



Vanu Anywave® Base Station Subsystem

Operator Guide



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Vanu Anywave Base Station Subsystem Operator Guide

Contents

CHAPTER 1. <i>Introducing the Vanu Anywave BSS</i>	2
Introduction	2
Manual Scope and Objectives	2
What makes Vanu Anywave BSS different?	3
System Operator Role	5
CHAPTER 2. <i>BTS Components & Connections</i>	6
Overview	6
BTS Server	7
BTS Server, Front View	7
BTS Server, Front Panel Control Switches and LEDs	8
BTS Server, Back View	9
RF Front End	10
Protium RF Front End Unit	10
Overview of Protium RF Front End Connections	11
Protium Duplexer Connections	11
Protium Up/Down Converter Connections	12
Protium Front-End LEDs	14
Power Shelf	15
Power Amplifier	16
Power Amplifier, Front View	16
Power Amplifier, Back View	17
Power Amplifier, Back View	18
GPS Timing Source	19
GPS 4 Timing Source Connections	19
GPS 4 Timing Source Indicator LEDs	20
CHAPTER 3. <i>Base Station Operation</i>	21
Hardware	21
Appendix A: Acronym Glossary	22
Index	23

Figures

Figure 1: Hardware Architecture	4
Figure 2: BTS Server Front View	7
Figure 3: Server Control Switches and Status LEDs	8
Figure 4: BTS Server, Back View	9
Figure 5: Protium Translator System Block Diagram	10
Figure 6: Protium Duplexer Connections	11
Figure 7: Protium RF Up/Down Converter Connections	12
Figure 8: Protium Front End LEDs	14
Figure 9: Powerwave Power Shelf	15
Figure 10: Powerwave Amplifier, Front View	16
Figure 11: Powerwave Amplifier, Rear View	17
Figure 12: GPS 4 Timing Source Connections	19
Figure 13: GPS 4 Timing Source Indicator LEDs	20
Figure 14: Intel Server Power Button	21

Preface

The Anywave® Base Station Subsystem (BSS) Operator Guide is intended for system users who have completed the Vanu Anywave System Training Course. This Anywave BSS Operator Guide provides an overview of the Vanu Anywave Base Station Subsystem application structure, along with information on how to perform system tasks, general system maintenance, and basic issue resolution procedures.

The Anywave BSS Operator Guide provides information on the following areas:

- Introducing Vanu Anywave Base Station Subsystem
- BTS Overview

CHAPTER 1. *Introducing the Vanu Anywave BSS*

Introduction

Welcome to the Vanu Anywave Base Station Subsystem Operator Guide. This manual is designed to serve as a knowledge resource for the Vanu system currently installed at your site, and to assist you in your role as System Operator. This guide focuses on ongoing system maintenance, and prepares you to provide first line technical support for your Anywave BSS.

The following is a high level overview of the scope and objectives of this guide:

Manual Scope and Objectives

This manual will cover BTS Hardware Components and Connections

What makes Vanu Anywave BSS different?

The Vanu Anywave GSM BSS provides radio access network functionality by implementing the BTS (Base Transceiver Station) in software running on a general-purpose server. Signal processing, protocol processing, and all other radio access network functionality are implemented as application level software running on top of a Debian GNU/Linux system.

The Anywave BTS system uses Protium wideband RF front ends from Protium Technologies.

The Vanu Anywave BSS is composed of three major subsystems:

- RF front end, supporting the 850 MHz band, and providing Analog-to-Digital and Digital-to-Analog conversion
- Signal Processing
- Back end network connectivity

Vanu, Inc. integrates these subsystems, running its software on top of the COTS hardware that comprises a complete radio access network, including the traditional functionality of the BTS.

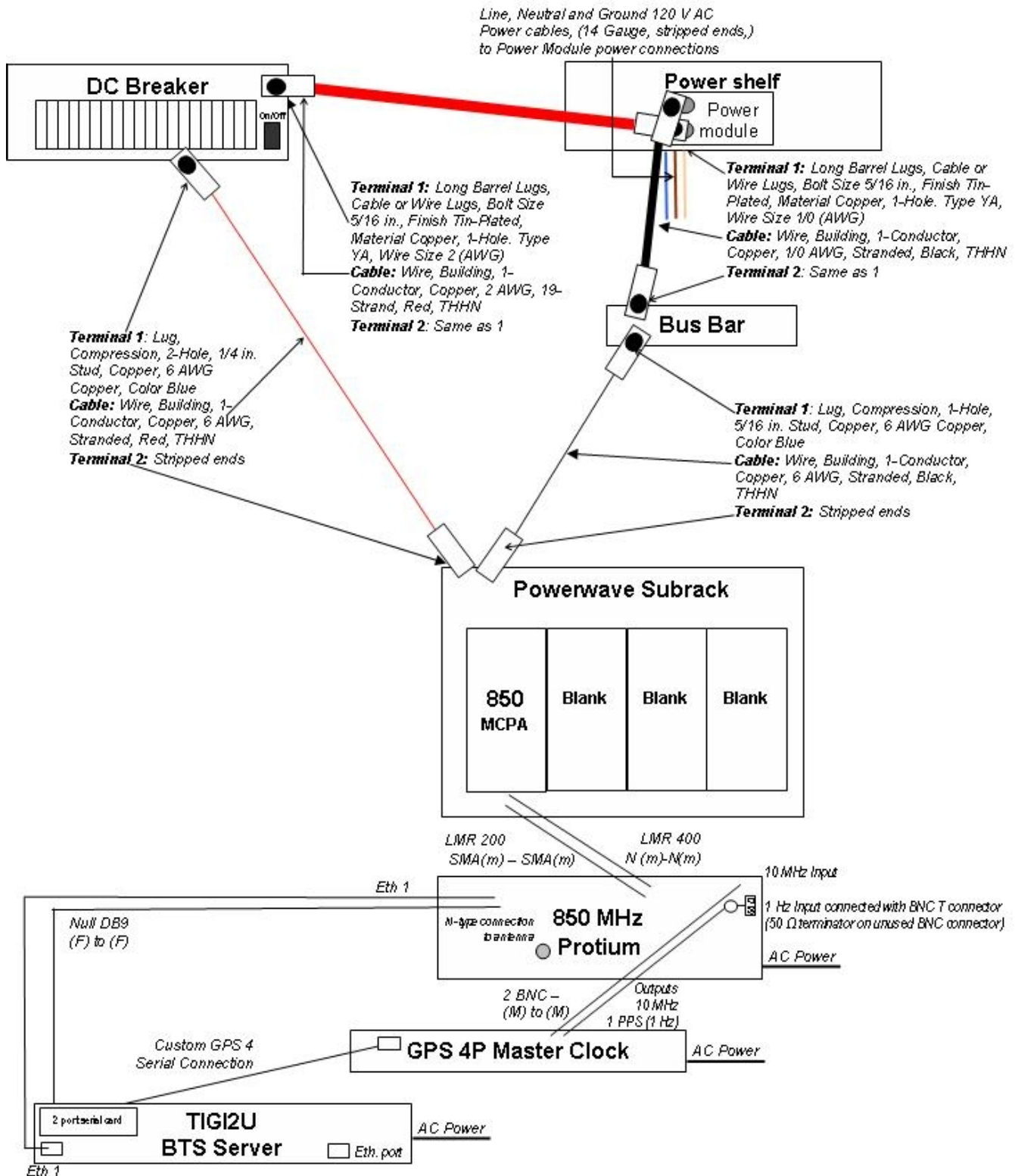


Figure 1: Hardware Architecture

System Operator Role

As System Operator, you will maintain and support all components of the Vanu Anywave wireless infrastructure. By the time you receive this document, you will already have met several important milestones. You will have worked with Vanu, Inc.'s Deployment group to plan and deploy your current installation, and you will have attended the Vanu, Inc. System Operator Training Course. Both of these milestones will lay the foundation on which to build your knowledge base for Vanu, Inc. products and prepare you to service your system.

The following is an overview of the System Operator role and some of the duties you will be expected to perform:

- Manage technical issues regarding hardware and software required to run the Vanu Anywave network.
- Diagnose radio access network problems and proactively monitor network performance.
- Introduce and train other users who will support the system.

CHAPTER 2. *BTS Components & Connections*

The BTS provides the air interface in a particular region, also known as a cell, to each Mobile Station (cell phone) located within its border with an active connection.

In this section, we will review the following list of BTS Hardware components:

- BTS Server
- RF Front Ends
- Power Amplifier
- Power Shelf
- GPS Timing Source

Overview

The Vanu Anywave BTS implements all of the signal processing required for full GSM base station functionality in software running on a server. A standard system implements the components of the GSM Phase II specification for voice communications. It supports mobile phones using full-rate (GSM 6.10) vocoders. For the purpose of your deployment, each Vanu BTS is complemented by a Protium RF Front End.

BTS Server

The Anywave BTS software application is hosted on an Intel TIGI2U NEBS server running a Debian GNU/Linux operating system. The RF data enters the server from the Protium RF front end units through an Ethernet connection. GSM audio signaling is routed internally from mobile to mobile using the Anywave Micro-MSC. An Ethernet port connects the BTS server to the Ethernet switch. Connections from an Ethernet port in the BTS server are used to connect it to the Protium RF Front End units.

The Intel TIGI2U server is a Network Equipment Building Standards Level 3 and ETSI certified server. The TIGI2U server has redundant power supplies, fans, and hard drives to ensure that the BTS remains functional in the event of hardware failure.

BTS Server, Front View

Peripheral Bay

Control Switches and Status LEDs



Figure 2: BTS Server Front View

BTS Server, Front Panel Control Switches and LEDs

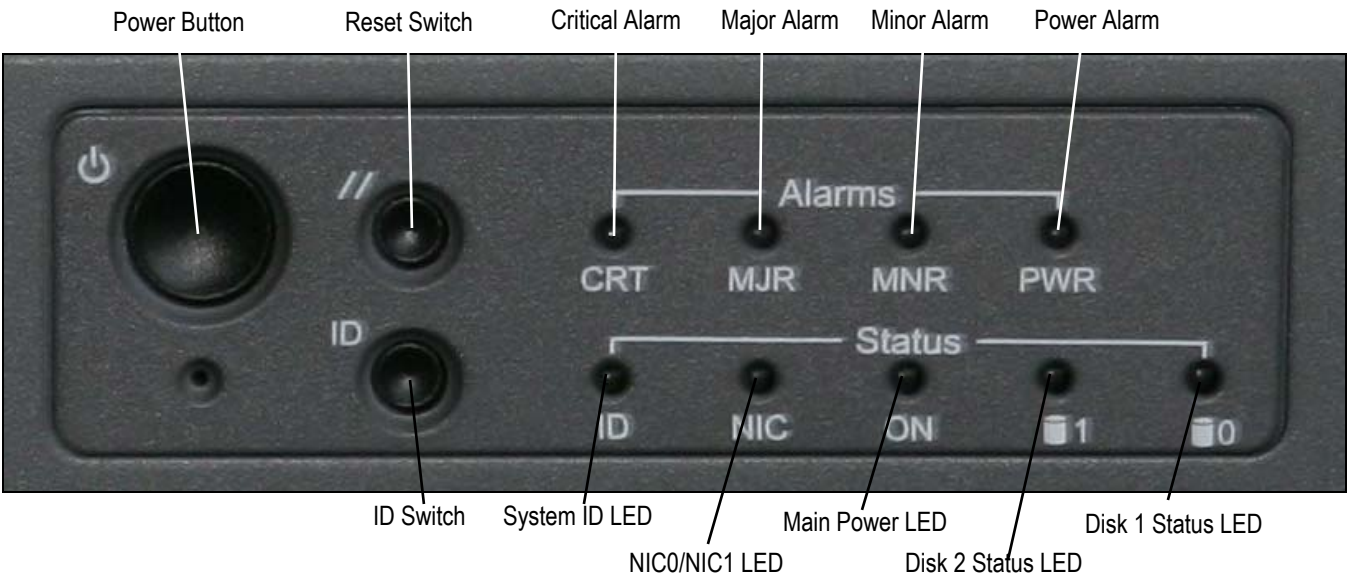
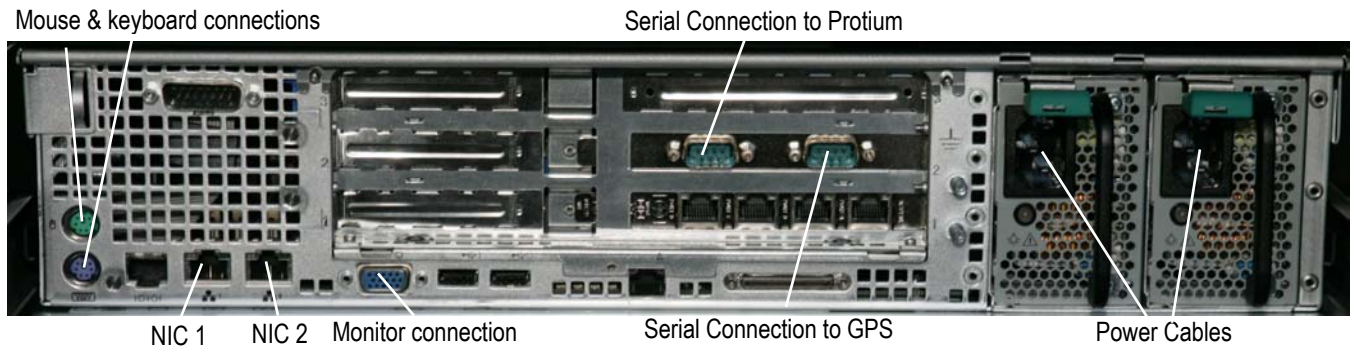


Figure 3: Server Control Switches and Status LEDs

Power Button
Reset Switch
Critical Alarm LED
Major Alarm LED
Minor Alarm LED
Power Alarm LED
ID Switch
System ID LED (white)
NIC0/NIC1 Activity LED (green)
Main Power LED
Disk 2 Activity/Fault LED (green/amber)
Disk 1 Activity/Fault LED (green/amber)

BTS Server, Back View**Figure 4: BTS Server, Back View**

Qty	Connection
1	Mouse connection
1	Keyboard connection
1	NIC 1 Ethernet connection
1	NIC 2 Ethernet connection
1	Serial connection to Protium RF Front End
1	Serial connection to GPS Timing Source
1	Monitor connection
2	Power jack connections to 120 V power source

RF Front End

The wideband RF front ends perform transmission and reception over the air interface between the BTS and a number of GSM mobiles. Using a wideband multi-channel front end allows one BTS unit to transmit and receive multiple carriers over a wide frequency band of up to 25 MHz.

The RF front ends include both the RF up/down converters and the digital IF subsystem, which perform digital filtering, timestamp injection and other functions. The BTS software communicates with the RF front ends using digital baseband samples.

Protium RF Front End Unit

Your deployment includes four Protium RF Front Ends, all of which have a Duplexer, an Up/Down converter, and also do channelization and resampling. The Protium RF Front End Units are divided into two compartments for noise containment. The lower compartment contains the Duplexer and associated filters. The upper compartment contains the RF Up/Down converters, analog-to-digital converters, digital-to-analog converters, and other digital hardware.

The RF signals are piped between the two compartments externally to maintain the noise separation. We will refer to the lower compartment as the Duplexer and the upper compartment as the Up/Down Converter for simplicity. The units will be installed and serviced as one box, but for clarity we will describe them here as two components.

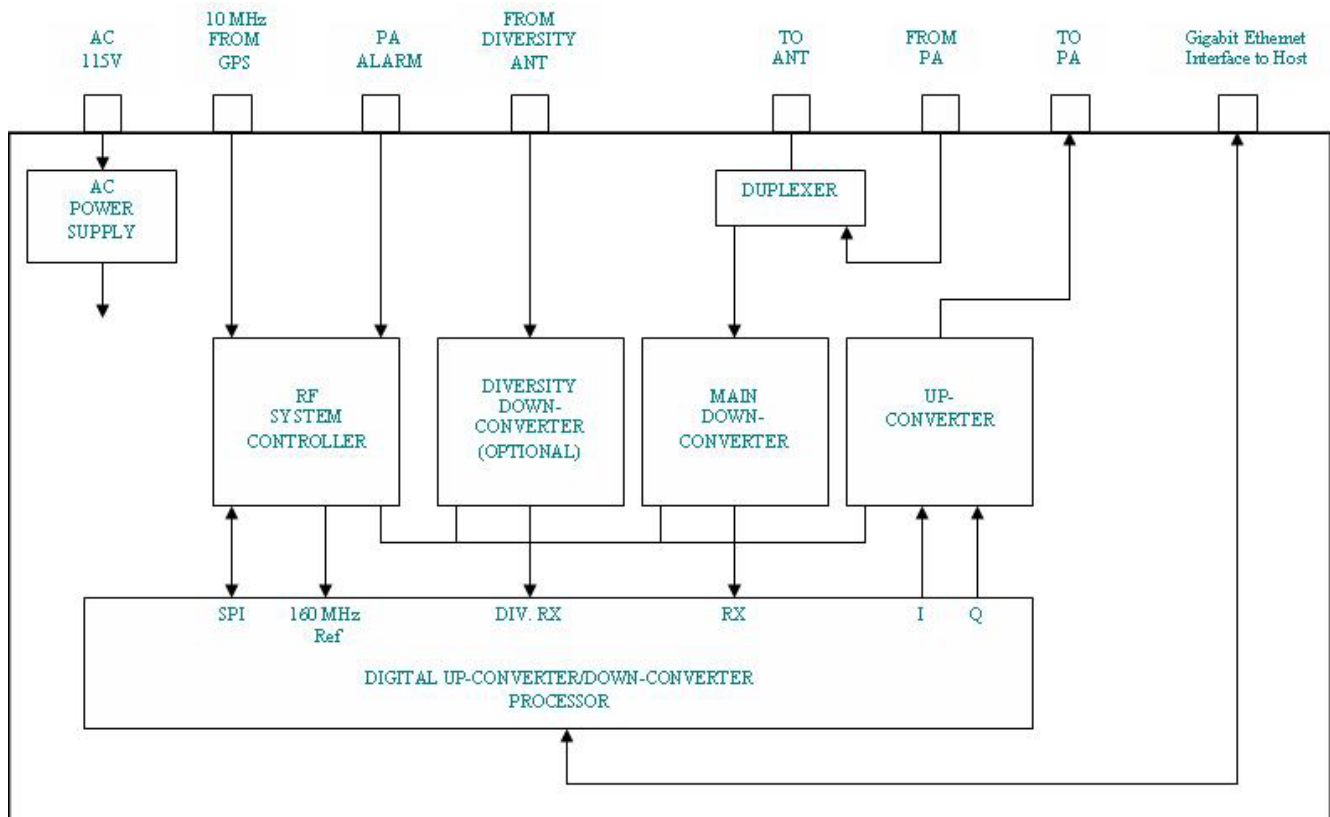


Figure 5: Protium Translator System Block Diagram

Overview of Protium RF Front End Connections

The RF signal is received through the Main Antenna port, located on the Duplexer panel. RF data received from the Main Antenna is run through the Duplexer, out the Main RX SMA port, then over a cable to the Main RX SMA on the Up/Down Converter panel. This signal is then converted to digitized data and sent out through an Ethernet port to the server. These digitized data are then converted to an RF signal and transmitted out the BTS antenna.

This section provides a general overview of the connectors on the RF Front End Up/Down Converters and Duplexers.

Protium Duplexer Connections



Figure 6: Protium Duplexer Connections

Qty	Connection
1	PA In port: an N connector linking the Power Amplifier to the duplexer. The amplified RF signal from the PA enters the duplexer at this port.
1	Main Antenna port: an N Connector connecting the Antenna Coax Cable to the duplexer.
1	Main RX port: an SMA connector connecting to the Upper RX SMA Connect. The RF signal travels from this port to the Protium upper half to be digitized.
1	Diversity RX port: an SMA connector connecting to the Upper Diversity RX port, routing filtered secondary RX data.
1	Diversity Antenna port: an N connector connecting the Diversity Coax Cable from the secondary antenna to the secondary RX path filter.

Protium Up/Down Converter Connections

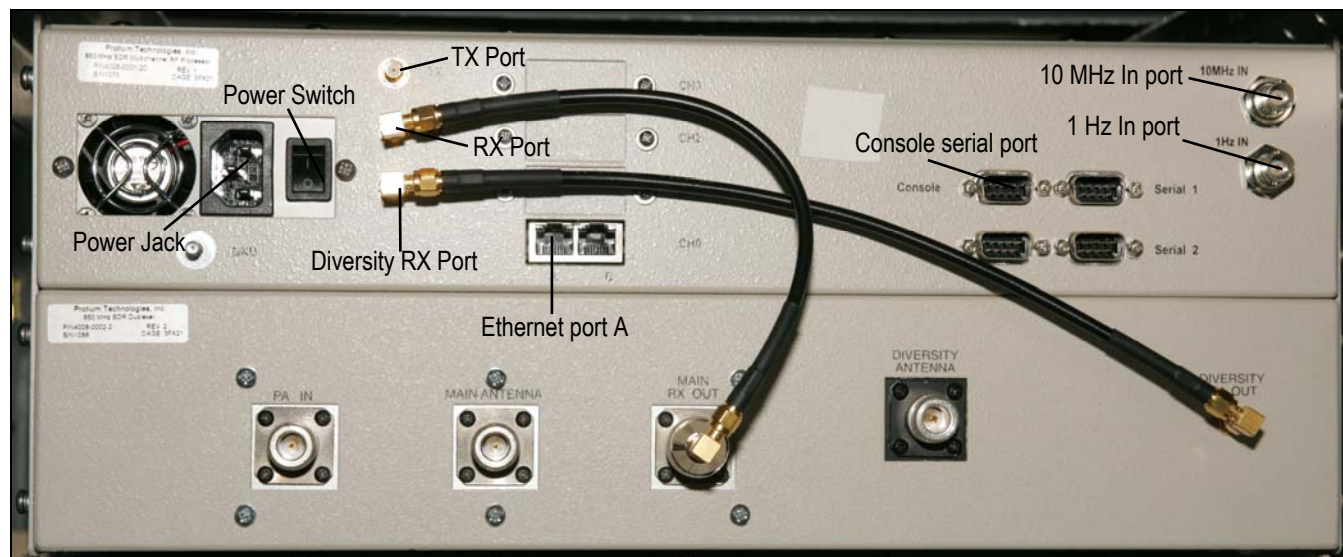


Figure 7: Protium RF Up/Down Converter Connections

Qty	Connection
1	Chassis Power Jack: Standard power connection for RF Unit
1	Power Switch: On and Off switch
1	TX SMA Port: TX connection to PA In port on the PA.
1	RX port: RX connection to Main RX port on duplexer
1	Diversity RX port: Connects to the lower Diversity RX port on the duplexer
4	Ethernet Ports: Data path between Protium and the assigned Ethernet port on the BTS server.
1	Console Port: An RS232 DB-9 port used to monitor system error messages and to configure the unit from the server. This connection is made between the BTS server and only one RF Front End.
1	10 MHz In port: 10 MHz Reference input from GPS Timing Source
1	1 Hz In port: 1 PPS Reference input from GPS Timing Source

Protium 850 RF Front End



Protium 850 Indicator LEDs

The front of the Protium unit has two LED lights, which serve both compartments of the RF Front End unit. The green LED indicates that power is active on the unit. The red LED indicates that an alarm in the system has been triggered.

Protium Front-End LEDs



Figure 8: Protium Front End LEDs

Qty	Connection
1	RF Alarm LED
1	Power LED

Power Shelf

The Powerwave Power Shelf converts 120 V AC current to 28 v DC current. The capacity to hold up to three power modules makes it easy to swap out an existing power module if necessary, or to increase DC power. The Power Shelf used in your deployment will have two power modules, with a total of 8 connections (4 red, 4 black) to the Powerwave MCPA. Each power modules will have its own 120 V power source.

Please Note: The power source connections are directly in front of the power module being used.

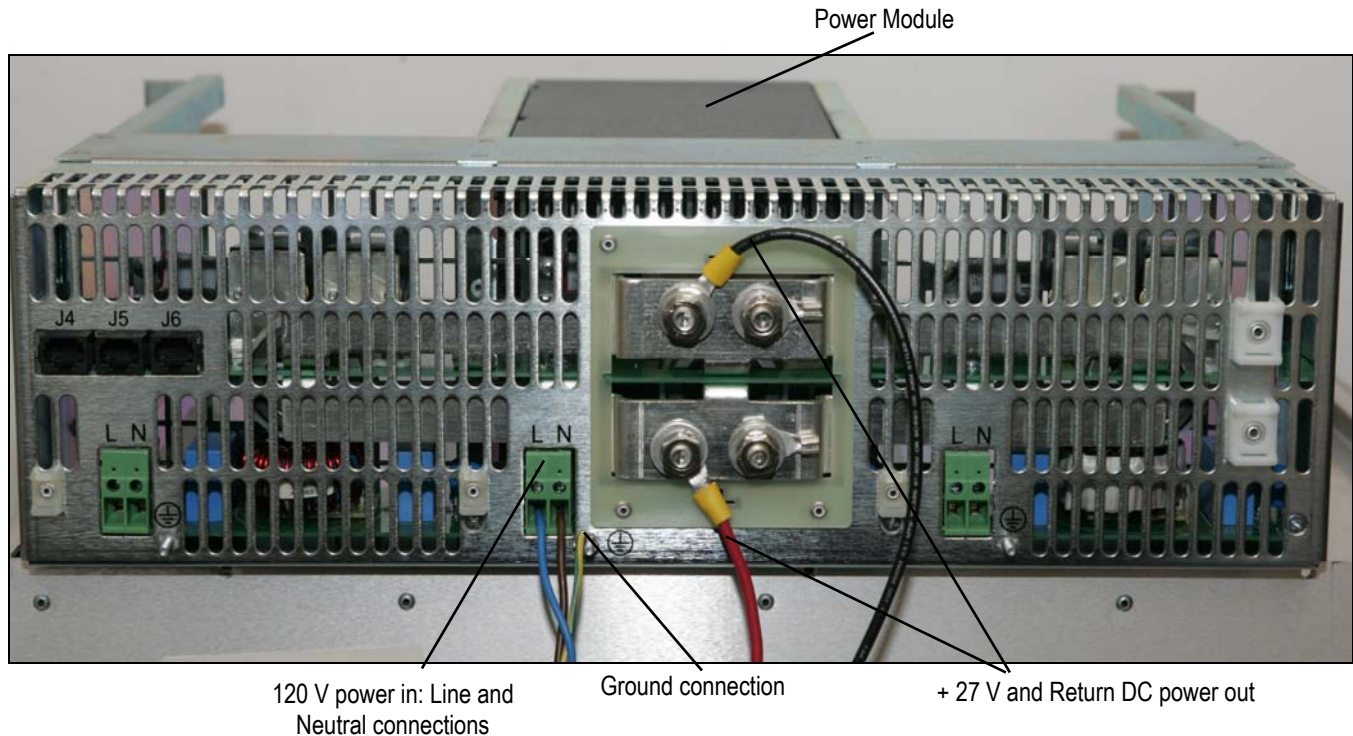


Figure 9: Powerwave Power Shelf

Power Amplifier

The Powerwave Amplifier is used as the Power Amplifier for each RF Front End in the network. The output from the RF Front End is sent to the PA via a Coax cable and is then amplified by 63 dB.

You will have four Power Amplifiers in your deployment. Only the two PAs in use should be powered on. The two PAs not in use should be shut off using the On/Off Reset Switch located on the front of each PA.

Power Amplifier, Front View



Figure 10: Powerwave Amplifier, Front View

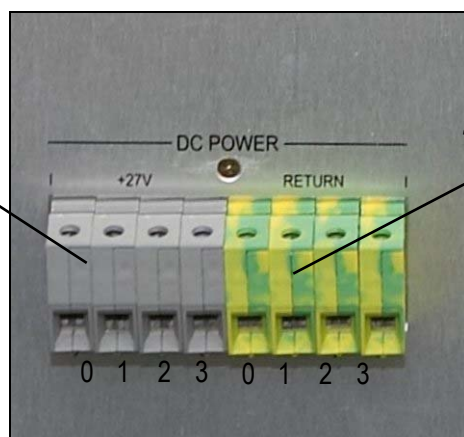
Qty	Connection
1	Status LED
1	Reset Switch
4	RF Output Connections to the RF Front End PA In port for slots 0-3
4	RF Input Connections from the RF Front End Tx port for slots 0-3

Power Amplifier, Back View**Figure 11: Powerwave Amplifier, Rear View**

Qty	Connection
4	Power Terminal block for slots 0-3. (See "Note" about power connections on page 15.)

Power Amplifier, Back View

3: "+ 27 V" Power Block



4: "Return" Power Block

GPS Timing Source

The Brandywine GPS 4 Timing Source simply provides a 10 MHz and 1 Hz clock signal to the Protium for precision timing. The Timing Source provides a reference clock to the RF equipment for timestamping. Timestamps are used to ensure the correct alignment of data throughout the system. The serial port connection from the GPS Timing Source to the BTS server is used for configuration and diagnostic purposes.

GPS 4 Timing Source Connections

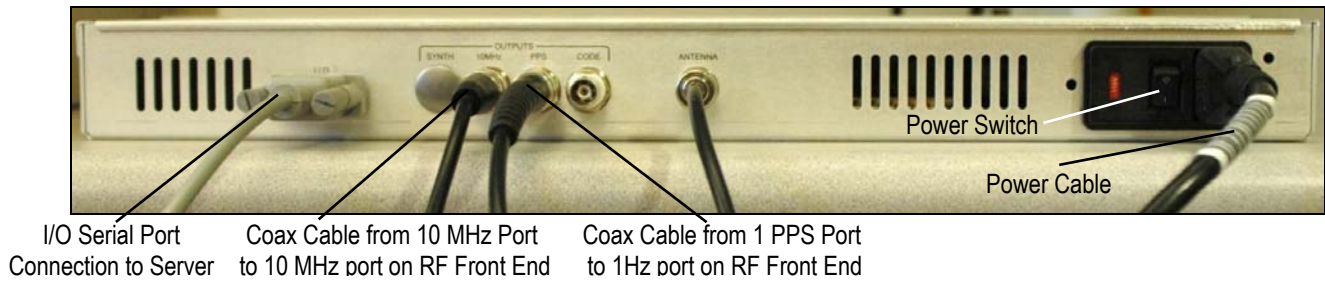


Figure 12: GPS 4 Timing Source Connections

Qty	Connection
1	Cable from serial port to server
1	Coax cable from the 10 MHz port to Protium 10MHz Port
1	Coax cable from the 1 PPS port to Protium 1 Hz Port
1	Coax cable to the external antenna
1	Power cable

GPS 4 Timing Source Indicator LEDs



Figure 13: GPS 4 Timing Source Indicator LEDs

Power: Indicates that the unit is powered on.
Locked: The Protium unit is synched with the GPS.
Holdover: There is a valid clock, but it is not synchronized with the GPS.
Alarm: The GPS unit is not functioning properly.

Please Note: The “Power” LED should be lit when the unit is powered on.

CHAPTER 3. *Base Station Operation*

Hardware

Once all the hardware is connected, the system can be launched. Turn on the power for each of the hardware components. The power buttons or switches are located on the front of the TIGI2U server, below, and on the back of the Protium (see Figure 7, page 12) and GPS timing source unit (see Figure 12, page 19).



Power Button

Figure 14: Intel Server Power Button

Base Station Set Up

Once the system is powered on, the base station will be functional within minutes. The BTS application will start automatically.

Appendix A: Acronym Glossary

ARFCN	Absolute Radio Frequency Control Number
BSC	Base Station Controller
BSS	Base Station Subsystem
BTS	Base Station Transceiver Subsystem
GPS	Global Positioning System
HLR	Home Location Register
iLO	Integrated Lights Out HP remote management system
MSC	Mobile Station Controller
PA	Power Amplifier
PCI	Peripheral Component Interconnect
PPS Port	Pulse Per Second port
RF	Radio Frequency
RH	Radio Head
SDR	Software Defined Radio
SMS	Short Messaging Service
TRAU	Transcoder and Rate Adaptor Unit
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
WAP	Wireless Application Protocol
WIC	Wide Area Network Interface Cards

Index

A

Acronym Glossary · 22
 Air interface · 10
 Analog-to-Digital
 converters · 10
 Antenna
 Main · 11

B

Back end connectivity · 3
 Base Transceiver Station · *See* BTS
 BTS · 6, 10
 server · 6, 7

D

Digital-to-Analog converters · 10
 Duplexer · 10

E

Ethernet · 11

G

GPS
 indicator LEDs · 20
 timing source connections · 19
 GPS Master Clock · 6
 GSM · 3
 base station · 6
 Phase II · 6
 signals · 10

H

Hardware
 running · 21

I

Intel Server · 7

L

Linux · 3, 7

M

Manual
 Objectives · 2
 Scope · 2
 Mobile Station · 10, *See* Mobile phone
 Mobile Station Controller · *See* MSC

P

Power Amplifier · 6
 Power Converter · 6, 15
 Protium · 10
 back view · 11, 12
 connections · 14
 duplexer connections · 11
 front end unit · 10
 front end view · 14
 RF connections · 12
 signal lights · 14
 Protocol processing · 3

R

Reference Clock · *See* Timing Source
 RF
 Front End · 16
 RF Front End · 6, 10
 LEDs · 14
 RF up/down converters · 10
 RX · 11

S

Signal processing · 3
 SMR Amplifier · 16
 Subsystems · 3
 System Operator Role · 5

T

Timestamping · 19
Timing Source · 19
Transcoder and Rate Adaptor Unit · *See* TRAU

U

Up/Down Converter · 10

V

Vocoders · 6