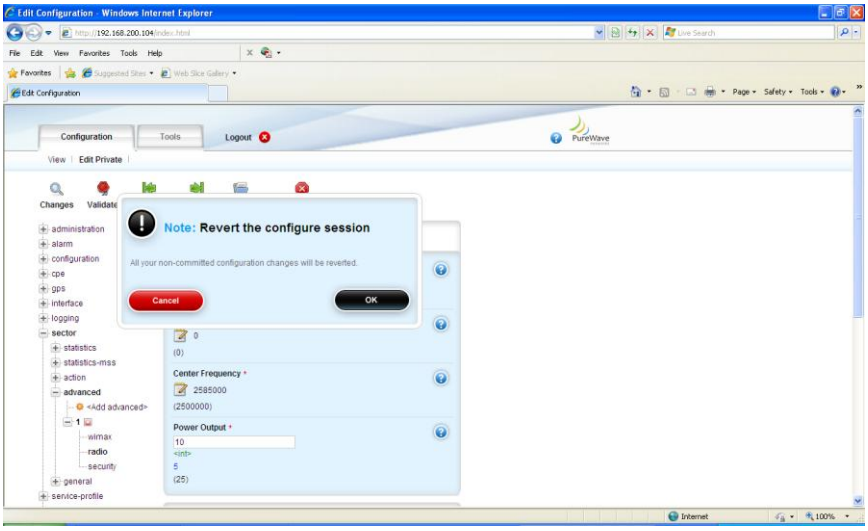

Figure 18: Revert All Configuration Changes

If the User has made some configuration changes and these have been committed and saved the User can make use of the ***Rollback All*** window option. A rolling audit log of all configuration changes in stored within the Base Station (refer to figure 19). This log is a record of:

- ***Rollback File***. This is the name of the configuration file.
- ***Creator***. This is the creator of the change. This will be the login name that was used at the time of the configuration change.
- ***Date***. This was the date of the change.
- ***Via***. This was the method of access to the Base Station that was used to effect the change.
- On the right side of the window, is a text pad that provide details of the parameters and how they were changed.

To effect the ***Rollback*** procedure then the User simply has to highlight the relevant rollback file and then select the ***Load*** Command Menu Option (refer to figure 19).

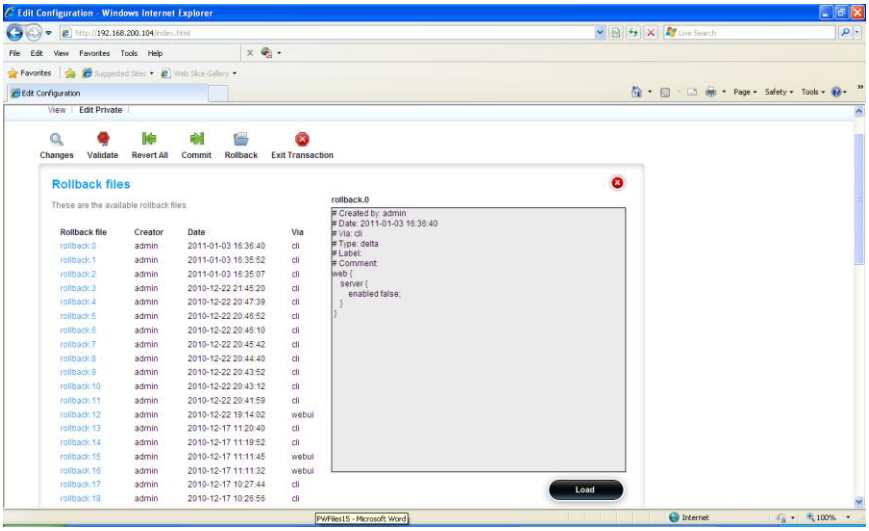

Figure 19: Rollback Option

If the User has made some configuration changes and they wish to Validate the changes then the User can select the ***Validate*** Command Menu Option. If the User, after making the relevant changes, selects the Validate option then if the intended changes are valid, then a window appears stating "The configuration is ready to be committed" appears (refer to figure 20). The User simply selects the ***OK*** prompt to proceed and navigate back to the Edit Mode.

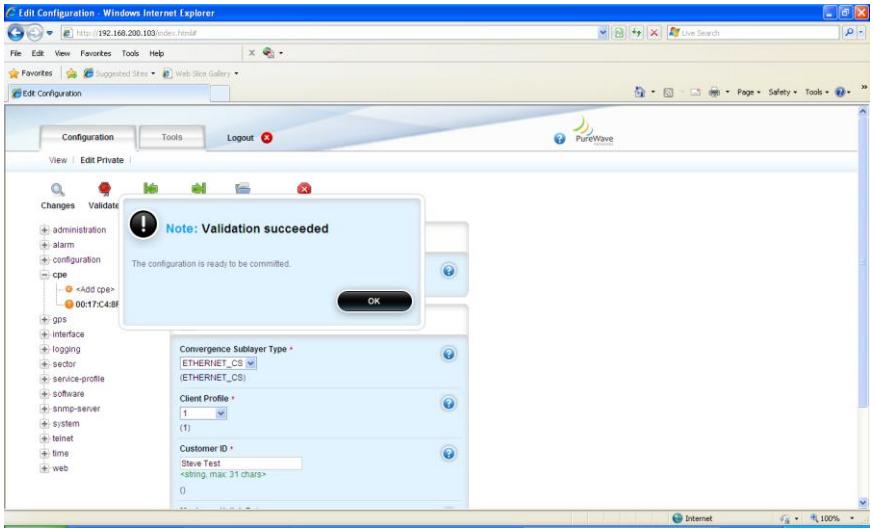

Figure 20: Validate Option

The ***Commit*** Command Menu Option performs a crucial procedure in that it commits all configuration changes to the running database.

When in Edit mode, the method of configuring and saving changes remains the same. A user may change any number of parameters but none of those changes will take effect until they are *committed*.

Clicking the Commit Menu will result in one of the following actions

- If no configuration changes have been made, then a window appears stating "There is nothing to commit". The User simply selects the ***OK*** prompt to navigate back to the Edit Mode.
- If changes have been made, then a window appears stating "Do you want to commit your pending configuration changes?" (refer to figure 21). The User simply selects the ***OK*** prompt to proceed.

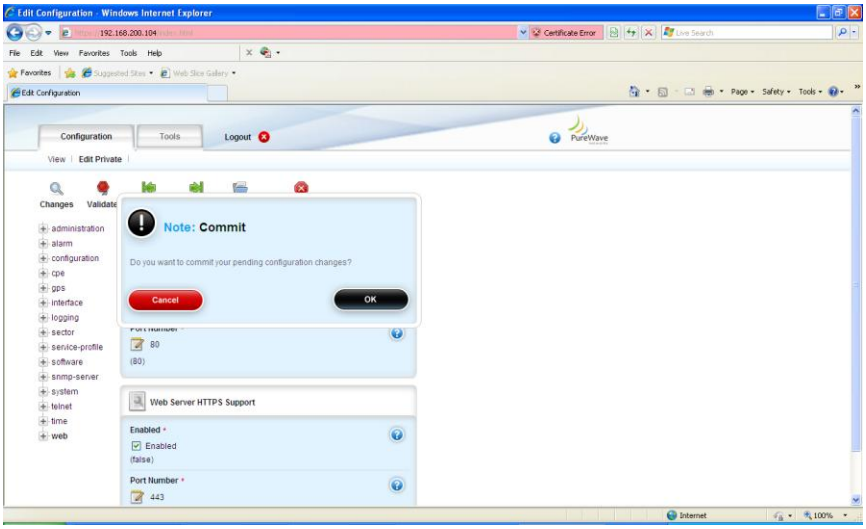

Figure 21: Commit Option

- When ***OK*** has been selected then a window appears stating "The configuration has been committed" (figure 22). The User simply selects the ***OK*** prompt to proceed and navigate back to the Edit mode.

Note: System configuration changes are first made to the running configuration database in memory. In order to make the change persistent and survive a restart, the "**Configuration-Write**" command must be used.

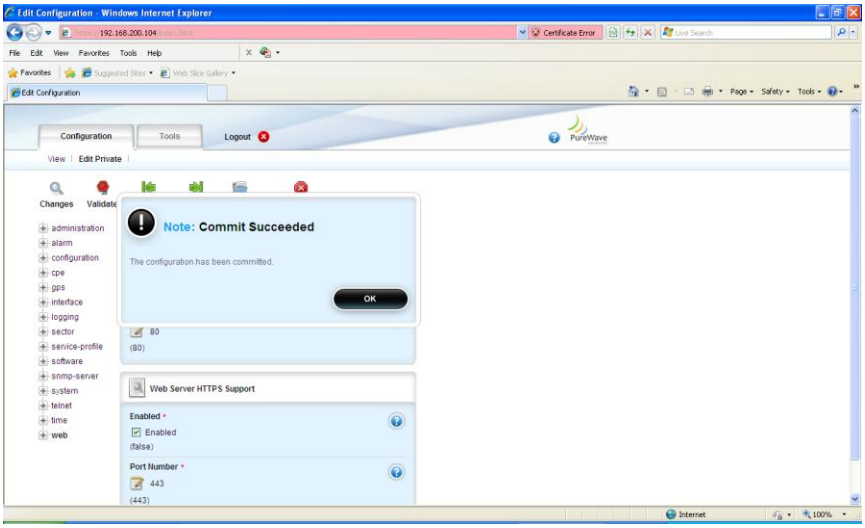

Figure 22: Commit Option Successful

Unsaved configuration changes persist for only the current boot. If the Base station is rebooted then those changes will be lost if the configuration has not been committed.

Several menus have two sets of parameters, these are defined as:

- ***Configured Parameters*.** These are the most recently saved settings and are stored in the system's configuration database
- ***State Parameters***. These are the readings of the actual state from the Base Station. State Parameters may be identical to Configured Parameters, or they may be committed but unsaved parameters that differ from the Configured Parameters.

After a reboot, both sets of parameters will be identical.

The "**Save Procedure**" is to ensure that the running configuration is saved is:

(1) At the Main Web GUI Interface Screen, select the ***Configuration*** Tab, select the ***configuration*** Main Menu Option then the ***write*** Main Menu Sub-Element. The User will have to click on the ***Perform*** Command Menu Option to copy the running configuration to the startup (see figure 23).

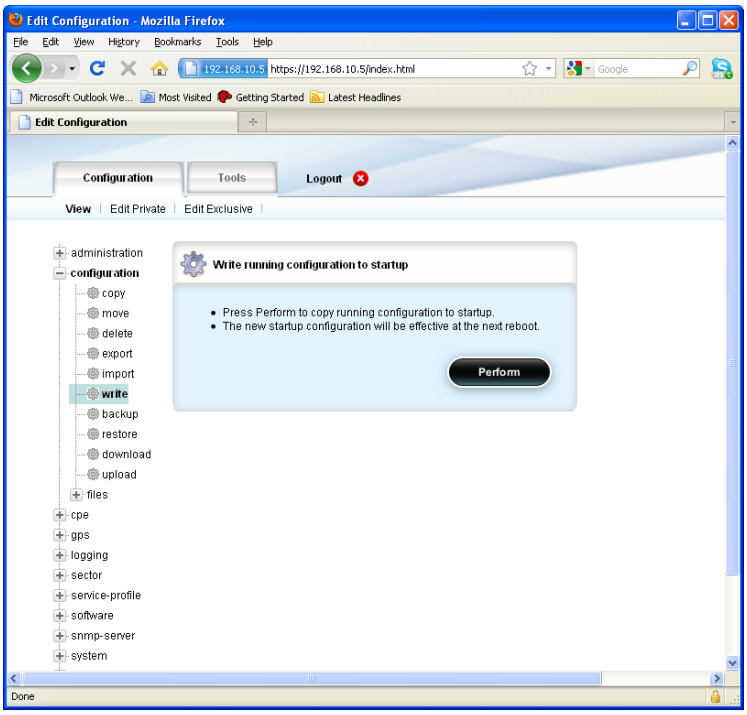

Figure 23: Writing Running Configuration to Startup

(2) A pop up window indicating that the write was successful will be displayed (refer to figure 24).

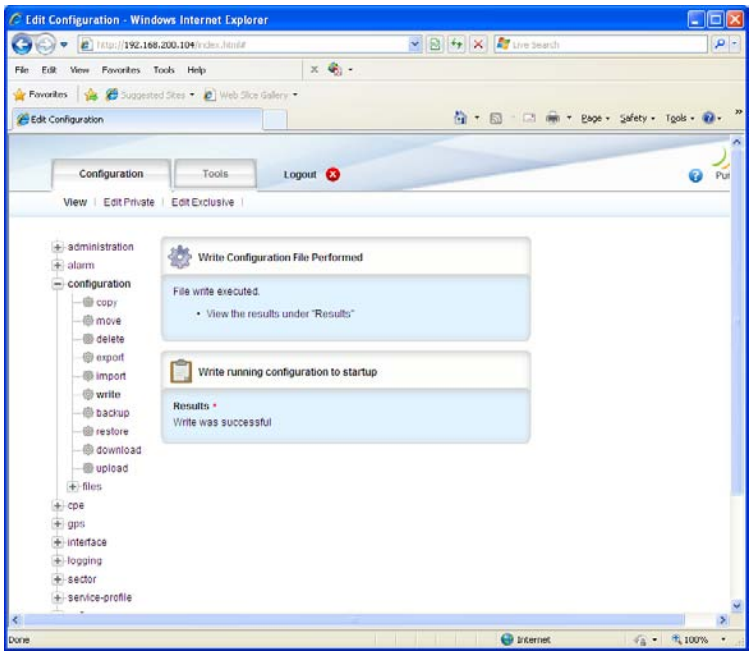

Figure 24: Writing Running Configuration to Startup Successful

Note: Several configuration changes require that the Base station be rebooted.

The procedure to reboot a Base Station is as follows:

(1) At the Main Web GUI Interface Screen, select the ***Configuration*** Tab, select the ***administration*** Main Menu option and then ***reboot*** Main Menu Sub-Element. The User will have to click on the ***Perform*** Command Menu Option to reboot the entire Base Station (refer to figure 25).

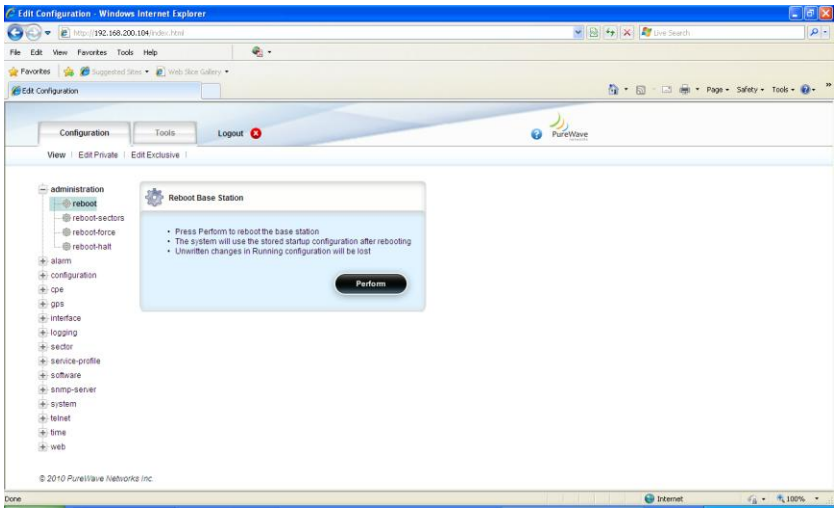

Figure 25: Reboot Base Station

(2) Upon clicking perform, the user must confirm the reboot operation by clicking ***Ok***. After the reboot option has been performed then an appropriate window indicating a successful reboot execution will be displayed (figure 26). The subsequent time for the Base Station to become operational is approximately 5 minutes.

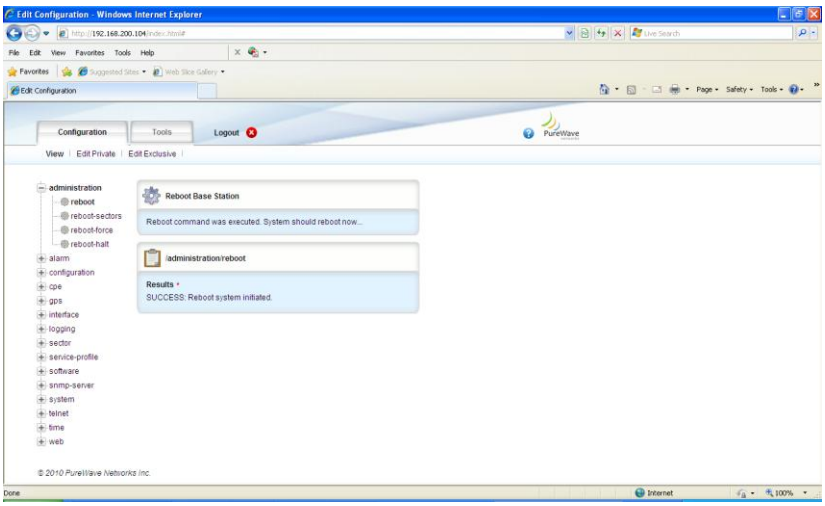

Figure 26: Reboot Base Station Successful

(3) The system will use the stored startup configuration after rebooting. Unwritten changes in the running configuration will be lost.

(4) There are two reboot options under the administration Main Menu options including

- ***reboot***. This option will reboot the Base Station
- ***reboot-sectors***. This option will reboot the internal elements of the Base Station that are pertinent to the sector RF elements only. After the reboot-sectors option has been performed then an appropriate window indicating a successful reboot execution will be displayed. The subsequent time for the Base Station to become operational is approximately 2 minutes.

3.4.2 Web GUI CLI Access Level

The PureWave Quantum Base Station has a Command Line Interface (CLI) that can be accessed from within the Web GUI. To access the Web GUI CLI then at the Main Web GUI Interface Screen, select the ***Tools*** Tab. The User will be presented with a number of User tools (figure 27).

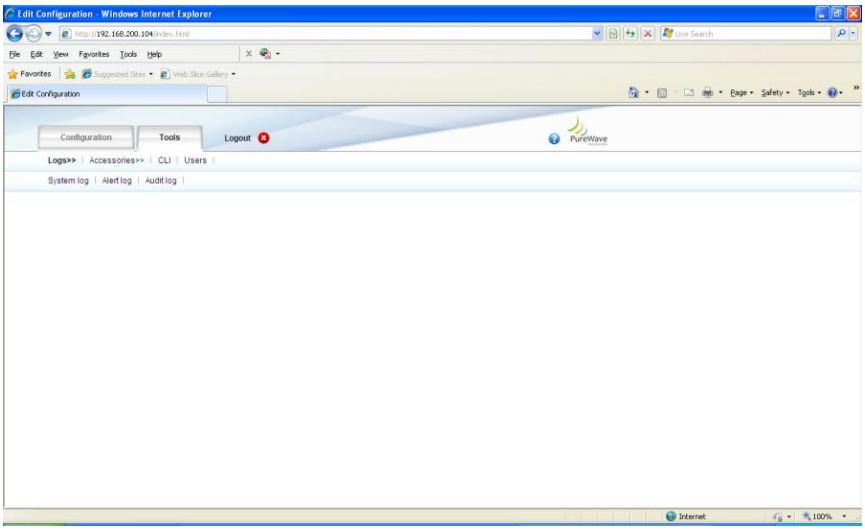

Figure 27: The Tools Tab Menu Options

The User is presented with four ***Tools*** Command Menu Options. These are:

- ***Logs.*** This allows the User to display and hence view:
  - ***System log***
  - ***Alert log***
  - ***Audit log.***
- ***Accessories.*** The following protocols are made available to the User:

- ***Ping***
- ***Traceroute***
- ***CPU Load***

- ***CLI.*** The User has access to the CLI and can execute all the CLI commands directly if required.
- ***Users.*** This indicates all the Users that are currently connected to the Base Station. It also provides a means to physically "kick" them off their connection. In addition, a message board is provided thus enabling instant messages to be sent to the Users that are currently connected to the Base Station.

3.4.2.1 Tools Logs

At the Main Web GUI Interface Screen, select the ***Tools*** Tab and then ***Logs*** (refer to figure 28).

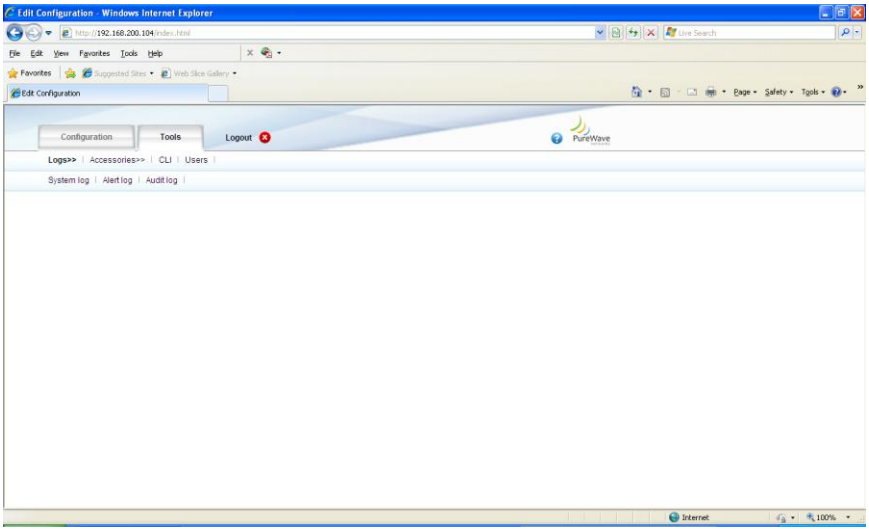

Figure 28: The Tools Tab Logs Menu

To view the relevant Log, the User simply has to select one of the 3 logs that are available to view. These logs are system, alert and audit logs. The three Tools logs are displayed in figures 29 through 31 below.

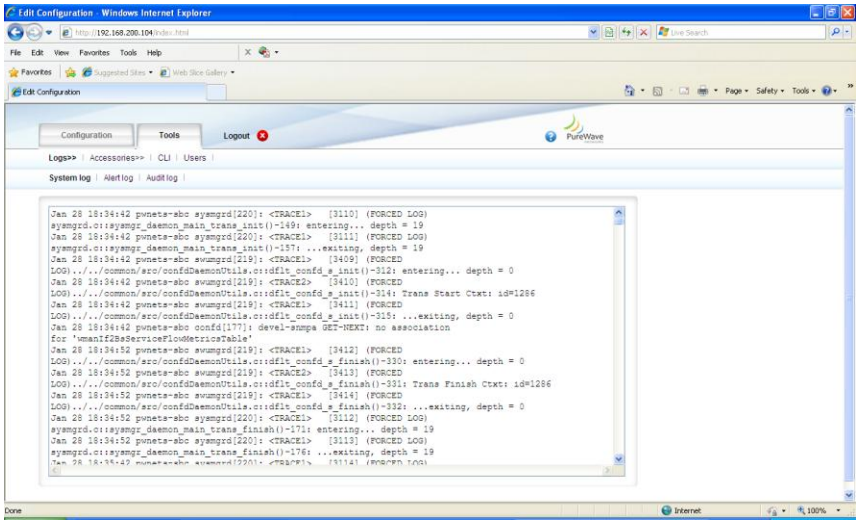

Figure 29: The Tools Tab System Log

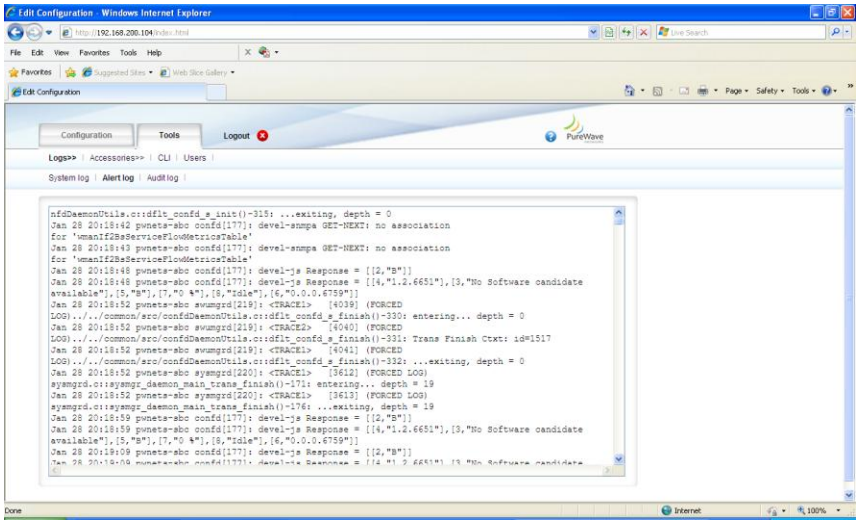

Figure 30: The Tools Tab Alert Log

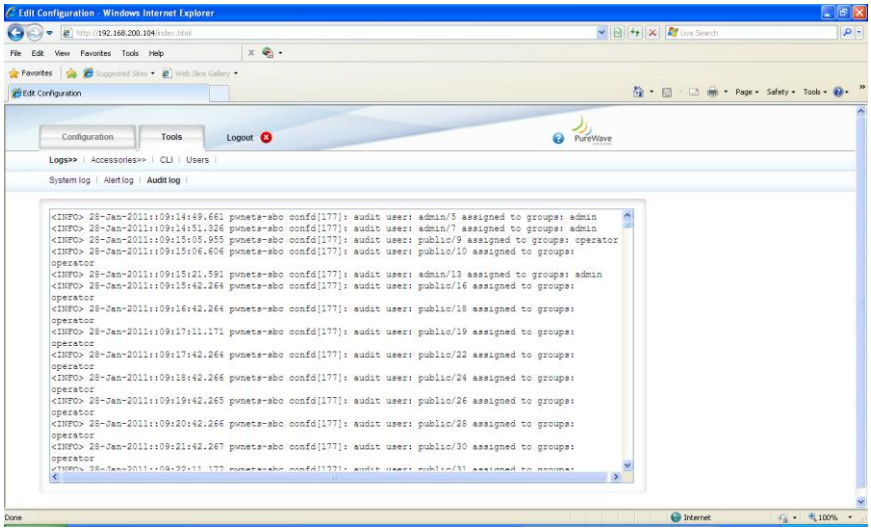

Figure 31: The Tools Tab Audit Log

3.4.2.2 Tools Accessories

At the Main Web GUI Interface Screen, select the ***Tools*** Tab and then ***Accessories*** (refer to figure 32).

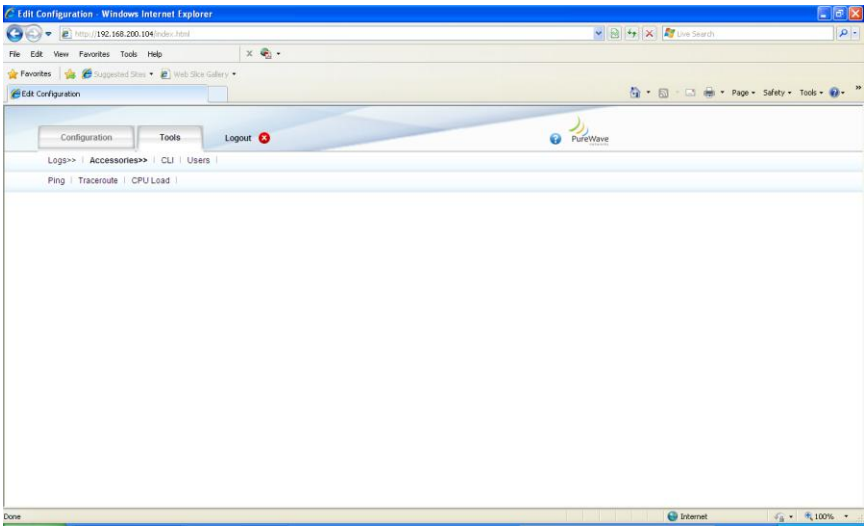

Figure 32: The Tools Tab Accessories Menu

To perform the relevant protocol, the User simply has to select the relevant option. To enable ***Ping*** or ***Traceroute***, the User must:

(1) Select the ***New*** button

(2) A popup window will appear, this will enable the User to specify the host (figure 33).

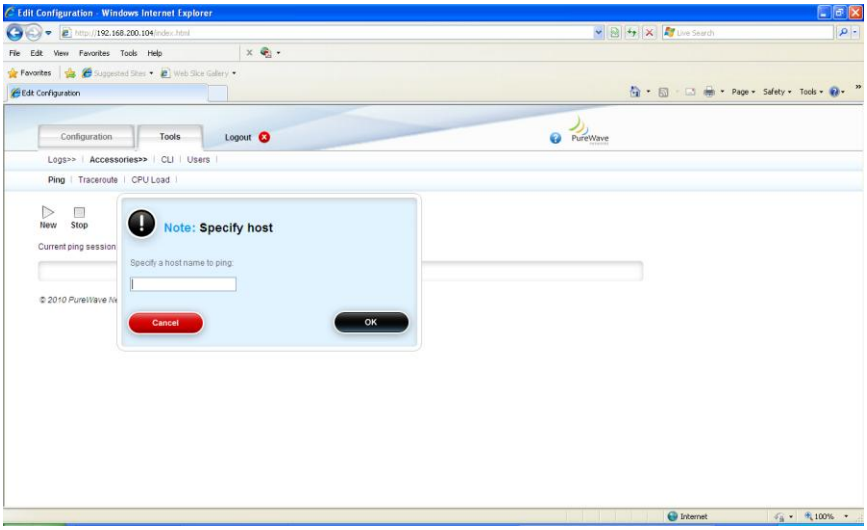

Figure 33: The Accessories Ping Command

(3) The User must now select the ***OK*** command button.

(4) The results of the action will then be displayed (refer to figure 34).

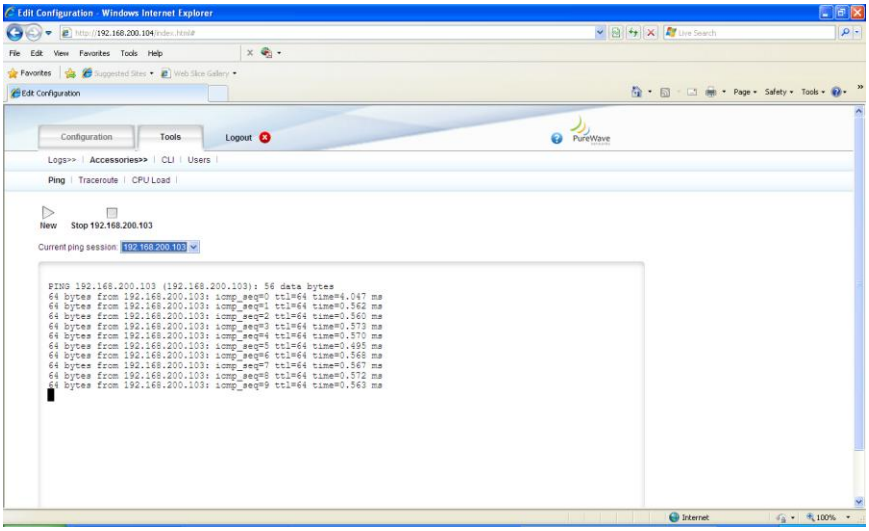

Figure 34: The Accessories Ping Results

To examine the ***CPU Load***, the User simply has to select the ***CPU Load*** option. The User is presented with a display of the current CPU load. This will automatically be updated every 5 seconds and it will calculate the load averages over 1, 5 and 15 respectively (refer to figure 35).

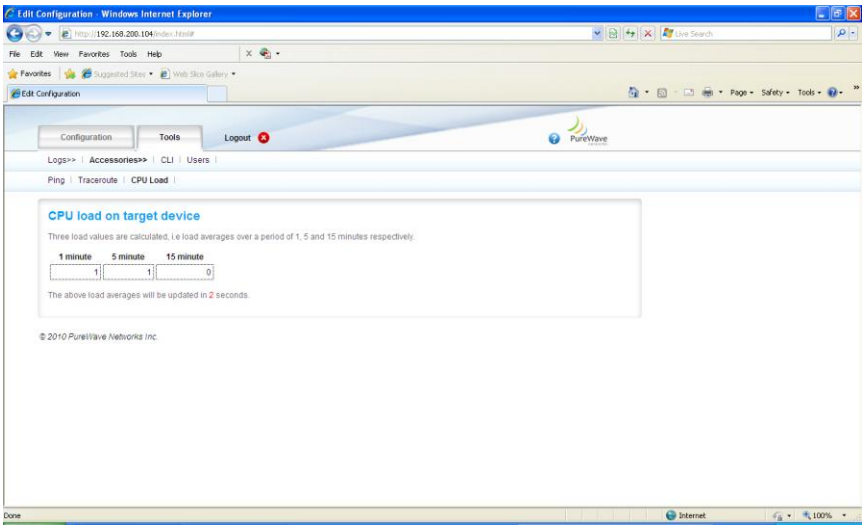

Figure 35: The Accessories CPU Load Results

3.4.2.3 Tools CLI

At the Main Web GUI Interface Screen, select the ***Tools*** Tab and then ***CLI.*** The User is presented with a CLI screen (refer to figure 36). The User is free to enter all the available CLI options

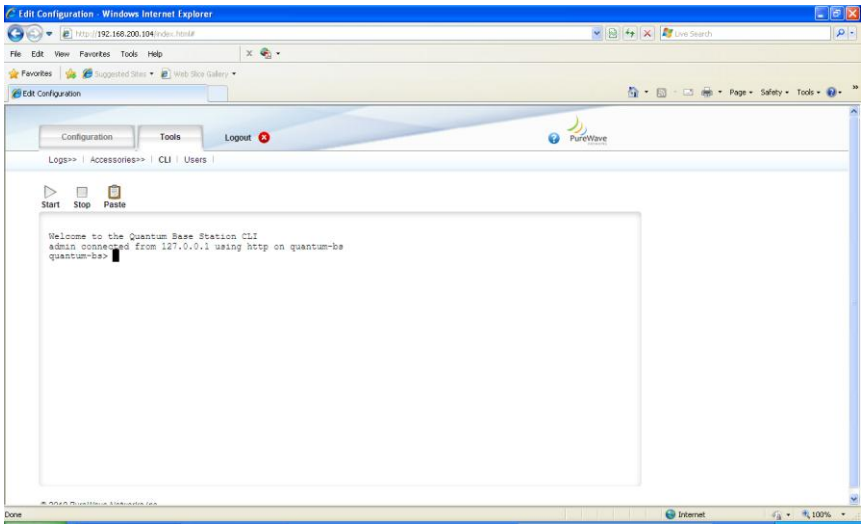

Figure 36: The Tools Tab CLI