Wireless to the MAX

PacketMAX 5000

PacketMax 5000 Installation and Operation Manual

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CE Notice

Declaration of Conformity

Aperto Networks Inc. of 1637 S. Main Street, Milpitas CA 95037, USA, declare under our sole responsibility that the product PacketMax 5000 system to which this declaration relates, is in conformity with the following standards and/or other normative documents.

- EN 301 753
- EN301 489-4
- EN60950

We hereby declare that all essential radio test suites have been carried out and that the above named product is in conformity to all the essential requirements of Directive 1999/5/EC.

The conformity assessment procedure referred to in Article 10 and detailed in Annex [III] or [IV] of Directive 1999/5/EC has been followed with the involvement of the following Notified Body: Compliance Certification Services, 561F Monterey Road, Morgan Hill, CA 95037

CE 0984 ⓘ

Waste Electrical and Electronic Equipment (WEEE) Directive Compliance

Aperto Network products sold within the European Union (EU) are subject to the requirements of the Waste Electrical and Electronic Equipment (WEEE) Directive; as implemented by national legislation in each EU country. The objectives of the Directive are to reduce the environmental impacts of WEEE by promoting re-use and recycling, as an alternative to disposal.

From 13 August 2005, product placed on the EU market is required to be marked with the symbol shown below. This symbol indicates that end-of-life electronic equipment generated within the EU should not be mixed with other types of waste or placed in the general waste stream; but should be segregated for the purpose of re-use or recycling.

Preface

This manual is part of the documentation for the PacketMax fixed broadband wireless system for delivering high-speed subscriber services. The PacketMax documentation set includes:

- *PacketMax 5000 Installation and Operation Manual*
- WaveCenter Element Management System (EMS) Pro User Manual.
- *PacketMax 100/300 Installation and Operation User Manual*

Scope of This Manual

This manual documents the PacketMax 5000 Base Station Unit (BS). It provides the following information:

- **Chapter 1 Overview of Base Station**: Provides the conceptual overview of the PacketMax System.
- **Chapter 2 Base Station Components**: Provides descriptions of the PacketMax 5000 hardware components.
- **Chapter 3 Installing the Base Station IDU**: Provides step-by-step procedures for installing the PacketMax Base Station Indoor Unit.
- **Chapter 4 Installing the Base Station ODU Radio and Antenna**: Provides step-by-step procedures for installing the PacketMax Base Station Outdoor Unit Radio and Antenna.
- **Chapter 5 Commissioning the Base Station**: Illustrates how to commission the PacketMax Base station.
- Appendixes: Provides additional information, such as Event Reporting; Command Line Interface; Cables, Spares, and Accessories; System Specifications, PacketMax Certifications, and Troubleshooting steps.

Installation and operating instructions for subscriber equipment (CPE) and WaveCenter EMS Pro are provided in the *PacketMax 100/300 Installation and Operation* manual, WaveCenter EMS Pro Installation Manual, and WaveCenter EMS Pro User Manual.

Conventions Used in This Manual

PacketMax manuals represent special kinds of text as follows:

- Files names and URLs are represented in italics, with variables described inside angle brackets. For example, if the URL *http://<IP address>/* is referenced, you will replace the variable *<IP address>* with the appropriate real IP address.
- Management interface text is represented by a bold font: for example, the **Generate Config File** button.
- Labels on equipment are represented in a bold font: for example, **the Control connector**.

WARNING: This format is used to indicate the possibility of personal injury or serious damage to equipment.

CAUTION: This format is used to indicate the possibility of system or equipment operation problems.

Items of special importance will be formatted and marked by a pointing-hand icon, as this paragraph is.

Intended Audience for this Manual

This manual is intended for system designers and planners, base station installers, system operators, and others requiring or desiring information about the PacketMax 5000 BS and the PacketMax System. It provides information specific to the PacketMax system, but cannot and should not be considered a tutorial on relevant technologies and practices.

NOTE: It is highly recommended that all customers who intend to deploy the PacketMax System, attend both the PacketMax and the WaveCenter EMS Technical Training courses taught periodically by Aperto Networks Technical Training Department.

It is expected that system designers and planners are knowledgeable about radio communications, cellular communication systems, and IP networks. Tutorials on these subjects are beyond the scope of this manual, and are readily available in published and online materials.

Installation of radio equipment involves numerous factors, such as lightning and weather protection, requiring considerable expertise. It is assumed that equipment installers are professionals with knowledge of the principles, standard practices, pro-

cedures of cell site installation, all relevant safety requirements, and applicable local building codes.

General Cautions and Warnings

Observe the following when installing or operating any PacketMax System components.

Carefully follow all local building and electrical codes, especially the latest revision of the National Electrical Code (NEC) and standard safety procedures for installing and working with this type of equipment. Improper procedures or installation can result in damage to the equipment or the building, and injury or death. If you are not sure about whether the installation follows these codes, contact a licensed building inspector or electrician in the area for assistance.

Always use quality components—including cables, connectors, mounts, etc.—specifically rated for your particular environmental conditions and system performance requirements.

Always use appropriate tools, and follow the instructions of the tool manufacturers.

All outdoor installation, including equipment mounting and cabling, should be performed by trained microwave radio technicians familiar with usual and customary practices and procedures.

Take extreme care to avoid contacting any overhead power lines, lights, and power circuits while you are installing outdoor equipment. Contact with any of these objects could cause injury or death. Do not install outdoor equipment near power lines.

Observe all customary and mandatory safety requirements when installing and operating PacketMax equipment.

Make sure that the outdoor radio/antenna is grounded in accordance with local, state, federal, and National Electrical Code (NEC) requirements. Pay special attention to NEC sections 810 and 820. See the instructions in Chapter 4 of this manual.

For the PacketMax 100/300 Series Indoor Unit, use an outlet that contains surge protection and ground fault protection, or use a surge protection device. This will protect the Indoor Unit and equipment connected to it from damage resulting from AC current surges, lightning, etc. For complete protection, all connections to the Indoor Unit (i.e., from radio/antenna and PC/hub) should be connected to a surge

protection device. To ensure the best signal, use surge protectors designed for the specific application.

RF Exposure Guidelines

In order to comply with FCC and Industry Canada requirements for maximum RF exposure levels to persons, the antenna must be mounted in such a way that during operation, a minimum separation distance of 21 cm is maintained between the antenna and all persons.

Prohibition against Unauthorized Modifications

The user is cautioned that changes or modifications not expressly approved by Aperto Networks could void the user's authority to operate the equipment.

Units sold in the United States can only be used in the FCC specified band of 5.725 to 5.850 GHz.

Because Aperto cannot be responsible for improper installation or use of its equipment, failure to follow these and other published cautions and warnings may void your equipment warranty.

What is new?

Revision History

Release 2.3	
Topics added/revised	**Section**
3 DES Encryption	See 3 DES Encryption.
Certificates and Management	See Certificates and Management.
LAN Upgrade Tool	See Upgrades.
VLAN	See VLAN Mode.
MSC FacePlate features	See Main System Controller Card.
Hot-Swap	See Hot Swap.
Auto-Provisioning	See Provisioning the Base Station with WaveCenter EMS.

Revision History

5.8 GHz Base Station Radio	For information on installing the 5.8 GHz radio, see Installing the Base Station Radio ODU. For technical specificaions on 5.8 GHz radio, see PM-BSR-58 Radio Specifications.
External Synchronization Support	See Synchronizing Multiple BSs at a Site.
Point-to-Point Mode	Pont-to-Point Mode allows you to increase the number of supported hosts up to 7500. For more information on Point-to-Point Mode, please refer to the Point-to-Point Mode section.

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1

Overview Of Base Station

This chapter provides a description of the PacketMax Broadband Multiservice Wireless Access System, including system architecture, functionality, features, benefits, as well as hardware and software components.

This chapter covers the following topics:

- Conceptual Overview of the PacketMax System
- Bridge Mode and VLAN Mode of Base Station
- Features of PacketMax System

1.1 Conceptual Overview of the PacketMax System

PacketMax[tm]5000 (PM 5000) is a carrier-class WiMAX Base Station (BS) that is certified by the WiMAX forum (See Appendix D). It is the network industry's highest performing quality base station. PacketMax 5000 Base Station is based on a carrier class ATCA chassis. The system is compliant with the options in the current 802.16-2004 WiMAX specification using the OFDM256 PHY option.

This base station is a modular design and supports large number of deployments. The wireless sectors on the PacektMax 5000 indoor unit is equipped to be 1:N redundant at the wireless port level and 1:1 redundant at the backhaul card level. Currently, it has 4 ports and abundant processing power and bandwidth.There is a high capacity non-blocking backplane with 2.56 Gbps of switching capacity. Figure 1-1 shows the PacketMax overview.

A PacketMax System can include:

- PacketMax infrastructure products such as base stations and point-to-multi point systems:
  - PackeMax 5000 Base Station, supporting multiple wireless sectors.
  - Base Station Radios (BSR) and antennas for wireless communication with subscribers. Antennas typically cover a 60°, 90° and 120° sector. So, a 360° cell requires six or four radios, respectively; omnidirectional or other antennas may also be used.
- PacketMax Subscriber Station products, which serve as interfaces between the PacketMax wireless network and the subscriber' computer/LAN including:
  - PacketMax 100 Series Subscriber Stations, which include an integrated outdoor radio/antenna and an indoor power supply.
- Management tools and utilities, which run on standard computer platforms.

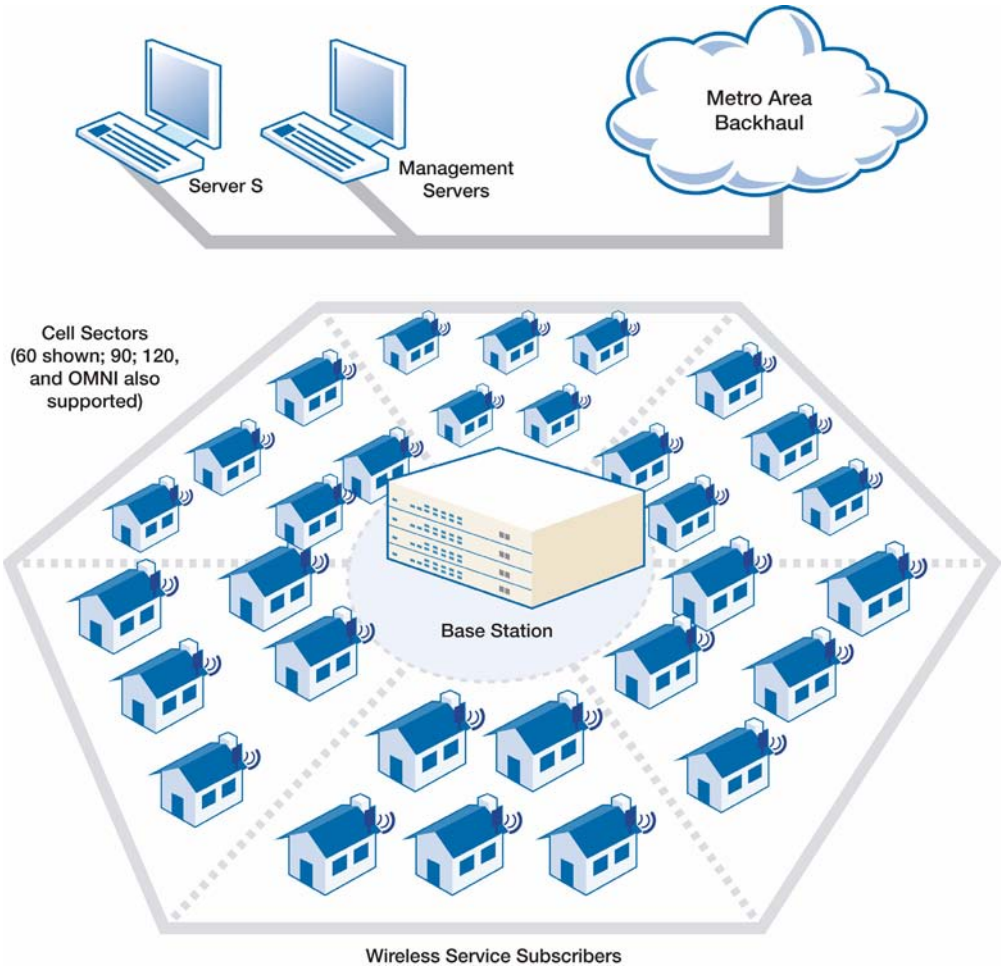


Figure 1-1 PacketMax System Elements

1.1.1 Cell Size, Capacity, and Scalability

Aperto's advanced wireless technologies support a wide range of cell requirements, and make the PacketMax System an exceptionally scalable solution. PacketMax cell specifications include the following:

- Cell radius depends on the frequency band, line-of-sight, and local conditions. Consult Aperto Networks Customer Service for more details.
- A cell can employ multiple Base Station. Thus, a single cell can serve thousands of subscribers.
- Subscriber data rates can be individually configured.
- The ratio of downstream to upstream traffic can be adjusted.

The PacketMax System ensures that a wireless network can grow to thousands of subscribers in urban or suburban areas through high frequency reuse and dense multicell deployment. Combining high frequency reuse with advanced interference management and mitigation techniques, the PacketMax System conserves valuable

spectrum by covering extensive geographical areas with a minimum number of channels.

As the number of subscribers and the bandwidth needs in a cell increase, new sectors can be added, and multiple Base Station can be stacked to provide additional bandwidth using multiple channels per sector. To extend service offerings geographically, a service provider simply deploys additional cells.

Cells can be interconnected and channels synchronized from a central site without additional synchronization equipment. Aperto's family of products provide the appropriate infrastructure.

1.1.2 Frequency Bands

The PacketMax System can be deployed in the standard frequency bands used variously throughout the world for licensed or unlicensed wireless broadband networking. The PacketMax products operate in 3.3, 3.5, 5.8 GHz Frequency Bands.

1.1.3 PacketMax Network Connectivity

The PacketMax Base Station network connectivity has been highlighted in Figure 1-2. This system demonstrates a bridge mode type of setting for the PacketMax system, as follows.

- The PacketMax 5000 is shown connected to the EMS Backend Server and the EMS Client through the management interface on the MSC.
- The MSCs and WSCs in the base station are connected through a Backhaul plane. Further, WSCs on the Base Station are connected to the Base Station Radio through RF connectivity.
- The Base Station Radio is then connected to the Antennas that communicate with the Subscriber Station PacketMax 100 (integrated antenna).
- The EMS Backend Server, EMS Client, Base Station and the Subscriber Unit should all be on the same network.

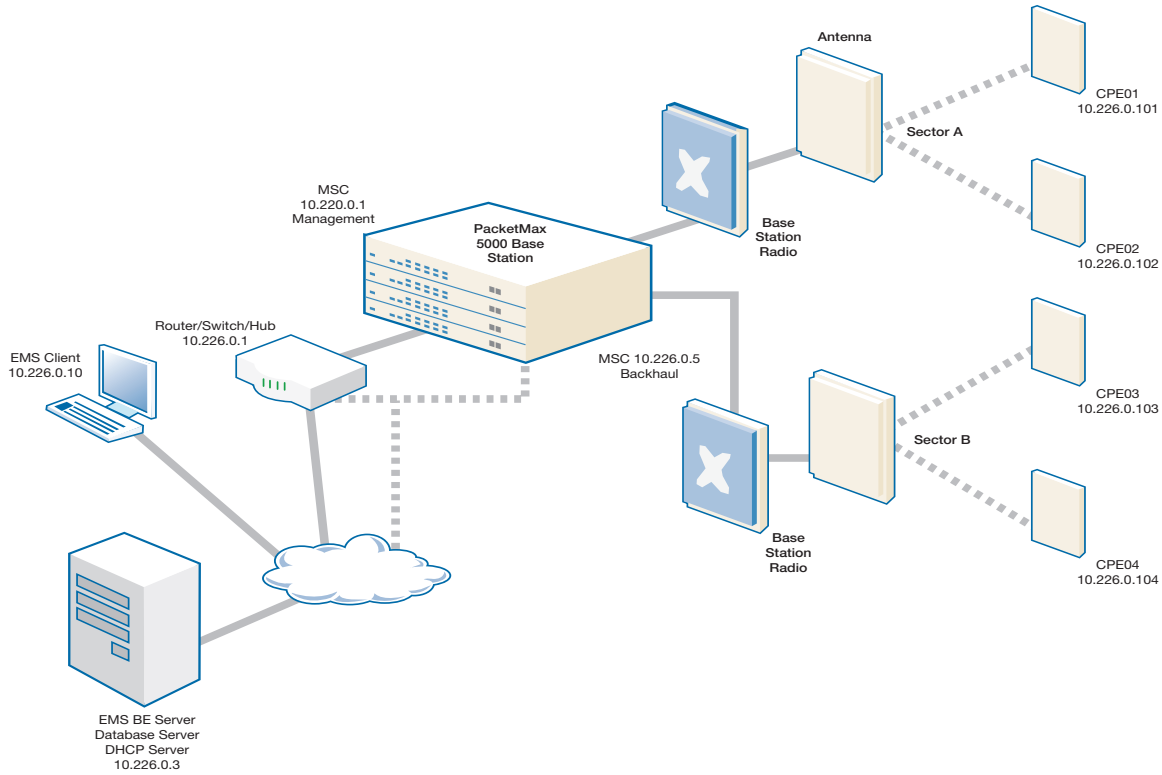


Figure 1-2 PacketMax System network

1.2 Bridge Mode and VLAN Mode of Base Station

1.2.1 Bridge Mode

Following are the specifications of Bridge Mode:

- The Management Port is part of the Bridge.
- The 10/100 Base-T Management port can be used for data or management traffic.
- The gigabit-ethernet is backhaul port, meant for sending and receiving data traffic and can also be used to pass IN-BAND management traffic. Only one of these Backhaul ports will be part of the Bridge and is user configurable.

In Bridge mode, consider the pointers listed as below:

- Do not connect both the Management and the Backhaul port to the network.
- Connecting these ports will cause a loop, as both the ports are part of the Bridge.

- The solution is to not use the dedicated management port but rather to use in-band management on the backhaul port. In doing this, it is required to configure the DHCP server settings on the BS to submit requests through the backhaul port.
- The basic goal is to allow DHCP/TFTP to happen over the Backhaul link, rather than only over the Management port (fei).

1.2.2 VLAN Mode

VLAN Mode: Virtual Local Area Networks (VLANs) is a method that allows network administrators to create logical broadcast domains, which implies division of local area network by software rather than using cables. The broadcast domains can span across one switch or multiple switches. Thus VLANs:

- Reduces the size of broadcast domains
- Reduces network traffic
- Increases Network security
- Reduces the need to create subnetworks
- Enables network to be logically separated and not physically.

For the Data Traffic in the VLAN Mode, the VLAN IDs are configured when provisioning SS using EMS.

1.2.2.1 VLAN Configurations

In the PacketMax system there are two types of management configurations, based on the network design, on the PM5000 and they are:

- Out of band Management
  - Users can choose the management port on the MSC of the PM 5000 system, management traffic. All other traffic will pass through the backhaul port.
- Inband Management
  - Users can choose the backhaul port on the MSC of the PM 5000 system, for management traffic. In this configuration, both management and data traffic will flow over the backhaul port.

Optionally, Management VLAN may be specified for management traffic.

The backhaul port connected to the VLAN switch, needs to be configured to dot1q trunk (IEEE 802.1q) standard.

1.2.2.2 Out of band Management with Management VLAN

Outbound Management traffic adds security, when the management VLAN is enabled. The outbound management is tagged with this VLAN ID. Both BS and SSs should use same VLAN ID as Management VLAN ID. For example, if VLAN ID number is 1 on BS, it has to be the same (VLAN ID 1) on SS as well. The management VLAN ID needs to be set:

- On the PM5000 BS, manually.

NOTE: Changing Management Port in VLAN requires MSC reboot.

- On the SS, using the Installation Manager.

Please refer to Chapter 6 “Commissioning the Base Station”, for setting up Management VLAN ID on the BS and refer to the PacketMax 100/300 User Manual for setting up the Management VLAN ID on the SS.

Typically management port is used for sending/receiving management traffic (Ping/TFTP/DHCP packets from/to BS or SS). Figure 1-3 displays DHCP/TFTP over management port (a management interface set-up).

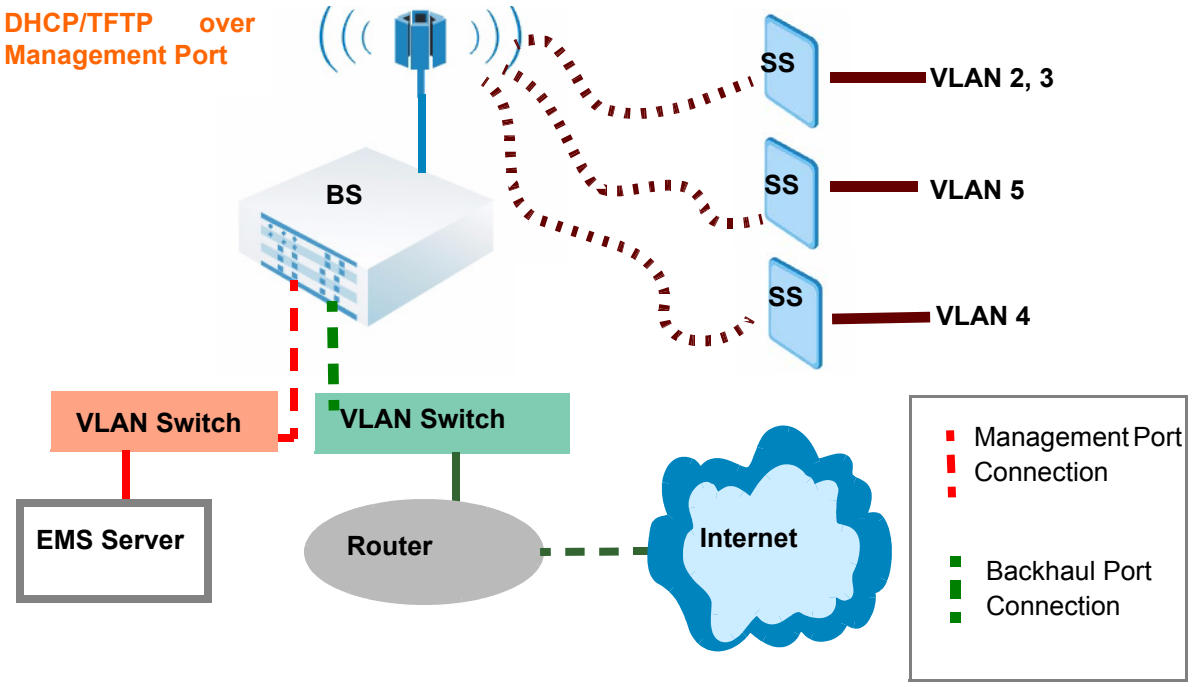


Figure 1-3 Out of band Management

1.2.2.3 Inband Management with Management VLAN

The date/traffic are segmented by traffic VLANs and is implemented by the backhaul ports (**Inband management**). This VLAN carries inbound traffic.

The Backhaul Interface can be either Fast Ethernet or Gigabit interfaces. Backhaul port could be used for sending/receiving data traffic. Figure 1-4 displays DHCP/TFTP over backhaul port (a backhaul interface set-up).

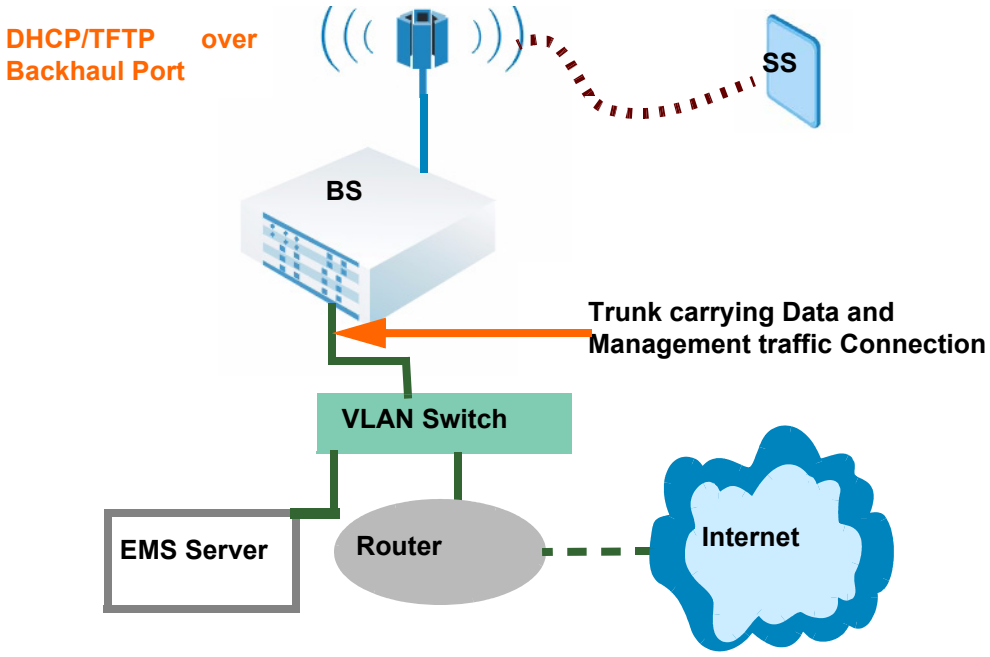


Figure 1-4 Inband Management

It is recommended to connect EMS server and Base station unit in the same VLAN, for the ease of management and quick troubleshooting incase of any failures.

1.2.2.4 VLAN Classifiers

The VLAN switch identifies traffic corresponding to each LAN interface by attaching a VLAN tag to the Ethernet frame as the traffic is switched to its WAN interface. The Ethernet switch provides isolation of one customer LAN traffic from another customers. As each customer's traffic can be identified with a VLAN ID, it can be mapped onto an individual Service Flow enabling individualized QoS on a per customer basis.

A VLAN Classifier is a set of rules that determine how the PM 100/PM 300 assigns a VLAN ID and priority to a packet based on a wide range of packet parameters such as:

- Source or destination IP address(es).
- Source or destination MAC address(es).
- IP TOS.
- TCP/UDP Port numbers.

NOTE: VLAN classifiers are applied only when the unit is configured with them enabled. This is configured in EMS, and is described in the WaveCenter EMS User manual.

NOTE: IP addresses used for VLAN classifiers do not warn the user when the resulting address is the broadcast or network address.

1.2.2.5 VLAN Application Example

An example (Figure 1-5)using the Point-to-Multipoint PacketMax 5000 Product with two SSs (Subscriber Station) and a Cisco 2950 Series VLAN switch is described in this section.

- The Base Station Backhaul Fast Ethernet Port is Trunked, via the MSC (Main System Controller), to the Cisco 2950 Series VLAN Switch.
- Two ports on Cisco VLAN Switch are configured in Access mode to tag all incoming packets. The first port is configured with VLAN ID 101 and the second VLAN ID 102; these ports are used to connect non VLAN enable devices.
- Two PacketMax SSs are configured in VLAN mode to tag all incoming packets. One SS is configured to tag all incoming packets with ID 101 and the other with ID 102.
- The PacketMax products (MSC and SS) are configured to be managed using VLAN ID 100. Hence, another Port on the VLAN switch is configured to tag all packets coming from the EMS Server with VLAN ID 100 to the Base Station Management interface on the MSC.

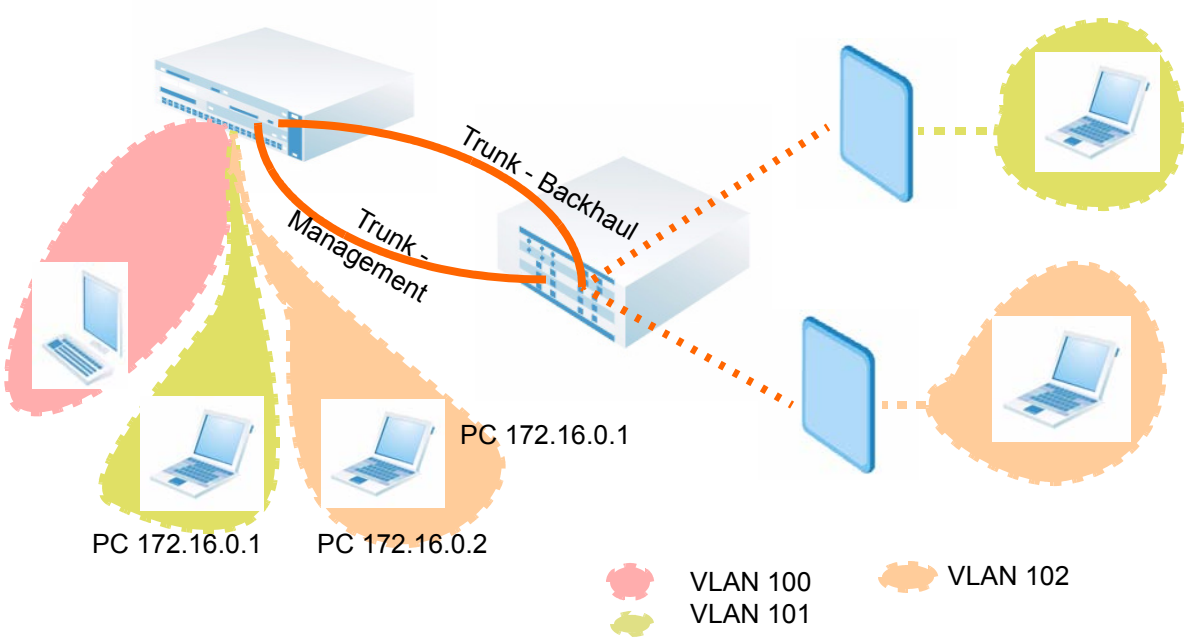


Figure 1-5 VLAN Application

1.2.2.6 Looping Prevention

The communication between SS and PM 5000 and the communication between SS and EMS server occurs over the management VLAN. The management traffic destined to EMS server from SS is sent out only on management port of PM5000 and it will not be sent out of backhaul port.

Also, if backhaul port receives any management traffic, it will drop it. Hence, if you try to ping PM5000 (which is in VLAN Mode) using management VLAN ID through

backhaul, it will not work. Ping will work if it is tagged with appropriate management VLAN ID and it is sent through management port.

NOTE: Base Station Unit and Subscriber Stations need to be configured in the VLAN Mode to avoid any configuration issues. It is not recommended to run the base station in the Bridge Mode and Subscriber station in the VLAN Mode. However, this combination might work but we do not guarantee and Aperto does not support in this mode.

1.2.3 Point-to-Point Mode

The PacketMAX 5000/3000 Base Stations in combination with PacketMAX 100/300 Subscriber Stations provide high-speed, cost-effective links for point-to-point applications. With unprecedented interference resilience and minimal spectrum usage, they are ideal for such applications as high-speed backhaul of Wi-Fi hotspot networks, higher-capacity alternatives to T1/E1 connections, and building-to-building connections in the enterprise environments.

Features that support Point-to-Point applications include:

- Support for 3.3, 3.5, and 5.8 GHz frequency bands
- High interference immunity
- Exceptional wireless range (up to approximately 35 to 50 miles/ 55 to 80 km, depending on the frequency band)
- Outdoor radio units with connectorized output for high-gain antennas to extend the range of the wireless link.
- Synchronization between units
- Management via SNMP-based Element Management System.

Figure 1-6 PacketMAX 5000 in Point-to-Point Mode

Pont-to-Point Mode allows you to increase the number of supported hosts up to 7500. You can enable or disable the Point-to-Point Mode from the SS Configuration screen in the WaveCenter EMS Pro.

The following table lists the number of hosts supported in Point-to-Point mode, based on the product and the frequency band:

Table 7-7 Number of Hosts Supported in Point-to-Point Mode

Product	Frequency Band	Number of Hosts Supported	
		Point-to-Point Disabled	Point-to-Point Enabled
PM 100	3.5 GHz	5	5
PM 100	5.8 GHz	5	7500
PM 300	3.5 GHz	250	7500

1.3 Features of PacketMax System

Some features of the PacketMax System are as follows:

- IP Network Stack
- Services and Quality of Service (QOS)
- Automatic Repeat Request Support (ARQ)
- 3 DES Encryption

The following sections discuss about each of these features.

1.3.1 The PacketMax System's IP Network

Overall, the system has the following network architecture.

- The Base Station backhaul channel is part of a subnet which includes:
  - A gateway to the outside world (Internet or private network).
  - Access to a DHCP server (either the DHCP server or a DHCP relay agent must be on the same subnet as the BS's backhaul interface).
  - Access to a TFTP server identified by the DHCP server.
- Each wireless interface is the gateway for a subnet comprising itself, its Subscriber Stations and perhaps some or all of the hosts at the subscriber sites.

NOTE: A wireless interface can be configured for multiple subnets, if desired.

Subnets may be implemented at subscriber sites.

1.3.1.1 DHCP Server and IP Address Assignment

The PacketMax System supports Dynamic Host Configuration Protocol (DHCP), which manages IP address assignment for most interfaces in the PacketMax devices.

NOTE: In the configuration of the DHCP server, the PacketMax System IP addresses must be fixed—i.e., reserved for the specific units; they cannot currently be dynamically assigned, but this planned for a future software release.

Specifically, PacketMax System IP addresses are assigned as follows:

- The BS receives the IP address of its backhaul interface from the DHCP server for its subnet.
- The BS's wireless interfaces (WSC) are assigned IP addresses as part of the BS configuration (using the WaveCenter Configuration Manager).
- SS receive the IP addresses of their wireless interfaces from the DHCP server.
- Computers, PCs and other hosts that WaveCenter EMS configures for its DHCP server, connected to he SS receive IP addresses in a variety of ways:
  - From ISP's DHCP server, via DHCP relay agents in the SS.
  - By manual assignment by the ISP.

1.3.2 Services

Each Base Station Unit requires access to DHCP and TFTP servers to boot up properly. Access to additional servers is required for the support of specific features.

1.3.2.2 TFTP Server

For the PacketMax System, the main function of the TFTP server is to store the system configuration files, and download them on request. Each Base Station Unit and Subscriber Unit requests its configuration file on hardware or software reboot (cold or warm start). A TFTP Server is included in EMS.

NOTE: Whenever a Base Station Unit or Subscriber Unit boots up, the configuration file must be successfully downloaded from the TFTP server for the unit to become operational. If the configuration file is not successfully downloaded, the BS or SS will come up in standby mode.

1.3.2.3 SNTP Server

The Base Station Unit typically derives the time and date from an SNTP (Simple Network Time Protocol) server identified by the DHCP server. The BS includes time zone and daylight savings time parameters which it applies to the received time and date as appropriate. A SNTP Server is not included in EMS.

NOTE: Alternatively, date and time can be set via the Web and SNMP interfaces.

Subscriber Units use the BS as their time server.

1.3.2.4 DNS Server

The DHCP server should identify a DNS server to be used in the resolution of Internet domain names. This can be configured through the server configuration tool under DHCP settings. A DNS Server is not included in EMS.

1.3.2.5 SMTP Server

The PacketMax Base Station Unit can use E-mail to announce events. If this feature is to be used, an SMTP (Simple Mail Transfer Protocol) server must be specified. A SMTP Server is not included in EMS.

1.3.2.6 System Log Server (Syslog)

If a Syslog server is identified in the BS configuration, the Base Station will log all events to the specified server using the standard Syslog protocol. A Syslog Server is not included in EMS.

NOTE: Syslog is needed to effectively monitor the PacketMax system. Service providers should install this server in their network.

1.3.2.7 SNMP Manager

SNMP (Simple Network Management Protocol) is an industry standard for management of computer networks. PacketMax Base Station Units and subscriber Indoor Units include built-in SNMP agents. These agents can be accessed by SNMP management applications such as WaveCenter EMS Pro.

NOTE: PacketMax SNMP agents use SNMP v.2 syntax for objects.

1.3.3 MIBs

Each PacketMax BS and SS includes a SNMP agent supporting the following MIBs:

- MIB II (RFC 1213)
- Aperto private MIB
- Wimax-IF-MIB (objects for 802.16 based SS and BS)

The complete MIBs are provided on the PacketMax CD-ROM, and are available on the Aperto Web site, *www.apertonet.com*.

SNMP can be used to read configuration, status, and performance data from Subscriber Units. In addition, SNMP can be used to change some configuration parameters (those which can be changed via the Configuration Manager in EMS), and to upload the configuration changes to the TFTP server (if the TFTP server is configured to accept uploads).

The SNMP agents support trap reporting. Trap-reporting parameters can be specified via the Configuration Manager as well as via SNMP.

NOTE: Changes to the IP addresses of SNMP servers do not take place until a system reboot.

1.3.4 Service Offerings and QoS

The PacketMax System is designed to give service providers freedom in the definition of multiple services and the specification of quality-of-service (QoS) levels. Different kinds of applications can be used with the three types of classes of service (CoS). Before configuring individual subscribers, services and QoS parameters need to be identified. Factors involved include:

- Service Class, which may be:
  - Best Effort (BE)
  - Unsolicited Grant Service (UGS)
  - Non Real Time (NRT)
- Type of application
- Overall and peak bandwidths

Be sure to check values of UGS service flows when switching between the selections of VOIP FLOW types. The values of the previously configured information remain to aid the user to create multiple, similar flows.

- **BE** service flows are not given any performance guarantees, and are only allocated bandwidth after the requirements of the other service classes are satisfied (this is the class of service given to most current residential DSL and cable modem users). However, to prevent starvation, the group of all BE flows is guaranteed a configurable amount of bandwidth
- **UGS** flows are designed for constant bit rate traffic (CBR). In the uplink, the BS uses the unsolicited grant mechanism to schedule fixed-size grants at a recurring interval with as little latency as possible. Thus, UGS is suitable specifically for voice and other applications with similar real-time requirements.
- **NRT** service flows are given a guaranteed minimum amount of bandwidth, and can be offered as a higher-priced tier of service. Note that the configured bandwidth is a minimum that can be exceeded if extra bandwidth is available (in contrast to traffic shaping, which enforces a maximum). Uplink service flows provisioned as NRT, rely on the non real time polling scheme to request bandwidth.

1.3.4.8 Concepts of PacketMax Service Level Definition

The PacketMax quality-of-service (QoS) capability is based on sets of classifiers and service flows, and links between the two, as shown in Figure 1-7.

- A classifier is one or more layer 2 and/or layer 3 parameters which will identify a particular traffic flow.
- A service flow is a set of parameters which will determine the performance characteristics (QoS) of traffic assigned to that flow.

When a classifier is defined, it is assigned to a specific service flow. Thus, any traffic meeting the classifier specifications will be transmitted according to the performance characteristics of its assigned service flow.

Traffic not meeting any of the defined classifiers is assigned to a default Best Effort service flow. The characteristics of this default service are configurable, but the service class must be Best Effort (BE).

1.3.4.9 Assigning Service Levels

Service levels are assigned in the individual SS configuration files, allowing for maximum flexibility in differentiating services among subscribers.

To define the Service flows for a subscriber, EMS lets the user choose a Default Service flow. This is done by choosing the **Add Default Classifier** button. The WiMAX standard will drop any packet that does not meet any Classifier rule. So if the users do not want to define specific Classifier rules for each type of traffic pattern, then they can choose a Service Flow as the Default Service flow by adding a Default Classifier for that Flow. Only 1 Default Service Flow should be defined for each direction, i.e. one for the Upstream and another one for the Downstream.

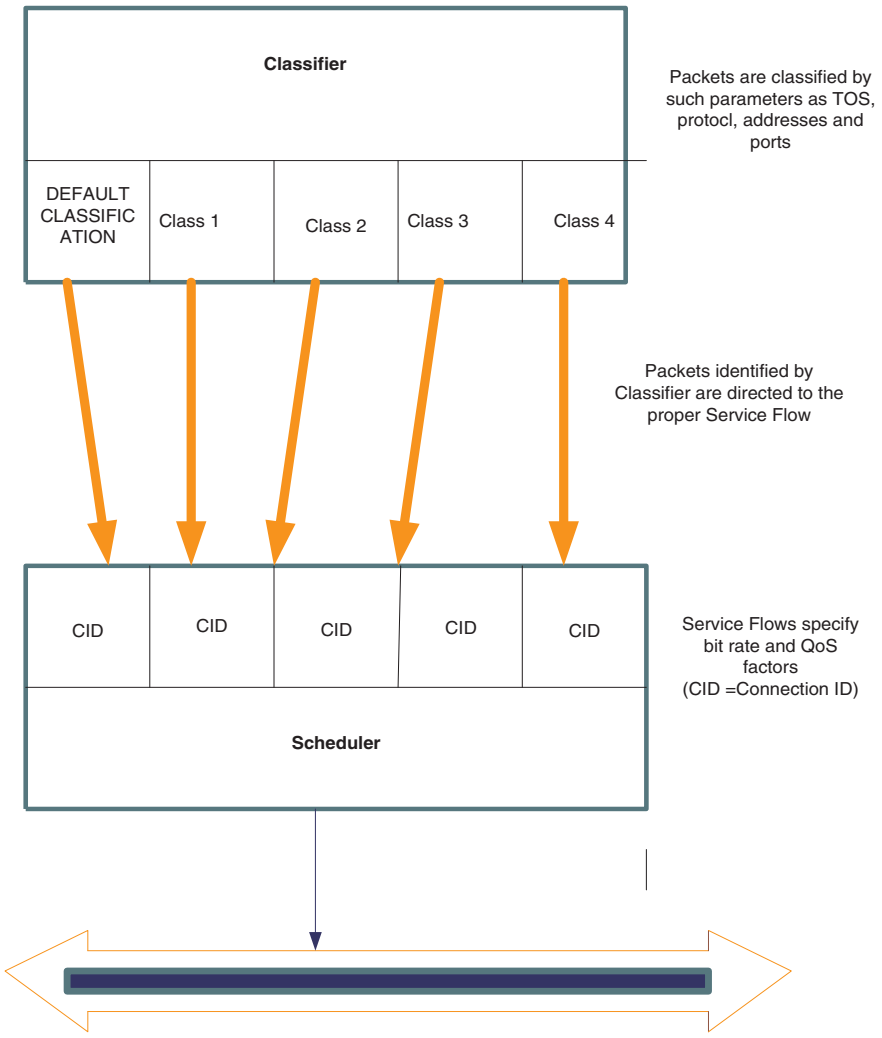


Figure 1-7 PacketMax Service Flows

1.3.5 ARQ Feature

ARQ is a technique that handles transmission errors that occur when data is transmitted over unclear (noise) channels. The way it works is that, the transmitter uses a sliding-window protocol to control the number of blocks waiting to be transmitted, retransmitted or acknowledged. The maximum number of unacknowledged blocks at the transmitter should not exceed the ARQ Window Size.

The IEEE standard defines an ARQ feedback mechanism, used by the receiver to provide feedback on ceaselessly received or lost ARQ blocks. A flexible bitmap-based ARQ Feedback is defined in the standard which can support four different types of acknowledgements. They are:

- Selective ACK – In this, each bit in the bitmap indicates whether the corresponding block has been received correctly or not
- Cumulative ACK – This is used to acknowledge correct reception of all blocks up to a specified sequence number
- Cumulative with Selective ACK entry – This combines functionality of Selective ACK and Cumulative ACK.
- Cumulative ACK with Block Sequence ACK entry – This has the ability to acknowledge reception of ARQ blocks in terms of block sequences.

The standard does not specify any rules on the usage of the four different feedback types and leaves it open to implementation. Aperto's implementation of the ARQ feedback mechanism relies on a proprietary scheme, which allows to optimally select the feedback type based on the block error pattern or in some cases to combine more than one types in order to efficiently use the bandwidth.

The ARQ feedback information can be sent either as a standalone MAC management message on the appropriate management connection, or piggybacked on an existing data connection. The frequency of acknowledgement generation and the bandwidth allocated for ARQ feedback traffic is controlled by the scheduler based on proprietary scheme controls ARQ feedback traffic.

ARQ parameters can be configured or modified on a per Service class/service flow basis to accommodate special traffic requirements. However, it is strongly recommended that the default settings are preserved since those are the result of an extensive simulation study and have been shown to result in very good performance under noisy link conditions.Some of the configurable ARQ parameters are:

- ARQ_WINDOW_SIZE
- ARQ_BLOCK_SIZE
- ARQ_BLOCK_LIFETIME
- ARQ_RETRY_TIMEOUT
- ARQ_SYNC_LOSS_TIMEOUT
- ARQ_RX_PURGE_TIMEOUT

These parameters are discussed and explained in the *WaveCenter EMS User Manual*.

1.3.6 3 DES Encryption

3 DES encryption scheme helps secure the communication channels between the base station and subscriber station by encrypting the data flow between the two.

The Encryption procedure is as follows:

1. At first, the SS initiates the authorization process and sends message to the BS indicating that it is capable of encryption.
2. The BS authorizes the SS by verifying the device and Vendor Certificate of the SS during the Privacy Key Management (PKM) Message Exchange.
3. An Authorization Key (AK) is used to decrypt the Traffic Encryption Keys (TEKs) using PKM protocol. The AK is periodically refreshed and is encrypted using 3DES.
4. In the BS, the TEKs are generated and send to SS using the 3DES encryption format. The SS decrypts these TEKs using a Key Encryption Key (KEK) generated from the AK. If the BS encrypts the TEK using the RSA Public Key of SS, then the SS decrypts it using its Private Key.
5. The TEKs are used for encrypting data on different Service Flows (SF) between the BS and SS.
6. All the Service Flows for one SS will have the same key in both upstream and downstream.

NOTE: To enable encryption on every service flow, please refer to the WaveCenter EMS User Manual.

7. The traffic between the BS and SS can now be encrypted/decrypted using the TEK keys.

8. If the CPE fails authentication, the CPE can re-try authentication.

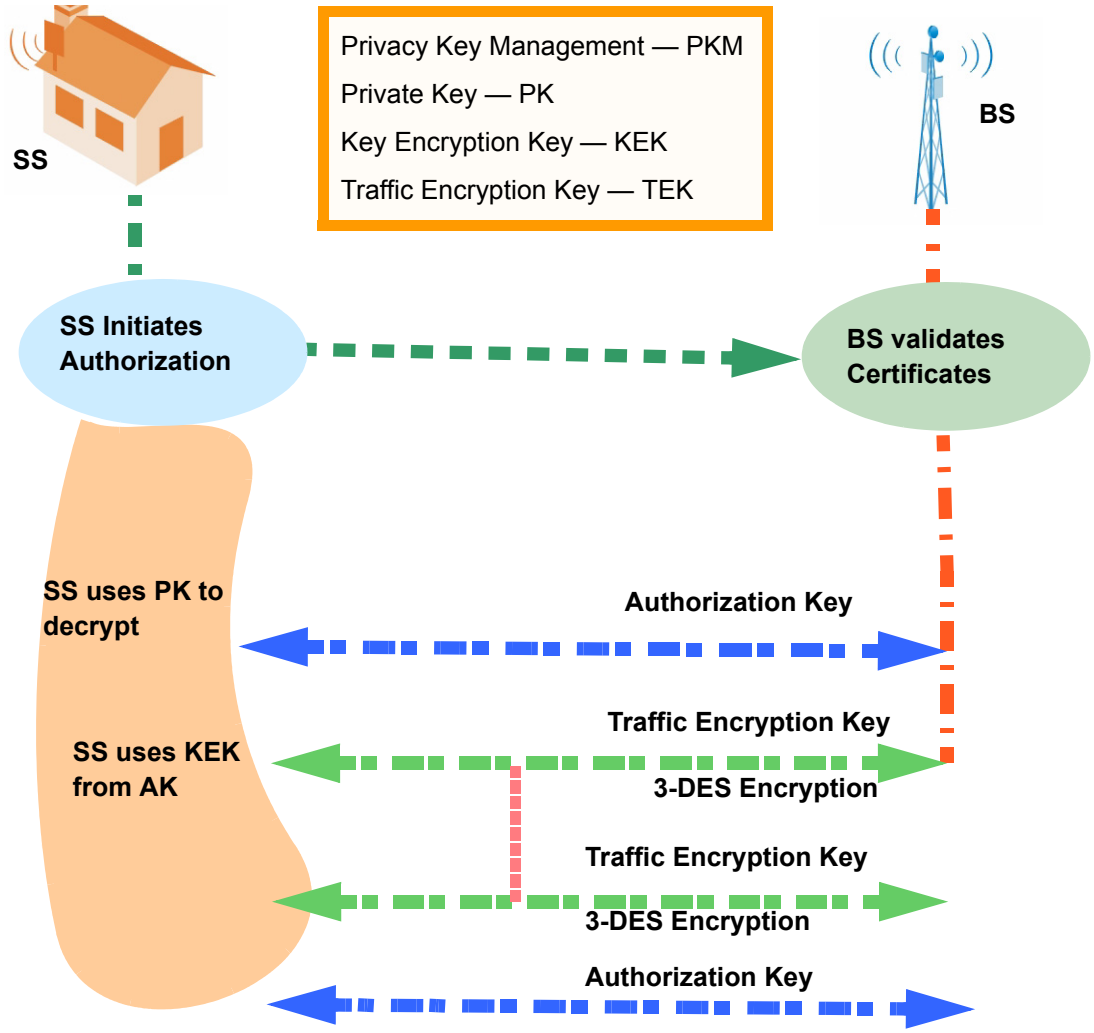


Figure 1-8 3-DES Encryption

NOTE: TEK is encrypted using KEK derived from Authorization key and 3DES Algorithm, while data is encrypted using TEK and DES Algorithm.

1.3.7 Certificates and Management

WiMax forum prescribes X.509 based digital-certificate for authorization process. which is part of the negotiation process as described in the above section. The certificates are used to strengthen the security process.

The Aperto WiMax Root Certificate, is a Self-Signed certificate issued by the Aperto Certifying Authority (CA). The CA is stored in the BS. The X.509 certificates are injected into the subscriber station devices at manufacturing time and can later be upgraded from the EMS.

The Root Certificate is the same across all Base Stations and shall be available on MSC, as the Certificate Verification happens on MSC. In the case, when primary and

redundant MSCs are installed, the Certificates need to be available on both the MSC Cards (Primary and Redundant). Currently we are upgrading the Primary MSC with the Wimax Root Certificate during the Upgrade Process.

1.3.7.10 Certificate Upgrades

Some important factors that users should take a note of, for certificate upgrades are:

- In a redundant BS configuration, the certificates need to be installed using the LAN upgrade tool.
- Once the user has a device which is certified, the LAN upgrade and Bulk Upgrade tool has to be used to upgrade the certificates.

1.3.8 Upgrades

There are two types of upgrades that can be done using the EMS, and they are:

- Bulk Upgrade : The bulk upgrade feature of EMS allows the users to upgrade the BS/SS efficiently.
- LAN Upgrade: When there is network connectivity to the BS, users can upgrade the SS using the LAN upgrade tool in EMS. This implies that LAN Upgrade can be used typically in a laboratory environment.

2

Base Station Components

This chapter explains PacketMax 5000 components and their functionalities, necessary to complete the installation for PacketMax.

This chapter contains the following topics:

- PacketMAX Base Station
- 5-Slot ATCA Chassis
- Wireless System Controllers
- Main System Controller Card
- MSC Redundancy
- AC Supply
- Power LEDs and ESD connector
- Hot Swap
- Maintaining Proper Chassis Air FLow
- Fan Unit
- Serial Cable Pinout
- PacketMax 5000 Rear Panel
- AC Power Connection
- Base Station Radio

2.1 PacketMAX Base Station

A PacketMax Base Station 5000 consists of the following components:

- 19 inch rack-mountable standard compliant ATCA chassis.
- Either AC and DC power supply.
- One or more Wireless System Controller Cards (QWCs)
  - Base Station Radio Connection
- One or two (for redundancy) Main System Controller (MSC) Card.
  - Serial port for CLI management.

The Front Panel of the PacketMax 5000 has

- Wireless System Controllers (WSC) and Main System Controllers (MSC) with their ports and interfaces
- Access to Modular Fan Unit
- Access to Modular AC Power supplies at the bottom.

Figure 2-1 shows the front view of the a PacketMax 5000 picture, with two MSCs and three WSC Cards installed.

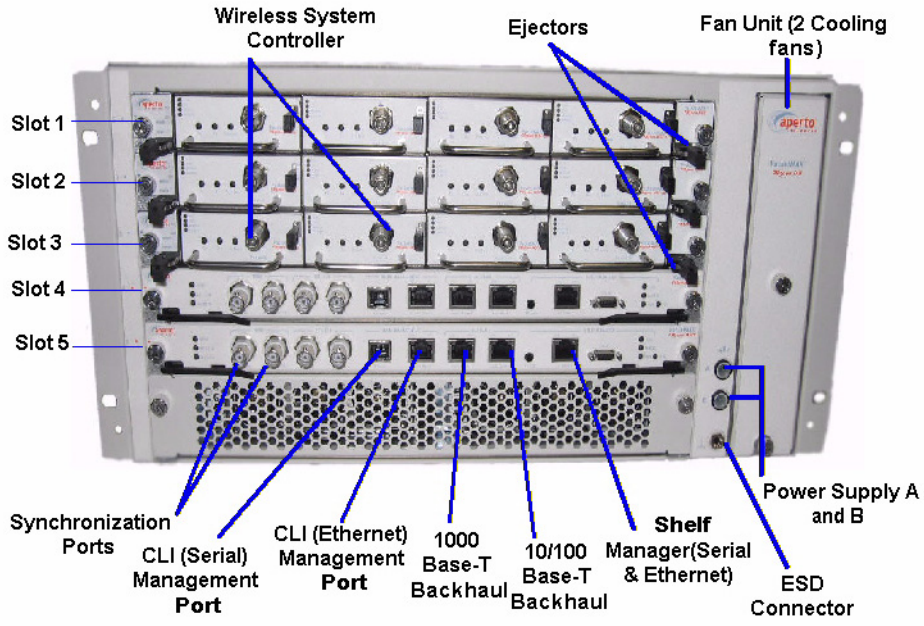


Figure 2-1 PacketMax Interface for PacketMax 5000

2.2 5-Slot ATCA Chassis

The PM500 Base Station is based on a 5U high ATCA compliant modular chassis. The chassis contains five physical slots numbered 1 through 5 that accommodate three different Aperto hot-swappable cards:

- Main System Controller (MSC)
- Wireless System Controller (WSC-S-24)
- Quad Wireless Controller (QWC) (holds up to four WSC-S-48's)

Table 2-A lists and defines the slot positioning rules for the above-listed cards. Fully populated slots for slots 3, 4 and 5 with three QWC cards, each containing four WSC-S-48's, defines the 12 sector system.

Table 2-A Slot Positioning Requirements for MSC/WSC-S-24/QWC

Slot Number	Required Cards
1	Dedicated MSC (copper of fiber Ethernet interface)
2	Dedicated MSC/WSC (WSC-S-24)
3	One WSC-S-24 or one QWC (each QWC holds up to four WSC-S-48's)
4	One WSC-S-24 or one QWC (each QWC holds up to four WSC-S-48's)
5	One WSC-S-24 or one QWC (each QWC holds up to four WSC-S-48's)

The PM5000 Base Station system assigns a logical port number for each WSC and is based on this card's physical slot location in the chassis. The logical port number acts as the internal address for the card and is used in the CLI, SNMP, and EMS management interfaces.

Table 2-B lists and defines the logical port number assignments for the WSC-S-48's (installed in a QWC).

Table 2-B Logical Port Number Assignments for WSC-S-48's (Installed in QWC)

Slot Number	Logical Port Assignments
5	10, 11, 12, 12
4	6, 7, 8, 9
3	2, 3, 4, 5
2	N/A
1	N/A

Table 2-C lists and defines the logical port assignments for the WSC-S-48's (independent of QWC).

Table 2-C Logical Port Assignments for WSC-S-24's (Card only)

Slot Number	Logical Port Assignments
5	10
4	6
3	2
2	1
1	N/A

Figure 2-2 displays the slot and plot numbers on the PM 5000 hardware.

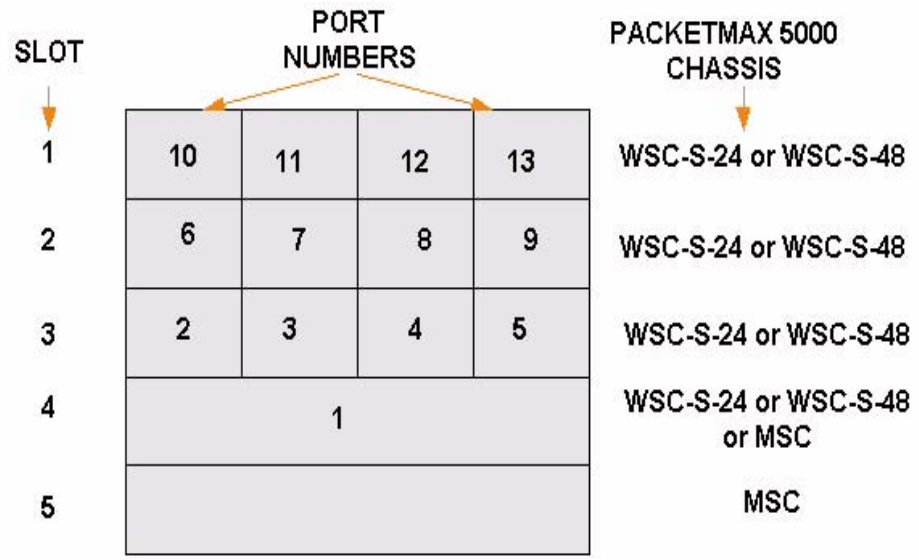


Figure 2-2 Slots and port numbers allotment of PM 5000

Figure 2-3 displays the slots and port numbers of a 4 sector base station and Figure 2-2 shows a 12 sector base station. Please note that the port numbers are labelled according to software configuration of the device.

NOTE: In Element Management System and CLI, while configuring, please enter the right port number.

Filler panels (PN PM 5000-FRONT PANEL) should be inserted, in to any unused slots. Build-to-order systems will include filler panels in any unused slots.

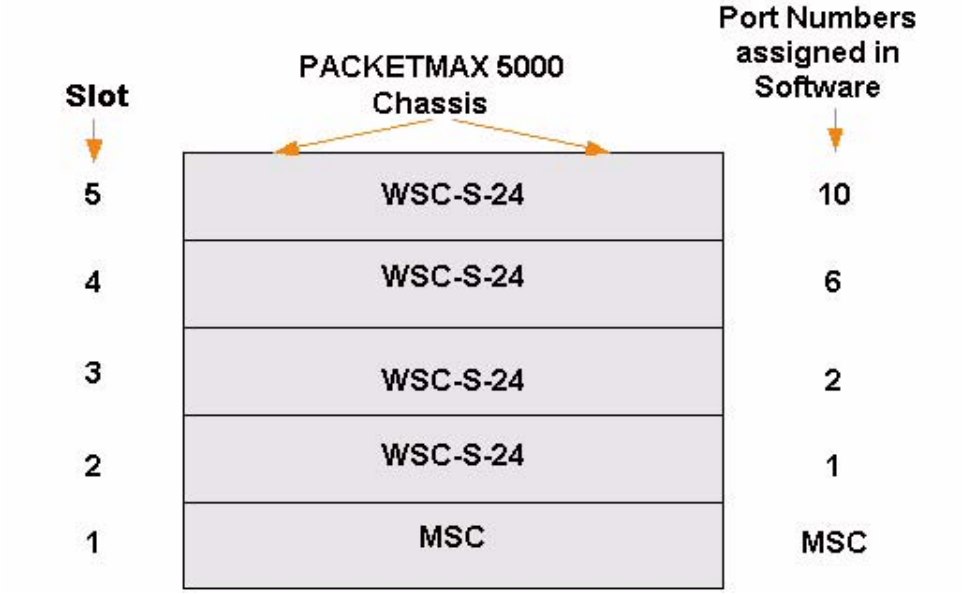


Figure 2-3 Slots and port numbers of four sectors BS

2.3 Wireless System Controllers

The WSC implements the 802.16-2004 MAC and PHY level functions.

The MAC functions include:

- A configurable Time Division Duplexing frame for efficient and flexible spectrum utilization.
- A standard OFDM256 TDD frame structure.
- Frame parameters that are configurable in the system.
- Automatic Retransmission request (ARQ), which is a fast retransmission protocol at layer 2 that allows the MAC to recover burst errors and thus to improve user throughput and overall system capacity.
- Parameters such as modulation, FEC encoding, burst size, retransmission policy and transmit power.
- Quality of Service (QOS).
- Radio Control.

The PHY level features include:

- Software selectable channel bandwidths, depending on the frequency band
- Modulation and encoding, which are optimized and selected on a burst by burst basis.
- Transmission and Reception of Intermediate Frequency (IF) signals to support BSR.

Each WSC has a wireless interface port that connects via a coax cable to the outdoor-mounted BSR. The WSC uses a 70 MHz IF signal to transport traffic control signals and power to the base station radio. The WSC card interfaces are labelled in Figure 2-4.

WSC cards are hot swappable, and can be replaced or added without having to shutdown the PM 5000 Base Station or disrupt traffic passing through other WSC cards.

2.3.1 Major Differences Between WSC-S-24 and WSC-48

Table 2-D lists the major differences between the WSC-S-24 and the WSC-48 which installs in a QWC.Figure 2-4 and Figure 2-5 illustrates the WSC-S-24 and WSC-48 respectively.

Table 2-D Major Differences between WSC-S-24 and WSC-48's

WSC-S-24	WSC-48
Occupies an entire ATCA slot	Installs in a QWC
Outputs 24 Volts DC	Outputs 48 Volts DC
Supports 20 dBm Base Station radios	Supports 20 and 30 dBm Base station radios

2.3.2 One Port WSC-S-24

The one port WSC as in 4 sector BS.

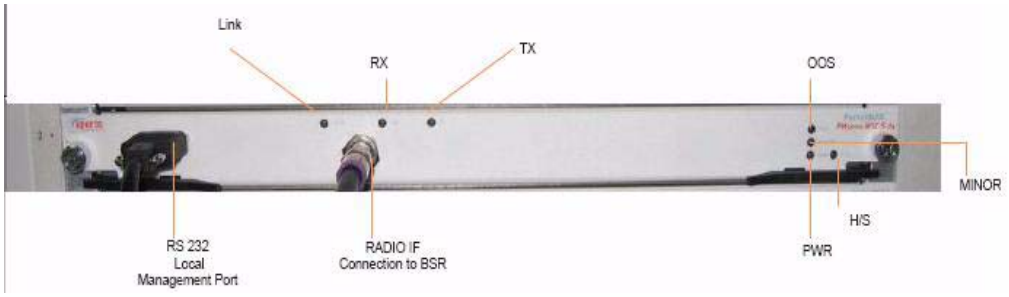


Figure 2-4 PacketMax Interface of WSC Card (WSC-24)

Table 2-E WSC-S-24 faceplate features

Function	Description
Main Management	
RS-232	Serial Management Port/ port used to connect to host computers. This is for Internal use only.

Table 2-E WSC-S-24 faceplate features

Function	Description
Radio IF	
Radio IF Port	Establishes connection to the Base Station Radio.
LEDs	
RX	Indicates the base station is receiving traffic from the BSR, when the green LED blinks.
TX	Indicates the base station is transmitting traffic to the BSR, if the green blinks.
Link	Indicates Link is established, when the green LED lights up.
OOS LED	The Out-of-Service (OOS) LED is used for two purposes. First, it indicates there is a critical problem with the WSC Card such that it is not operational. Second, it is also used to indicate the final step in the Hot Swap Card Removal Procedure. ON: 1) Indicates completion of the third and final step in the Hot Swap Card Removal Procedure and that it is now safe to remove the WSC card from the PM5000 chassis. 2) Indicates that the WSC card is not operational due to a problem OFF: Unit is operational (when PWD Led is ON)
Minor LED	Indicates that the WSC card is operational but a problem has been detected. ON: Indicates that the WSC card is operational but a problem has been detected.The WSC card will send an SNMP Alarm indicating what problem was detected. OFF: Indicates that the WSC card is operational and is functioning correctly
Pwr LED	Indicates that WSC has detected power (sufficient to operate the device) ON BLINKING:Power is detected OFF: Power is not detected
H/S LED	Used to indicate steps in the Hot Swap Card Removal Procedure ON:Indicates completion of first step in Hot Swap Card Removal Procedure OFF: Unit is operational (when PWD Led is ON)

2.3.3 QUAD Wireless Controller (QWC) Card - WSC-48

The Packet Max 5000 base station groups up to 4 wireless ports (WSC) in to a Quad Wireless controller that fits in to the ATCA base station chassis. Figure 2-5 shows a WSC-48.

Figure 2-5 PacketMax Interface of WSC-48

The QWC:

- Provides fault tolerant connectivity to the ATCA base station
- Provides power to the WSC ports and connected Base Station Radios
- Implements functions such as shelf manager

Table 2-F WSC-48 Faceplate Features

Function	Description
Main Management	
RS-232	Serial Management Port/ port used to connect to host computers. This is for Internal use only.
Radio IF	
Radio IF Port	Establishes connection to the Base Station Radio.
LEDs on card	
RX	ON:Indicates the base station is receiving traffic from the BSR, when the green LED blinks. OFF:Indicates the base station is not receiving traffic.
TX	ON:Indicates the base station is transmitting traffic to the BSR, if the green blinks. OFF:Indicates the base station is not transmitting traffic.

Table 2-F WSC-48 Faceplate Features

Function	Description
Link	ON:Indicates Link is established, when the green LED lights up. OFF:Indicates Link to ODU is not established.
OOS LED	The Out-of-Service (OOS) LED is used for two purposes. First, it indicates there is a critical problem with the WSC Card such that it is not operational. Second, it is also used to indicate the final step in the Hot Swap Card Removal Procedure. ON: 1) Indicates completion of the third and final step in the Hot Swap Card Removal Procedure and that it is now safe to remove the WSC card from the PM5000 chassis. 2) Indicates that the WSC card is not operational due to a problem OFF: Unit is operational (when PWD Led is ON)
Minor LED	Indicates that the WSC card is operational but a problem has been detected. ON: Indicates that the WSC card is operational but a problem has been detected. The WSC card will send an SNMP Alarm indicating what problem was detected. OFF: Indicates that the WSC card is operational and is functioning correctly
Pwr LED	Indicates that WSC has detected power (sufficient to operate the device) ON BLINKING:Power is detected OFF: Power is not detected
H/S LED	Used to indicate steps in the Hot Swap Card Removal Procedure ON: Indicates completion of first step in Hot Swap Card Removal Procedure OFF: Unit is operational (when PWD Led is ON)

2.3.4 Compatibility matrix with radio

The PM5000 WSC cards perform a check and validate that its BSR is compatible with that card (both in terms of voltage compatibility as well as power consumption). Table 2-G shows the compatibility matrix.

WARNING: You cannot have a WSC-48 card drive a 24 V radio.

Table 2-G WSC card and Radio compatibility

WSC Card	Compatible Radios
WSC-S-24	PM-BSR-35, PM-BSR-35X, PM-BSR-35X-48, PM-BSR-33, PM-BSR-33X, and PM-BSR-58
WSC-48	PM-BSR-35, PM-BSR-35X-48, PM-BSR-33, and PM-BSR-58

2.4 Main System Controller Card

The MSC serves as the brain of the PM 5000. It performs networking functions like Bridging, VLAN, VLAN Tagging (double) and Routing (Future). Remote network management and configuration is possible through dedicated management port (for remote out-of-band management) or via the Backhaul port for in-band-management. Local management is possible through a serial port. Its advanced processors deliver superior packet processing performance for critical functions like QoS classification, packet forwarding, and filtering. It also aggregates the traffic of up to 12 wireless sectors into a high-speed Gigabit Copper of Fiber Backhaul interface. The MSC card synchronizes all internal wireless sectors enabling efficient collocation and frequency reuse when multiple radios are installed in the chassis. External clock input/output ports enable the MSC card to synchronize either with other PacketMAX Base Stations installed at the same location or with a external clock source like a GPS receiver. Thus, the MSC monitors, controls, and assures proper operations of the modular base station chassis.

The Networking functions include:

- Management
- Backhaul and data aggregation
- Synchronization

The Shelf Management System (SMS) functions include:

- Watches over the basic health of the system, reports anomalies, and takes corrective action when needed.
- Retrieve inventory information and sensor readings as well as receives event reports and failure notifications from modules in the system.
- Perform basic recovery operations such as power cycle or reset each module in the system.
- Manage system power and cooling. The management entity on each intelligent Field Replaceable Unit (FRU) negotiate power usage needs with the SMS before it can be fully powered.

- Manage interconnect resources of the shelf. Boards must report their backplane interconnect types to SMS before the interconnects can be enabled.

The SMS is comprised of following major components:

- Distributed management controllers that manage and monitor the operation and health of each FRU in the system.
- An Intelligent Platform Management Interface (IPMI) infrastructure that provides communications, management, and control among the distributed controllers and to an overall system manage.
- A high-level, high-speed services for boards that need TCP/IP based management services such as remote booting, SNMP management, and other IP based services.

Table 2-H covers the faceplate features and Figure 2-6 shows the MSC card.

Figure 2-6 PacketMax Interface of MSC card

Table 2-H MSC Faceplate Features

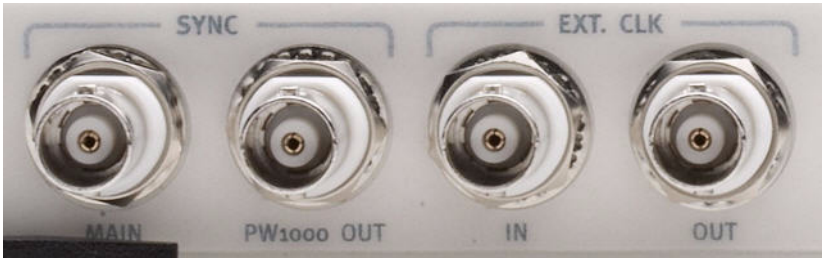
Feature	Function
Main Management	
	
RS-232 (Micro D-9 Serial Port)	Port used to connect to host computers. Configure this connection to support: 38400, no parity, 8 data bits, 1 stop bit, no flow control.
10/100/Base-T	Used for connectivity to network. Connection to Element Management System (EMS)
Sync*	
	

Table 2-H MSC Faceplate Features

Feature	Function
Main	Used for multiple BS synchronization and GPS synchronization. This shows the main BS.
PW 1000	Connection for PW 1000.
EXT-CLK (In and Out)	Connects the external 10MHz reference source for PacketMax signalling.
* Sync and EXT-CLK Interfaces are not currently supported.	
	Synchronization LEDs 
MASTER LED	Indicates redundancy mode of the MSC Card. ON: Indicates MSC is operating in Slave Mode OFF: Indicates MSC is operating in Master Mode When there is just one MSC installed in the system, the MSC card will always be in Master Mode.
SYNC LED	Indicates the synchronization mode of the MSC Card. OFF: Indicates No Power ON: Indicates MSC Card is operating in Sync Master Mode. ON BLINKING: Indicates MSC Card is operating in Sync Slave Mode. ❖ When in Sync Master Mode, the MSC Card is using its internal clock for SYNC and 10 MHz for frame synchronization. ❖ When in Sync Slave Mode, the MSC Card is using an external SYNC and 10 MHz clock signals that are connected to its BNC Input SYNC ports. ❖ When the MSC card is either Sync Master or Sync Slave Mode, the MSC card will always output a SYNC and 10 MHz signal.

Table 2-H MSC Faceplate Features

Feature	Function
EXT. CLK LED	Indicates whether or not a 10 MHz External Clock signal is detected on the MSC Card's EXT. CLK BNC Input Port. ON: A 10 MHz External Clock Signal is detected OFF: A 10 MHz External Clock Signal is NOT detected
Backhaul	
1000 Base-T	Connected to corporate network/routers/switches
100 Base-T	Connected to corporate network/routers/switches
Shelf Manager	
RS 232	Not used.
TELCO	Dry Relay Alarm Port. NOTE: Please Refer to ***Appendix B*** for details.
OOS LED	The Out-of-Service (OOS) LED is used for two purposes. First, it indicates there is a critical problem with the MSC Card such that it is not operational. Second, it is also used to indicate the final step in the Hot Swap Card Removal Procedure. ON: 1) Indicates completion of the third and final step in the Hot Swap Card Removal Procedure and that it is now safe to remove the MSC card from the PM5000 chassis. 2) Indicates that the MSC card is not operational due to a problem. OFF: Unit is operational (when PWR Led is ON)
MINOR LED	Indicates that the MSC card is operational but a problem has been detected. ON: Indicates that the MSC card is operational but a problem has been detected.The WSC card will send an SNMP Alarm indicating what problem was detected. OFF: Indicates that the MSC card is operational and is functioning correctly
PWR LED	Indicates that MSC has detected power (sufficient to operate the device) ON BLINKING:Power is detected OFF: Power is not detected
H/S LED	Same as in WSC faceplate feature in Table 2-F

2.5 MSC Redundancy

The MSC Redundancy feature prevents the MSC from becoming a single point of failure. This also reduces system downtime due to replacement of MSC cards. This feature requires that a second MSC card is installed in to the PM 5000 BS.

The configuration uses a secondary card of the same type to serve as a standby card and takes over if the active card fails. In this 1:1 redundant card configuration, one card operates in the active mode and a second card operates in standby mode, ready to provide services if an active card fails. To minimize switchover time and prevent service interruption, standby cards are dedicated to a single active card and cannot support additional cards. Standby cards do not support services until they transition to the active state. Figure 2-7 shows MSC Redundancy.

Figure 2-7 Redundant MSC

2.5.1 Redundancy support

MSC Redundancy support for PM 5000 is as follows:

- A Redundant system should have QWC with WSC-48. Single slot WSC-24 Redundancy is not supported
- The shelf manager version should greater than or Equal to 17 for MSC and QWC cards.
- The MSC, QWC and WSC should have the latest hardware revision.

EMS Configuration of MSC Redundancy

In EMS configuration of MSC redundancy, the actions as listed below can be configured during switch over process using the Server Configuration tool.

1. Reset: In this case, after switch over the active MSC will restart and connect as standby MSC
2. Shutdown: In this case, after switch over the active MSC will be shutdown.

2.6 AC Supply

The PM 5000 can accommodate either one or two (redundant) 1200 watt AC Power Supplies. Figure 2-8 shows the redundant power supply [AC 2]. The AC Power Supply

(P/N: PM 5000-ac-2001) can be accessed through the front panel by removing the Front Air Vent Cover. The PacketMax Rear Panel section covered in this chapter, discusses the AC interface.

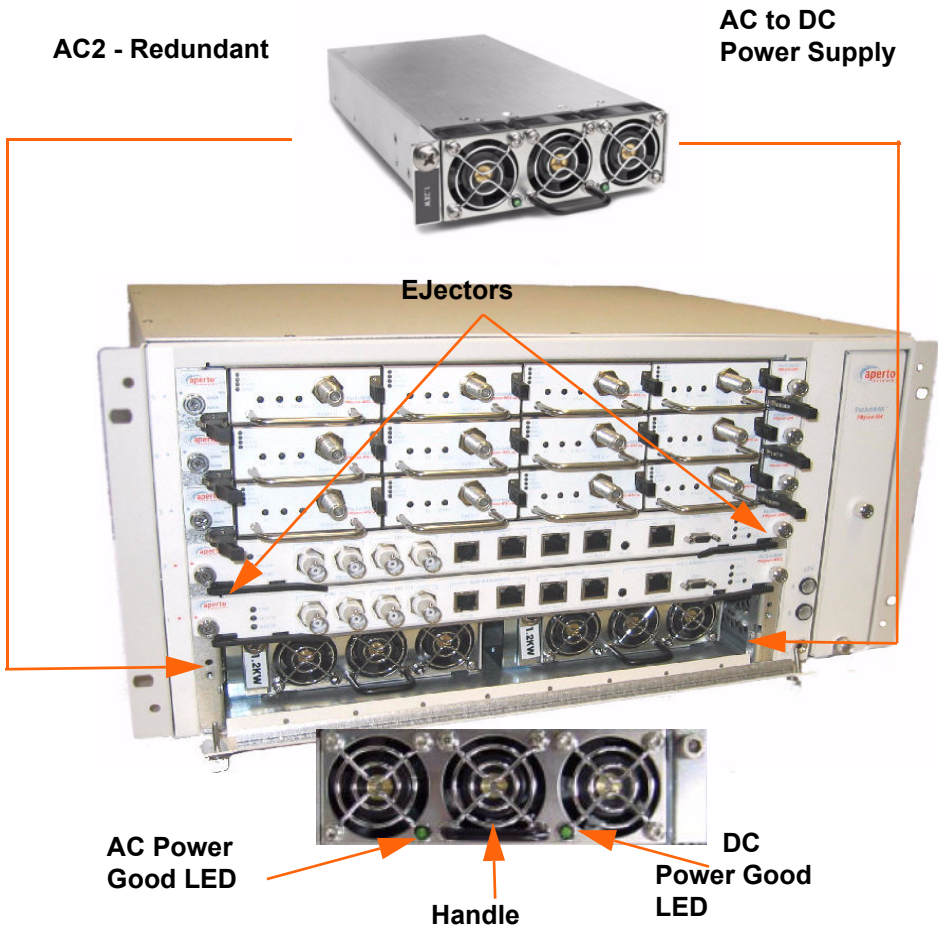


Figure 2-8 PM 5000 with two AC power supplies installed for redundancy

2.7 Power LEDs and ESD connector

When power supply A and B are turned on (indicates green) or off (not lit), the Power Supply LEDs as indicated in Figure 2-9 display the status of the power supplies.

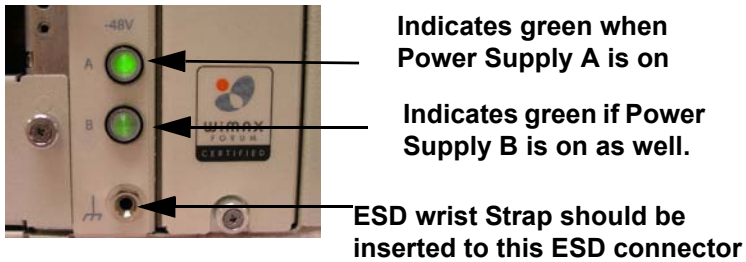


Figure 2-9 Front panel - Power Supply LEDs and the ESD Connector

While working with the PM 5000 base station, use of the ESD strap is highly recommended to prevent damage to equipment due to electro-static discharge.

2.8 Hot Swap

The MSC and WSC cards are hot-swappable. This implies that while the system is on, the cards can be swapped without disrupting the system or operation of other cards still installed and active in the chassis.

This multi-step procedure is designed to prevent against accidental enabling of the Hot Swap function through normal handling of the system.

NOTE: Before you eject and handle and PM5000 card, please be sure to put on a anti-static wrist strap and attach it to one of the ESD connectors on the PM5000 (See Figure 2-9). Doing this will help prevent accidental ESD damage to the card.

Sequence of LEDs

1: H/S LED

2. Blinking H/S LED

3. OSS LED

2.8.1 WSC-48 Hot Swap

To remove the **WSC-48** cards safely for **hot swap**, follow the instructions below:

1. When the blue H/S LED is on, push the ejector arm (pointed outward) located on each card (shown in Figure 2-10).
2. Hold and pull (outwards) the handle provided on each WSC-S-48 card.
3. Remove the card for Hot Swap.

To remove the **MSC** cards safely for **hot swap**, follow the instructions below:

1. Push in BOTH ejector arms located at each end of the card (shown in Figure 2-10) and hold them until the blue H/S LED light turns ON.
2. As soon as the LED light turns ON, gently pull back on both ejectors (but not all they way back such that the card gets ejected) and wait until the blue H/S LED light blinks. A blinking H/S LED signifies successful completion of the prior steps.

   If you wait too long to pull out both ejector arms, the cycle will abort and you will have to repeat this step from the beginning.
3. Push in and hold BOTH ejector arms on until the red OSS LED turns ON. At this time, the card is ready to be safely removed from the PM5000 chassis. Remove the card by pulling BOTH of the ejectors all the way out causing the card to be removed from the system.

NOTE: If you loose the sequence at any time, repeat again from Step 1.

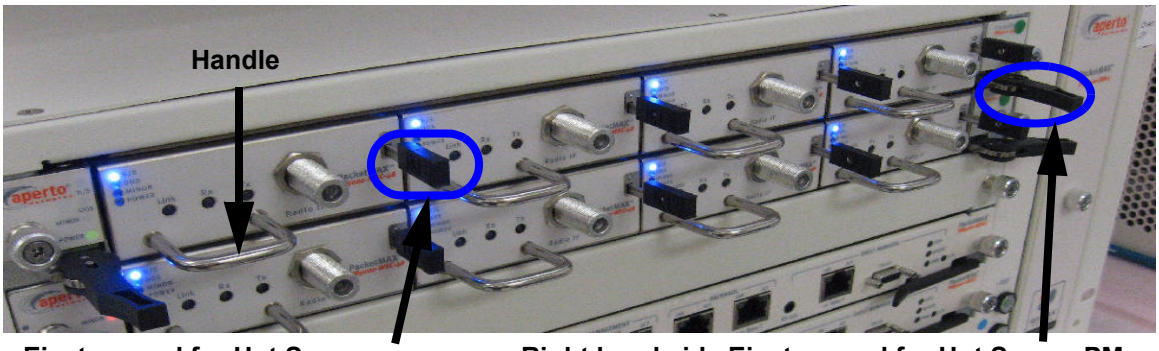


Figure 2-10 Ejector for hot swapping WSC Card

2.8.2 WSC-S-24 Hot Swap

To remove the **WSC-S-24** cards safely for **hot swap**, follow the instructions below:

1. Push in the right hand side ejector arm (vertically) located at end of the card (shown in Figure 2-10) and hold them until the blue H/S LED light turns ON.
2. As soon as the LED light turns ON, let go off the ejector and pull the ejector arm lightly outward.
3. Wait for about 2-3 seconds till the blue H/S LED blinks. Push the ejector (vertically) once again and wait until the red OSS LED turns ON.

   If you push on the ejector too soon and the Red OOS LED does not turn on, the cycle will abort and you will have to repeat the cycle starting from the beginning.
4. At this time, the card is ready to be safely removed from the PM5000 chassis. To remove the card, point the BOTH of the ejectors at each end of the card

towards you and then bend them (horizontally) outwards. This will eject the card.

NOTE: If you loose the sequence at any time, repeat again from Step 1.

2.8.3 MSC Hot Swap

To remove the MSC cards safely for **hot swap**, follow the instructions below:

1. Push in BOTH ejector arms located at each end of the card (shown in Figure 2-6) and hold them until the blue H/S LED light turns ON.
2. As soon as the LED light turns ON, gently pull back on both ejectors (but not all they way back such that the card gets ejected) and wait until the blue H/S LED light blinks. A blinking H/S LED signifies successful completion of the prior steps.

   If you wait too long to pull out both ejector arms, the cycle will abort and you will have to repeat this step from the beginning.
3. Push in and hold BOTH ejector arms on until the red OSS LED turns ON. At this time, the card is ready to be safely removed from the PM5000 chassis. Remove the card by pulling BOTH of the ejectors all the way out causing the card to be removed from the system.

NOTE: If you loose the sequence at any time, repeat again from Step 1.

2.9 Maintaining Proper Chassis Air FLow

Figure 2-11 Front Panel installed in PM 5000 chassis

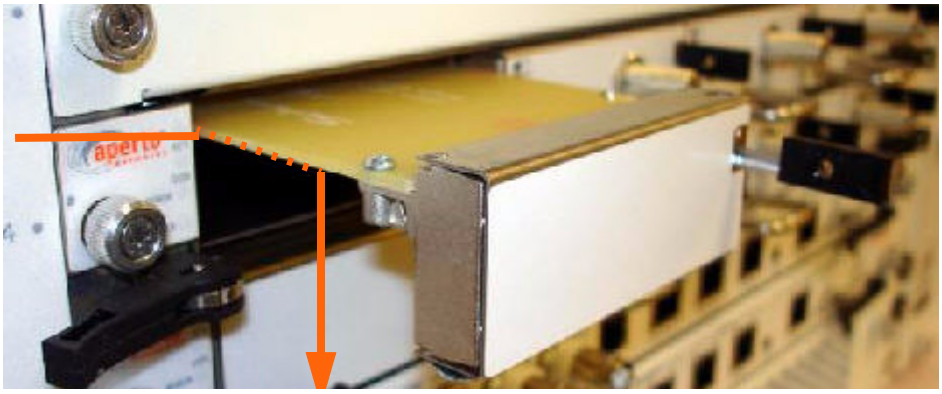


Figure 2-12 Front Panel installed as QWC card

To maintain proper air flow within the chassis and to comply with Electro Magnetic Interference (EMI) regulations, front panels must be installed on all empty slots. Hence, PM5000 slots that have no cards installed, need a front panel (P/N: PM 5000-FRONT PANEL) to be inserted. Each panel has a air baffle on the right hand side. This air baffle ensures that air flow from the fan units blow only over the inserted cards. It is critical to have front panels inserted into every “open” slot. Figure 2-11 shows the picture of en empty card inserted in to a base station slot in a PM 5000 four sector BS, while Figure 2-12 shows the 12 sector BS.

2.10 Fan Unit

The PM 5000 uses a hot-swappable modular fan-unit, (P/N: PM5000-FAN-1) that can be replaced while the system is running.

To replace a new fan, unscrew the screw below and pull out the fan. Replace the fan and shut the slot followed by tightening the screw. Figure 2-13 shows an open fan.

Figure 2-13 Fan - PM 5000

NOTE: You do not need to replace filter plate with other filter plate.

2.11 Serial Cable Pinout

The BS supports a direct serial RS 232 port for connection to a PC, and for local management configuration, and troubleshooting using a command line interface (CLI). The port employs a DB-9 female connector and operates with the following parameters: 38.4K baud, 8 bits, 1 stop bit, no parity.

To access the CLI through the serial port:

1. Ensure that your computer's serial port is configured for 38.4K baud, 8 bits, 1 stop bit, no parity, and no flow control.
2. Using the serial cable included with the PM 5000 system (See Figure 2-14), connect the cable to the DB9 serial port on your computer and to the RS 232 RJ11 Jack on the PM 5000 system.

Operation of the CLI, which can also be accessed from the Ethernet port using Telnet, is discussed in Appendix C of this manual. Please refer to *PacketMax CLI Reference Manual* for further information on CLIs.

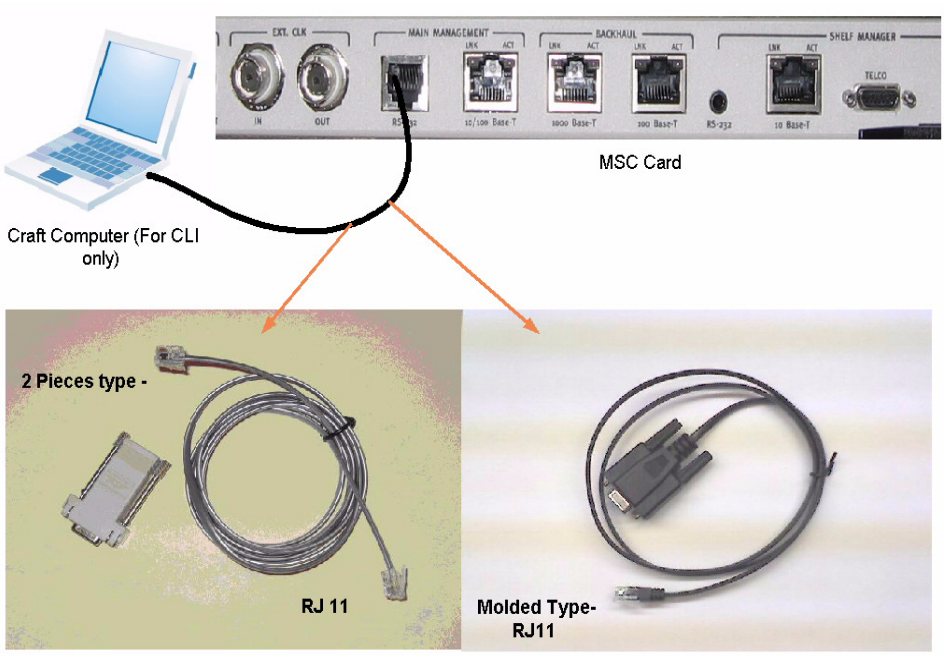


Figure 2-14 Connecting to the RS-232 Craft Port

NOTE: This serial cable PA-CABLE SERIAL-RJ11-DB9 is provided by Aperto.

The Assembly Instruction for Serial Cable, RJ11 to DB9 (Female) is as follows.

The Serial Connection is made with an RJ11 to DB9 connector (also referred to as a dongle). To establish connection:

1. Connect the RJ11 to the Base Station

2. Connect the serial DB9 end to the PC. This connection will assist in aligning the antenna and issuing CLI commands.

2.11.1 Serial Connection Instructions

Table 2-I shows the pinout of the serial connection needed to build a serial cable.

Table 2-I Serial Cable Connector Pinouts

DB9 (Female) Connector on computer	RJ11 (Male) Connector on the MSC card
1	--
2	3
3	2
4	--
5	5
6	--
7	--
8	--
9	--

Figure 2-15 shows a DB 9 and RJ11 Cable Pin-out.

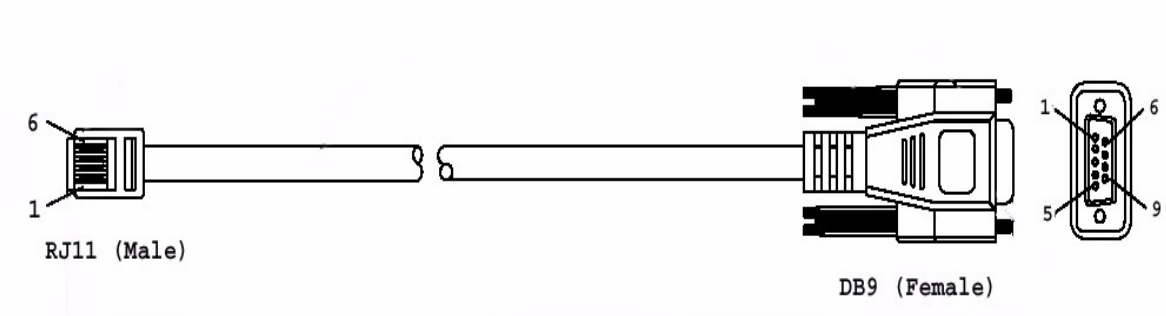


Figure 2-15 DB 9 (Female) and RJ 11 (Male) pinout

2.12 PacketMax 5000 Rear Panel

Depending on the user's needs, the BS could contain two hot-swappable, redundant, and load-sharing power supplies. One power supply will take over the entire load if the other one fails. The failed power supply can be removed and a new one installed while the BS is operating.

2.12.1 Grounding

WARNING: It is critical that users must properly ground their PM 5000 base station. Not grounding the PM 5000 BS can cause damage to the PM 5000 or other equipment that may be attached to it.

The BS rear panel contains a ground lug that is used to connect the system to ground.

Aperto recommends that a standard copper insulated wire that is at least 12 gauge or less be used to ground the PM 5000 chassis.

To properly ground the PM5000 chassis:

1. Use a grounding lug provided in the back of the system.
2. Crimp the copper grounding cable to the base station grounding lug and earth ground the other side of the cable.

2.12.2 DC Power Connection

A DC-powered PacketMAX 5000 includes two redundant 3-pin terminal blocks on the rear panel. These terminals are labeled **-**, **+**, and **GND**. DC Power is provided externally to the base station if DC chassis is being used; and there is no power supply provided in the chassis.

To apply power to the PacketMAX 5000, screw in securely and connect the 3 leads from a -48 V DC source that can supply up to 25 Amps to the terminals using 12 AWG or heavier solid copper wire. For cable lengths greater 10m (30ft) use 10AWG or heavier solid copper wire.

Since there is a on-off switch; disconnecting the power leads is the standard way to remove power from the Base Station Unit.

NOTE: Please be sure to verify, using a volt meter, the polarity of the DC Voltages. Not doing this could result in damage to the system.

NOTE: If you are using DC power to the BS, both power connectors on the back of the BS have to be connected to power outlets for the power supply to be redundant. The chassis has two redundant power backplanes and each of the two DC connectors on the back of he chassis is connected to one backplane.

Figure 2-16 shows the AC input in PacketMax 5000.

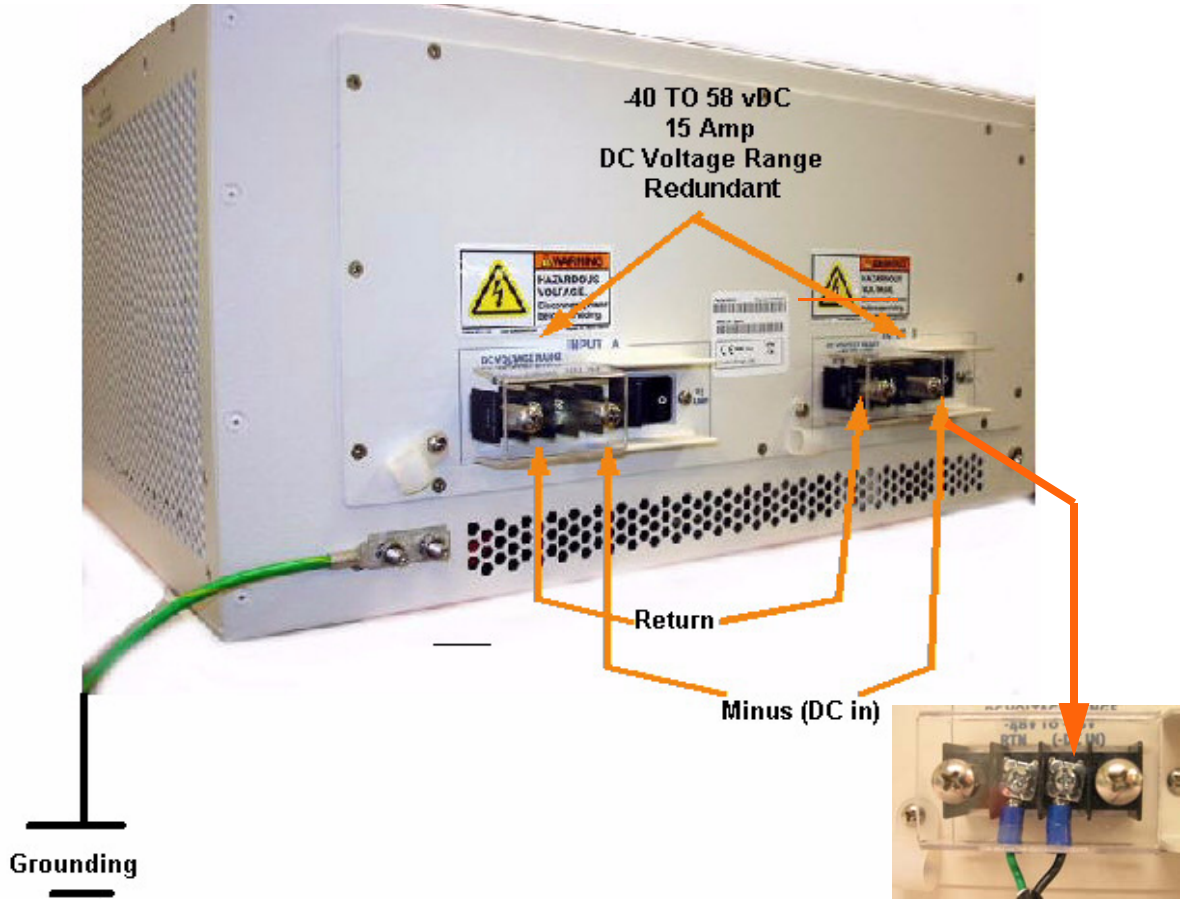


Figure 2-16 DC input- Rear of the PM 5000

2.13 AC Power Connection

The AC power connection on the rear panel of the PacketMax 5000 is a three-prong standard port for AC power that accommodates a standard IEC 320 plug. This port also contains an On/Off switch. Figure 2-17 shows the AC input in PacketMax 5000.

If two AC power supplies are in use, only then the users can have power redundancy. In the case that one AC chassis is in use, at least one AC power supply is required.

NOTE: If you are using DC power to the BS, both power connectors on the back of the BS have to be connected to power outlets for the power supply to be redundant. The chassis has two redundant power backplanes and each of the two DC connectors on the back of he chassis is connected to one backplane.

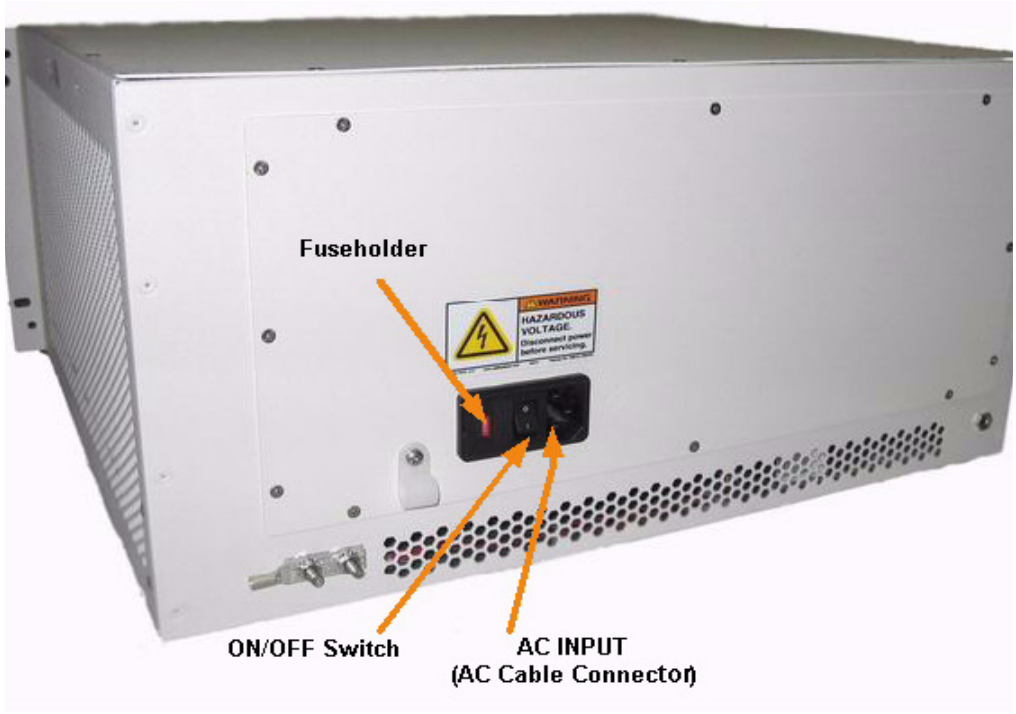


Figure 2-17 AC input- Rear of the PM 5000

2.13.1 Fuse

The AC power supply is protected by a fuse in a holder located next to the power connector on the rear panel of the Base Station. The fuse is a 10 A, 250 V time-lag high-breaking fuse, 5 x 20 mm (Bussmann S505-10A). Replacement fused can be ordered from Aperto parts.

Should this fuse blow, determine and correct the cause (if possible). Then replace the fuse as follows:

1. Disconnect the BS's AC power cord.
2. Remove the fuse holder.
3. Remove the fuse from the clips that hold it, and verify that the fuse has blown.
4. Place a new fuse in the clips.
5. Snap the fuse holder into the opening in the rear panel.
6. Reconnect the Base Station Unit's power cord.

2.14 Base Station Radio

The BSR consists of a RF transceiver (available in a variety of frequency bands) that connects to a base station antenna (120 degree, 60 degree, 90 degree, or omnidirectional) through a single coaxial cable, up to a maximum of 200 m (600 ft).

The BSR interfaces to the IF card of the WSS via a RG-6 cable. The input to the BSR is a composite signal and comprises DC power, 20 MHz reference signal, 70 MHz (IF) modulated signal, and the telemetry signals. The telemetry signals are used for communication between BSR and WSS for controlling the RF parameters and also for reporting radio status.

NOTE: A 1 m cable would have a loss of 0.5 dB. For more details on cable losses, please refer to the Maximum Allowable Cable Loss for IF Cable section.

See Chapter 3,"Installing Radios and Antennas" for information and details on installing the Base Station Radio.

Figure 2-18 Base Station Radio

3

Installing the Base Station IDU

This chapter outlines the basic procedure for installing a PacketMax 5000 wireless cell system and putting it into operation. It identifies the minimal requirements for getting the system up and running.

WARNING: Aperto assumes that installation procedures will be performed by qualified professionals following all safety and other requirements and acting in accordance with standard practices and procedures. Failure to meet safety requirements and/or use of non-standard practices and procedures could result in personal injury and/or damage to equipment.

All of the instructions presented in this chapter are discussed in more detail in subsequent chapters of this manual and in the *PacketMax Subscriber Equipment Installation and Operation* manuals.

This chapter contains the following topics:

- *Planning, Site Preparation, and Installation*
- *Installation Procedure*
- *Synchronizing Multiple BSs at a Site*

3.1 Planning, Site Preparation, and Installation

Before you begin installing the PacketMax equipment, make sure you properly plan the overall system and individual sites.

Table 3-A shows a list of the tool kit that Aperto recommends.

Table 3-A Tool Kit

Description	Manufacturer	Manufacturer Part Number
Blue Nylon Tool Case, 18 Inches	Ideal	35-418
Crimp Tool for LMR300/400 connectors	Times Micro-wave	CT-300/400
3190-406 DEBURRING TOOL FOR LMR400/500/600	Times Micro-wave	DBT-01
Cable Preparation Tool for LMR-400 attachment of CRIMP-style connectors.	Times Micro-wave	ST-400EZ
Plastic Pipe Scissors Cutter, Capacity 1 1/4 Inches, Replaceable Stainless Steel Folding Cutting Blade	Rigid	BK125S
Type-F Male Connectors	Times Micro-wave	EZ-400-FM-75
Philips #2 Screw Driver, 6 " long with handle	Any	Any
Ideal 62-202 MiniTracker Coax Tester	Ideal Indus-tries	62-202
Tie Wraps, 11 Inches Long, Nylon, Black,UV Protective	Vision Plastics	11-75-UV-100
Tubing, Cold Shrink, .31" to .56" Diameter	3M	8423-6
Tool, Crimpers, Cutters, All Purpose	Klein Tools	1002
Wire, Hook-Up, 10AWG, Green/Yellow	Manhattan Wire Product	M218-54

Step 1. Determine and Prepare Locations

A. Make sure the base station is located such that it can communicate with subscribers.

- Cell sector width may be 60º, 90º, or 120º depending on the antenna chosen.
- Distance between base station and subscriber site depends on the frequency band, line-of-sight, and local conditions. Consult Aperto Networks Customer Service for more details.

B. Make sure that the base station site includes a proper mounting structure for the radios and antennas, an indoor location for the Base Station Unit and a good path to run coax cable to connect the BSU to the BSR. Aperto Networks' Customer Service can provide training and assistance if needed.

C. Make sure all subscriber sites have an appropriate radio/antenna support or mounting location.

WARNING: Each Base Station is required to have lightning protection. Instructions and specific example of lightning protection equipment is contained in the Surge Protection document. This document is included in the CD that shipped with the equipment. If it is missing, please contact Customer Service. Failure to follow the instructions will void your equipment warranty. Your equipment warranty does not cover damage caused by lightning surge, or other environmental stress.

3.2 Installation Procedure

A. Inspect Package Contents, as displayed in *Figure 3-1*.

Figure 3-1 Package Contents

Table 3-B Parts List and Part Numbers

Parts	Part Numbers	Description
a	10007456	Serial Cable
b	10002537	Nut Retainer (U-Style)
c	PM BSU-CD-ROM	PacketMax Software and Documentation CD-ROM
d	10004194	Screw Cover (plastic)
e	10002438	1/4-20x0.75 in long Truss Head Screw

B. Mount the base station on a 19” rack, with the screws included with the base station. *Figure 3-2* shows mounting of base station with the screws.

i. Attach Rack Mount Brackets to side at each PM 5000 IDU.

ii. Pass the 4X1/4-20 TRUSS HEAD SCREW through the 4xNUT RETAINER.

iii. Mount the PM 5000 IDU on to the rack by securing the screw on to the rack.

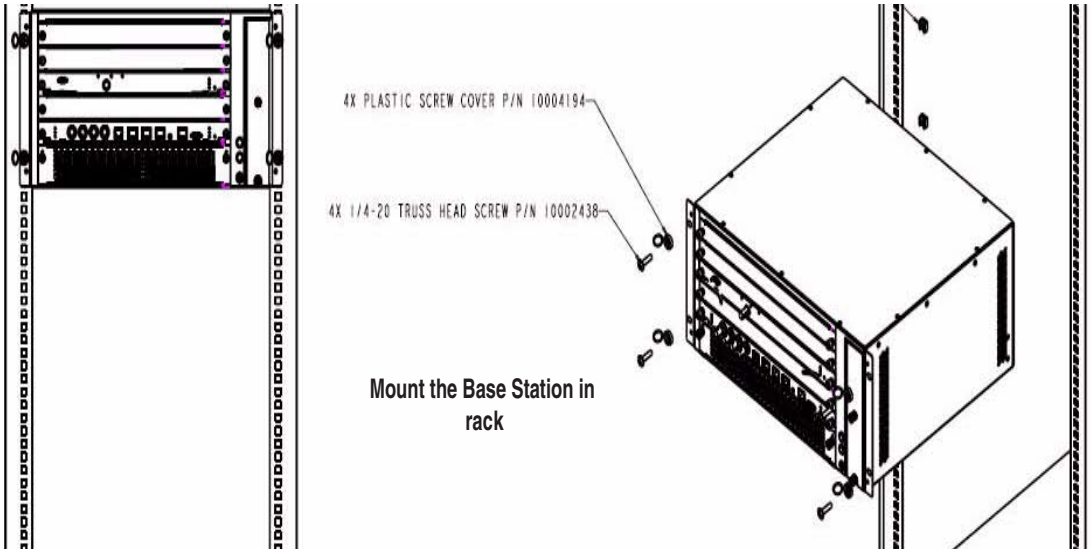


Figure 3-2 Mounting Base Station -PM 5000

C. Ground the Base Station

i. Using the ground lug located in the lower left side of the back panel (See *Figure 3-3*), ground the base station using either a 10 or 12 Gauge standard insulated copper wire.

ii. Be sure to observer all grounding and lightning requirement as described in Chapter 4.

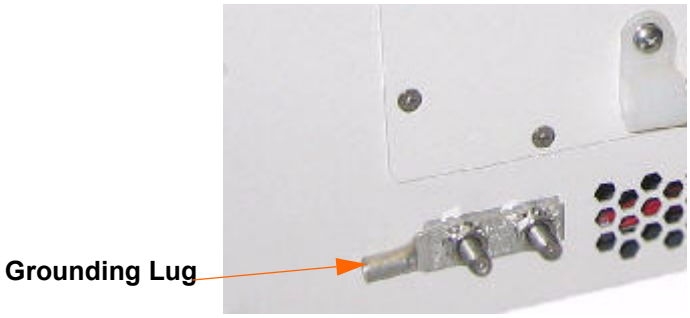


Figure 3-3 Ground lug on the Base Station

Step 2. Installing cards in the PM 5000 chassis

A. Mount the chassis using the mounting brackets supplied, or other brackets as required by the support structure, allowing for adequate air flow around and through the unit (See *Figure 3-2*).

B. Ensure proper Air Flow. There should be atleast 5” of unobstructed air clearance on each of the base station.

C. Before handling and installing the MSC and WSC cards, be sure to ground yourself by attaching a ESD strap to your wrist and connecting it to one of the ESD connectors (See *Figure 3-4*).

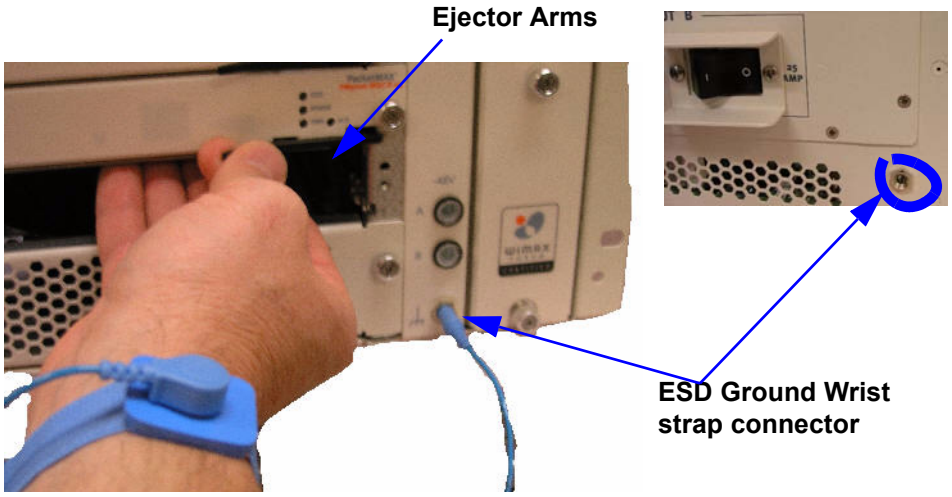


Figure 3-4 Ground Strap Connector- Front and Rear Panel

D. Install WSC cards in to the slots 2, 3, 4 or 5 of the PM 5000 chassis. *Figure 3-6* shows 3 WSC card and 2 MSC cards.

E. Similarly, each **WSC-S-24** has two ejector arms (See *Figure 3-6*) located on each side of the card, that are used to install an eject the card from the PM 5000 chassis. Insert the card in to one of its designated slots (*Figure 3-6*). Align the ejector arms so that they grip the inner tip of the chassis. Then, push the card in to the

slot, using the ejector arm to lock the card in to position. A Phillips screw driver can be used to further secure the card if required.

F. Install **MSC** (has two ejector arms as well) cards in to slot 1 and 2. *Figure 3-6* shows insertion of the MSC card.

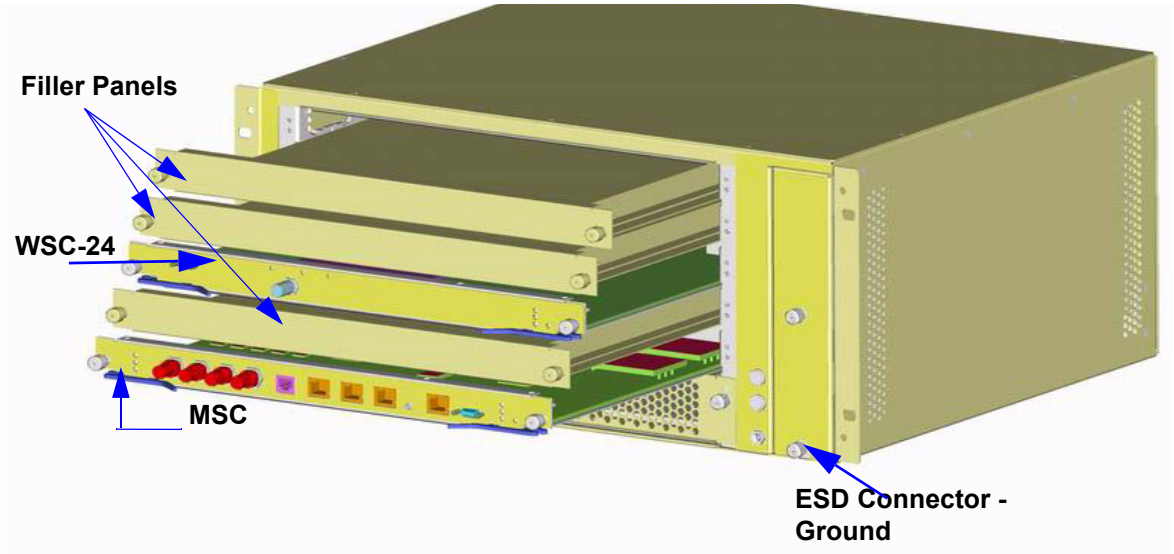


Figure 3-5 Insterting WSC, MSC and filler panels in to PM 5000 - 4 sector

Figure 3-6 Insterting WSC, MSC and filler panels in to PM 5000 - 12 sector

Step 3. Connect cables to the WSC and MSC card.

A. On any of the WSC cards (WSC-48 shown in the picture below) in QWAD, connect one end of the outdoor coax cable (IF port cable) to the WSC card (See *Figure 3-7*) and the other end to the base station radio (As demonstrated in Section 4.3 in Chapter 4).

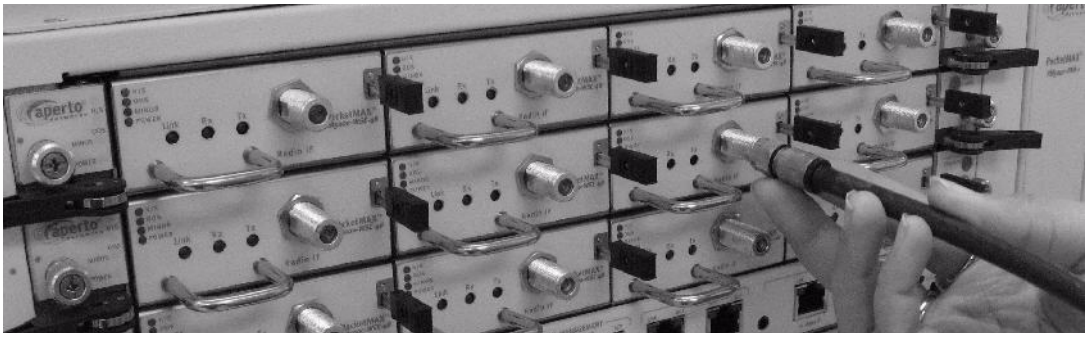


Figure 3-7 Connecting IF port cable

In a single sector WSC, connect one end of the IFport cable to the WSC card (See *Figure 3-8*) and the other end to a base station radio (As demonstrated in Section 5.3 in Chapter 5) .

Figure 3-8 Connecting IF port cable

B. On the MSC card,

i. For connection to Management port (RS 232 or 10/100 Base-T):

- Use one end of a RJ11 Connector with DB 9 Serial Cable and connect to the management port on the MSC card as seen in *Figure 3-9*. Connect the other end of the serial cable to the ethernet port on a computer or switch.

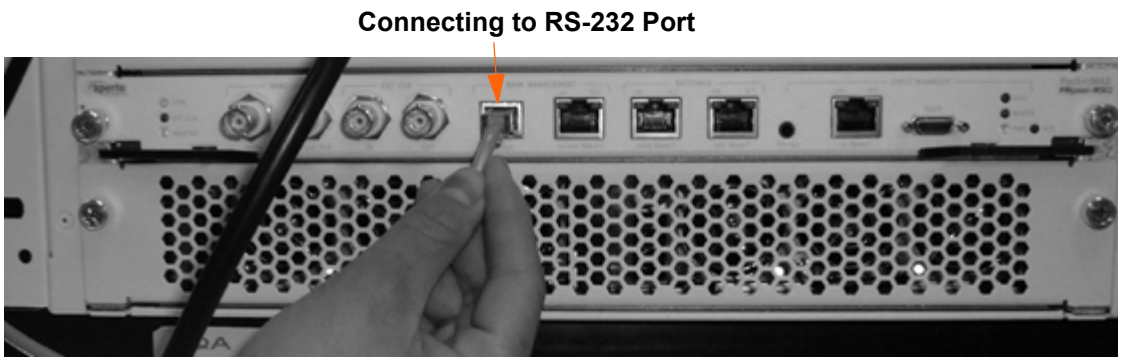


Figure 3-9 Connecting DB 9 serial cable to Management Port

ii. For connection to Backhaul port (1000 Base-T or 100 Base-T):

- Use one end of the Cat 5 Cable with RJ45 Connector and connect to the Backhaul port on the MSC card as seen in *Figure 3-10*. Connect the other end of the serial cable to the ethernet port on a computer or switch.

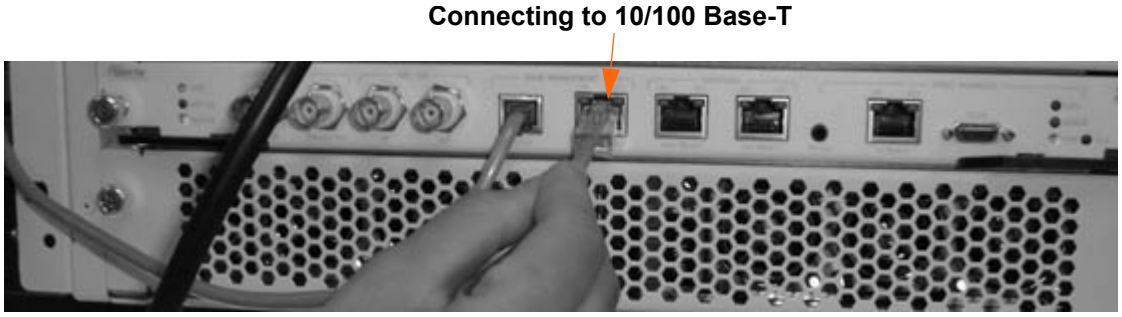


Figure 3-10 Connecting Cat 5 cable to the Backhaul port

Step 4. Install the Subscriber Station

Please refer to *PacketMax 100 User Manual* for further details on installation.

3.3 Synchronizing Multiple BSs at a Site

Time Division Multiple Access/Time Division Duplexing (TDMA/TDD) requires that all-frames of adjoining frequency channels at a given cell site be synchronized to prevent interference. When a set of base stations are synchronized together, they will all transmit at a time. Otherwise, additional frequency bandwidth must be provided between each frequency channel to avoid interference.

PacketMax Base Stations have the capability of synchronizing with each other by using and sharing the common reference signals: A 1Hz sync signal and a 10 MHz reference clock. This allows them to synchronize all of the adjoining frequencies, providing maximum efficiency of bandwidth utilization. The two clocks used for synchronization can be either externally generated (by a GPS receiver) or internally generated by the PM 5000 BS itself. Internally generated signals are available on the PM 5000s SYNC Output and 10 MHz Output BNC ports.

NOTE: For proper synchronization, the frame size and upstream/downstream frame parameters must be the same for all synchronized BSs.

The PM 5000 has four BNC connectors that are used to synchronize multiple base stations - two are used for Input Sync Signals (10 MHz and 1 PPS clocks) and two are for Output Sync Signals (10 MHz and 1 PPS clocks). The PM 5000 internally generates a 10 MHz clock and a PPS clock. If no clock sources are detected on its 10 MHz and Sync Input ports, the PM 5000 turns into SYNC MASTER mode, internally generates 10 MHz and 1 PPS clocks, and outputs them to its Sync Output ports. On the other hand, if external clocks are detected, the PM 5000 turns into SYNC SLAVE mode, using the external clocks to synchronize itself, and outputs them to its Sync Output ports. As the sync signal is always available on PM 5000's Sync Output ports, it is possible to daisy chain multiple PM 5000s together. Clock and Sync LED status is shown in *Table 3-3*.

Table 3-3 Sync and Clock LEDs

LEDs	Status
Ext. Clock LED	Off: No External clock detected, Internal Clock selected. On: Solid Green. External clock detected.
Sync LED	Off: N/A Solid Green: using internal source. Blinking: using external source. Solid Red: System Fault

To interconnect multiple Base Station Units:

1. Select one Base Station Unit as the main Sync Master.
2. Connect the **Sync Out** connector on the main Sync Master signal source to the **Sync In** of the Slave Base station units. Additional units connect from Slave Sync and Clock outputs.
3. Connect the **Clock Out** connector on the main Sync Master signal source to the **Clock In** of the Slave Base station units
4. Repeat steps 2 and 3, for all additional slave Base Station units.

A short coax cable (RG6 or LMR) with BNC connectors must be used to interconnect the base station radios. Note that two cables are needed for each base station connection. Although not required to co-locate multiple PM 5000 base stations, PM 5000

can support external clock resources, like those generated from a GPS receiver, that meet the requirements.

NOTE: A 1 m cable would have a loss of 0.5 dB. For more details on cable losses, please refer to the Maximum Allowable Cable Loss for IF Cable section.

4

Installing the Base Station ODU Radio and Antenna

The PacketMax base station antennas and radios are designed for mounting outdoors on common antenna masts, and include mounting brackets for such mounting. Different mounting hardware can be substituted as appropriate for your antenna support.

This chapter consists of the following topics:

- Radio Compatibility
- Installing the Antenna
- Installing the Base Station Radio ODU
- Grounding the PacketMax System

4.1 Radio Compatibility

Ensure that the radio selected is compatible with PM 5000. PM 5000 is only compatible with PM-BSR-33, PM-BSR-35, PM-BSR-58. It is not compatible with PM-BSR-33x or PM-BSR-35x. Use of PM 5000 with these radios can result in damage to the radio.

4.2 Installing the Antenna

Locate and install the antenna as close as possible to where you will mount the Base Station Radio.

Various antenna mounting systems can be used for the PacketMax System base station. Use one mounting system appropriate for your particular antenna, and follow the manufacturer's directions to install.

NOTE: If the antenna mounting system has a directional aspect (for example, a six-sided antenna mast), be sure to consider the physical sector locations when installing.

WARNING: Be sure that the antenna mounting system is appropriate for the weights and wind-resistance of all of the antennas and radios to be installed on it, and for local environmental conditions.

WARNING: Outdoor installation procedures should be performed by quality professionals following all safety and other requirements and acting in accordance with standard practices and procedures. Failure to meet safety requirements and/or non-standard practices and procedures could result in personal injury and/or damage to equipment.

4.3 Installing the Base Station Radio ODU

WARNING: Outdoor installation procedures should be performed by quality professionals following all safety and other requirements and acting in accordance with standard practices and procedures. Failure to meet safety requirements and/or non-standard practices and procedures could result in personal injury and/or damage to equipment.

4.3.1 3.3 and 3.5 GHz BSR Package Contents

The Base Station Radio (PM-BSR-33 and PM-BSR-35) includes the items shown and listed, in Figure 4-1.

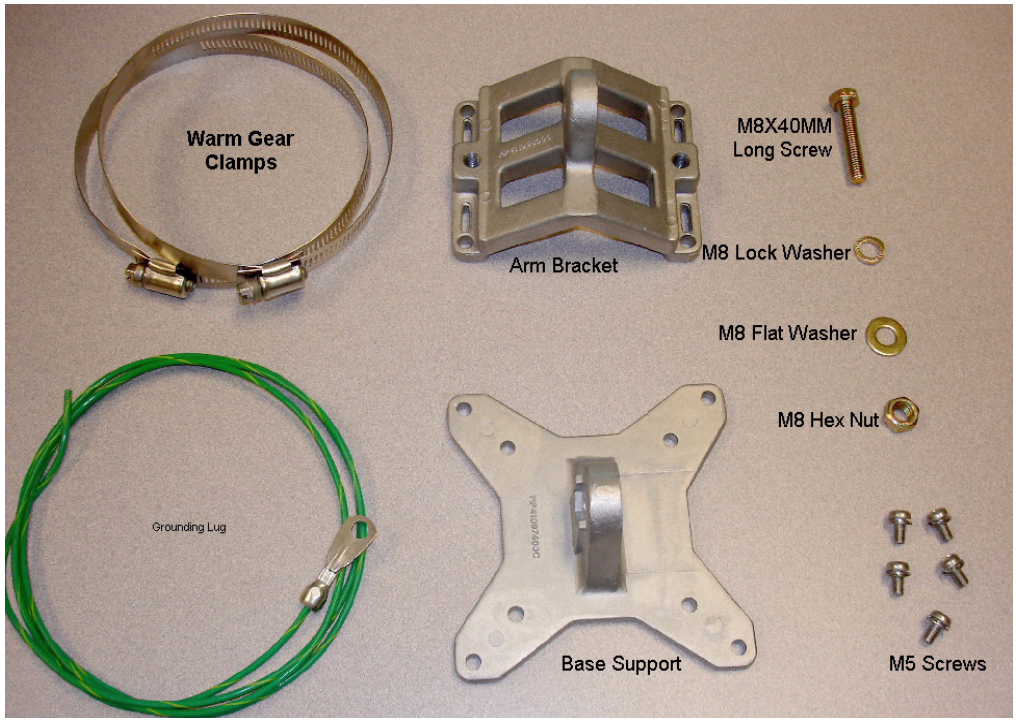


Figure 4-1 PM-BSR-33 and PM-BSR-35 Package Contents- Mounting Hardware

4.3.2 5.8 GHz BSR Package Contents

The 5.8 GHz base station radio package contains the items listed in the following figure:

Other Items needed to install the Base Station Radio are:

- IF Cable (outdoor rated high quality coax) with two type-F connectors
- Short RF Cable to connect BSR to the Antenna
- Grounding Cable (AWG 10 or 12, copper stranded, outdoor rated) and two Coax Surge Protectors (Aperto P/N: PA-SP-OUTDOOR-08 contains two surge protectors and two grounding wires).

4.3.3 Preparing and Mounting the 3.3 and 3.5 GHz BSR

Step 1. Attach Bracket and Grounding Wire to BSR

A. Attach the mounting bracket to BSR using the included screws.

B. Attach the grounding lug to the radio, as shown in Figure 4-2 (PM-BSR-33 and PM-BSR-35).

NOTE: The grounding lug does not exist on the BSR, the customer must install it.

C. Provide a proper grounding conductor (NEC Section 810-21) long enough to reach from the Outdoor Unit to the earth ground. Color of the insulator of Grounding conductor should be Green with Yellow strip. The size of the grounding wire should be AWG 10 or AWG 12.

D. Attach one end of the conductor to the lug on the radio.

E. Connect the other end of the grounding conductor to an appropriate earth ground using a grounding clamp.

NOTE: If you install a grounding electrode separate from the power service grounding electrode system, connect the separate electrode to the grounding system in accordance with the National Electrical Code (NEC) and local electrical codes.

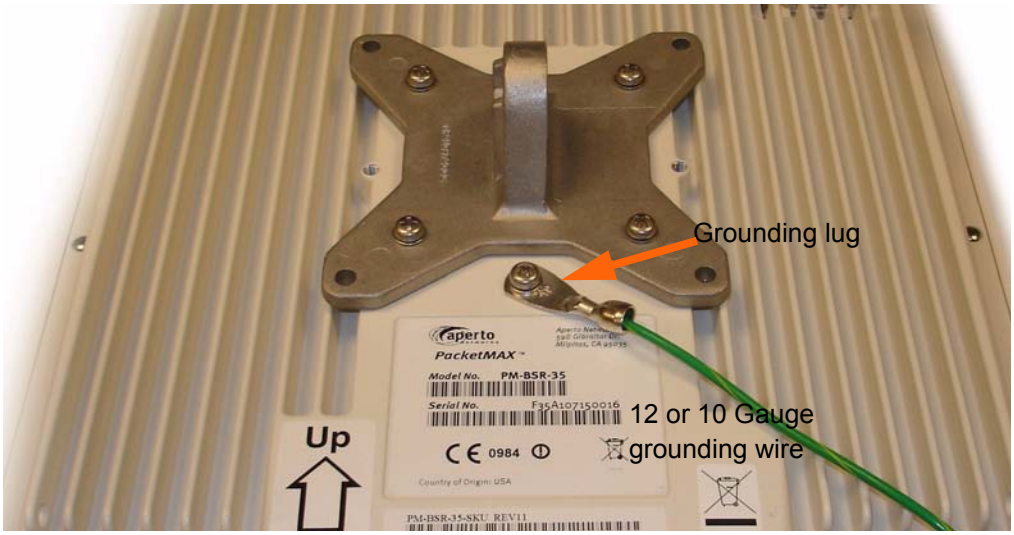


Figure 4-2 Grounding lug on 3.3 and 3.5 GHz radio attached to base bracket

NOTE: The "UP" sign in the BSR (Figure 4-2) indicates proper vertical orientation that would allow moisture to escape the unit.

Step 2. Mount Base Station Radio

A. Unscrew the Warm Gear Clamps. Slip it in the Arm Bracket holes.

B. Wrap it around the pole and screw it tightly.

C. Insert M5 screws through the bracket to the unit. Tighten the screws.

D. Attach Arm Bracket to the Base Support. Insert M8x40 mm screw (no washer required on this end) from one end of the bracket and insert M8 Flat Washer, M8 Lock Washer and M8 Hex nut in the respective order from the other end. Tighten the Hex nut.

The unit is now mounted on the pole. Figure 4-3 A, B,C shows the process.

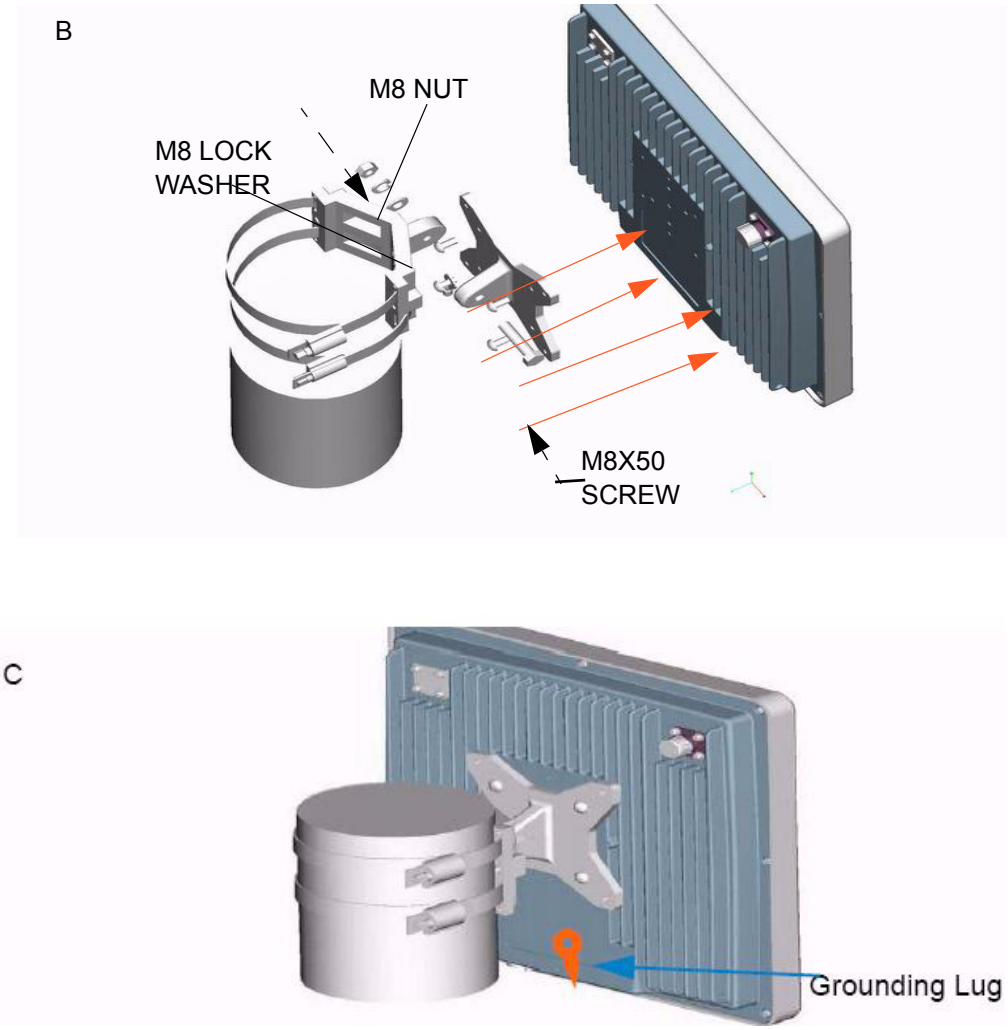


Figure 4-3 Installation of the Base Station Radio

4.3.4 Preparing and Mounting the 5.8 GHz BSR

Step 3. Assemble the Base Station Radio.

A. Attach the Base Support bracket to the Base Station Radio, as shown below:

Figure 4-4 Attaching the Base Support Bracket

B. Attach the Inner Mounting Bracket to the Base Support bracket, as shown below:

Figure 4-5 Attaching the Inner Mounting Bracket

C. Attach the grounding lug to the Base Station Radio, as shown below:

Figure 4-6 Attaching the Grounding Lug

Step 4. Mount the Base Station Radio

The PM-BSR-58 Radio comes with a handle that helps the technicians carry the radio with ease while mounting the radio to the pole.

Keep the one Inner Mounting Bracket on one side of the pole and the Outer Mounting Bracket on the other side of the pole. Then, Insert the screws through the bracket holes and tighten the screws.

4.3.5 Using the BSR with the Antenna and IDU

Step 5. Connect the Base Station Radio to Antenna- RF Cable

Please follow Appendix C for further specifications on cabling requirements.

NOTE: To connect the radio to the antenna, Aperto recommends using a short LMR 600 Cable with Male Type-N connectors. The RF cable should be made as short as possible (without sharp bends) to minimize cable RF attenuation. Aperto recommends applying a silicone sealant or other weatherproofing to the connections.

A. Remove safety cap from the RF Connector located at the back of the BSR.

B. Connect one end of a short coax cable (LMR-600 is recommended) to the RF connector on the BS radio, as shown in Figure 4-7.

C. Connect the other end of the short coax cable to the Type-N connector of the antenna.

D. Aperto recommends applying a silicone sealant or other weatherproofing to the connections as desired.

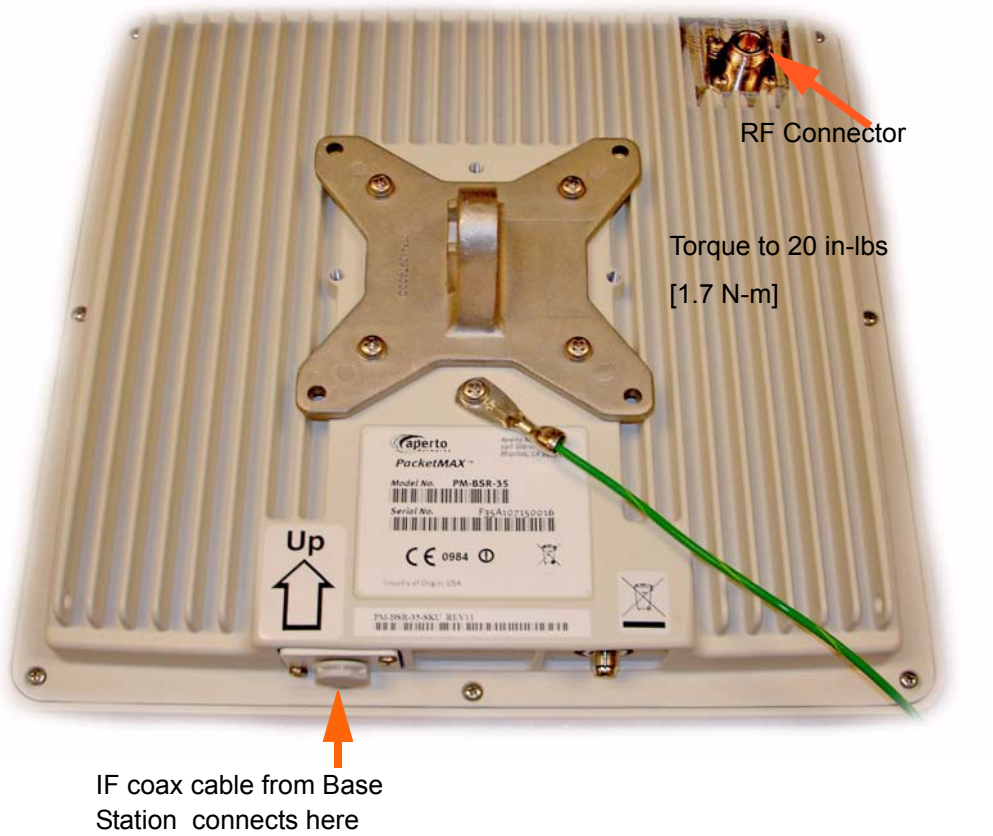


Figure 4-7 RF Cable connects BSR to the Antenna

Step 6. Connect the BSR (ODU) to the BSU (IDU) - IF Cable

The coax cable connects the Base Station Radio to the Base Station IDU and provides DC Power and IF Signalling. This cables runs from the outdoor radios to the indoor Base Station Unit, so a suitable cable run and building entry point must be identified. Maximum length depends on the BSR type and cable type used (Refer to Table 4-2).

NOTE: For these outdoor-to-indoor connections, the order of the steps in the installation procedure will vary depending on a number of factors, including site particulars and installers' preferred practice. For example, in some cases it may be best to run unterminated cable and then attach connectors; in others it may be more efficient to attach one or both connectors to the cable before running it. Also, cable dressing at various locations may be best performed at different points in the procedure. Therefore, the procedures given for radio-to-BS connections should be taken as a list of necessary steps and a suggested order, and modified as appropriate for your circumstances.

Choosing an IF Cable

The IF cable between the BS and BSR carries a multiplexed signal along with the DC voltage. They are identified below and the user should pay particular attention to the choice of IF cable, in field deployments as the cable loss is a function of length, frequency and quality.

Following are the various signals the IF cable carries between BS and BSR.

- DC voltage.
- 20 MHz reference signal.
- 70 MHz IF signal (bi-directional).
- Telemetry link (260 and 420 MHz) for communication between BS-BSR and BSR-BS (bi-directional).

When choosing IF cable of any given length and quality, the user should look at the maximum allowable loss of the cable that is recommended below for reliable operation of the system. The below table allows sufficient margin for surge protectors and connectors. Table 4-1 is based on a nominal Base Station Radio operating voltage of 52 Volts DC and 75% duty cycle.

Table 4-1 Maximum Allowable Cable Loss for IF Cable

Parameter	Value
DC Resistance inner +Outer conductor.	Maximum of 22 ohms
Loss at 20 MHz	Maximum of 20 dB
Loss at 70 MHz	Maximum of 9 dB
Loss at 260 MHz	Maximum of 20 dB
Loss at 420 MHz	Maximum of 20 dB
Cable Return Loss from 20 – 500 MHz	20 dB Typ

Apart from the above recommended cable loss characteristics, the RF shielding capability of the cable should be least 90 dB or better. As a last note, choice of quality connectors and cables with good weatherability and outdoor rated is highly recommended for reliable performance of the system.

Typical cable lengths for LMR Cables from Times Microwave, Inc

Following are the assumptions in coming up with the prescribed lengths.

- Two surge protectors are used each with ~ 0.1 dB loss at 70 MHz.
- Connectors on either end have a loss of ~ 0.1 dB each.
- PM 3000 BS outputs a nominal voltages of 52V at the IF port.

Table 4-2 LMR Cable Types and Maximum Lengths

Cable Type	Max Length with surge protectors for PM BSR
LMR-200-75	100 meters

Table 4-2 LMR Cable Types and Maximum Lengths

LMR-240-75	150 meters
LMR-400-75	250 meters
LMR-600-75	350 meters

NOTE: Be sure to use outdoor UV rated cables.

To install the radio IF signal cable, perform the following steps:

A. Run an appropriate length of cable from the Base Station to the radio. Include a service/drip loop as appropriate.

B. Install a weatherproof female F connector at the radio end of the cable.

C. Attach the cable to the female F connector on the radio. Tighten the connector until the cable is firmly secured, but do not overtighten.

D. Dress the outdoor portion of the cable as appropriate, making sure the cable has adequate strain relief. Do not let the cable hang unsupported from the connector.

E. Install a Female F connector on the BS end of the cable.

F. Attach the cable to the Radio IF connector (IF connector located on the card) for the appropriate Radio port on the Base Station Unit.

G. Dress the indoor portion of the cable as appropriate.

H. Seal the entry of the radio signal and control cables to the building as appropriate.

Step 7. Connect Surge Suppressors

To connect the relevant Base Station Sector to its BSR requires three lengths of cable plus two lightning surge suppressor units. Figure 4-1 shows the illustration that depicts the overall picture of surge suppressors, BSR, and BS.

A. BSR to surge suppressor: Connect one cable from the BSR IF input to one side of surge suppressor 1. Figure 4-8 shows a PA-SP-OUTDOOR-O8 surge suppressor and a BSR IF input picture.

B. Surge suppressor to surge suppressor: From the other end of the surge suppressor 1 connect another cable, which is then attached to the surge suppressor 2.

C. Surge suppressor to Base Station: Connect the third cable from the other side of surge suppressor 2 to the IF port on the Base Station.

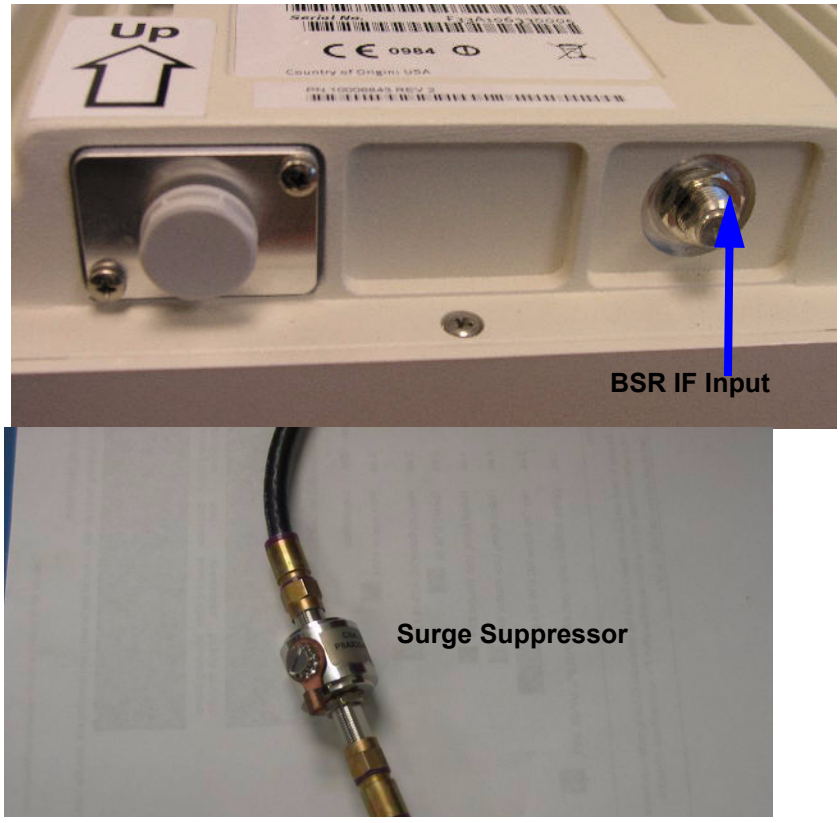


Figure 4-8 Base Station - Surge Protector - PA SP-OUTDOOR-08

Step 8. Ground the Base Station and both the surge suppressors

All protection conductors of the installation must be interconnected and connected to a single ground (or ground network).

NOTE: To minimize the residual voltages from lightning discharge currents, the connection of the suppressor to the ground network must be as short as possible (less than 50cm) and have the largest possible cross-sectional area (at least 4mm 2).

Single point grounding requires that the grounding leads from the antenna, radio and surge suppressor for a particular sector, be bonded together at the same point on the tower down conductor. Ensure that the components of any individual sector have the same ground point on the tower. The base station chassis ground and all the surge suppressors grounds must be grounded at the same point. Figure 4-9 displays a single point ground.

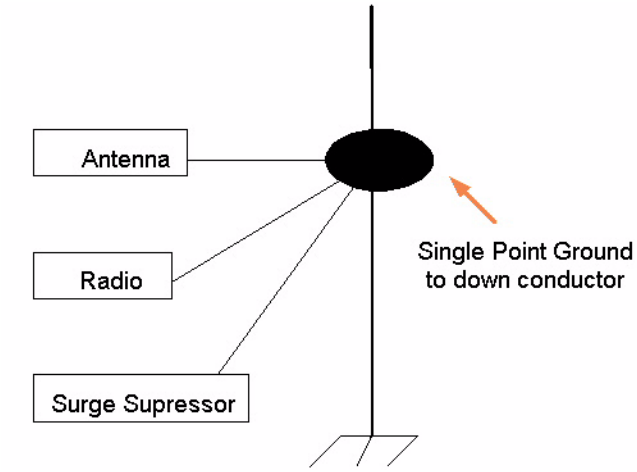


Figure 4-9 Single Point Ground

To properly ground the Surge Suppressors:

A. Locate and insert the grounding lug on the surge suppressor (Figure 4-8). Aperto recommends two grounding cables (60 inches, 10 AWG weather-proof cable).

B. Attach one end of the cable to the surge suppressor.

C. Cut the cable to the appropriate length and attach the other end to an appropriate earth ground. Make sure that the cable is straight and not looped.

To properly ground a DC powered Base Station:

A. Locate the CGND DC lug on the base station rear panel.

B. Provide a proper grounding cable (NEC Section 810-21) long enough to reach from the base station to the earth ground.

C. Attach one end of the cable to the lug on the base station.

D. Cut the grounding wire to the appropriate length. Make sure the wire is straight and not looped.

E. Connect the other end of the grounding cable to an appropriate earth ground using a grounding clamp.

NOTE: A base station AC unit is grounded via the AC power cable center prong. The AC receptable must have it's center prong connected to earth ground.

4.1 Grounding the PacketMax System

Aperto provides:

- Two Surge Suppressors for PacketMax IF Cables
- Two Grounding Cables
- Two Grounding Lugs

Grounding of the outdoor radio/antenna and the base station is an essential part of the installation process. A proper grounding circuit is illustrated in Figure 4-1.

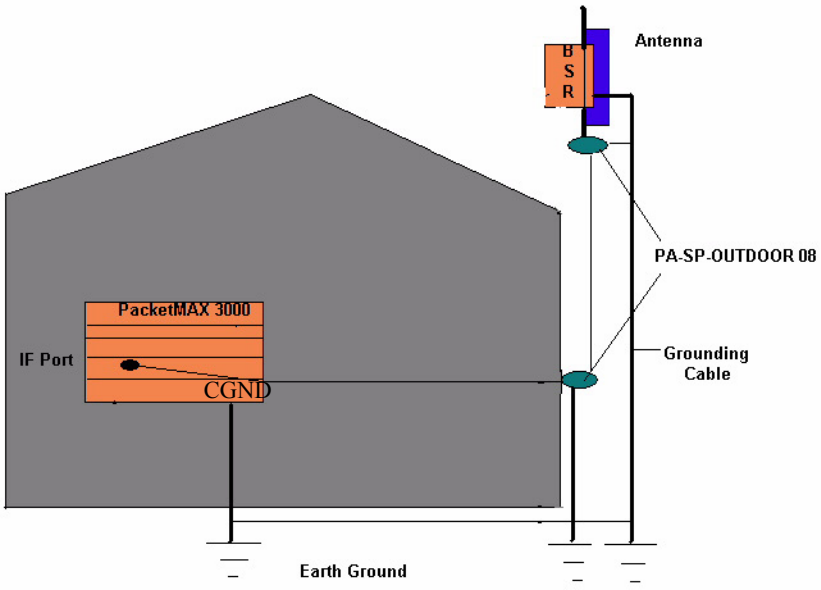


Figure 4-1 Grounding the PM 3000 System (IDU, Radio, and Antenna)

Make sure that the:

- IDU is grounded - (Refer to Ground the Base Station and both the surge suppressors section)
- ODU is grounded - (Refer to Attach Bracket and Grounding Wire to BSR section)
- Surge Protectors are grounded (Refer to Ground the Base Station and both the surge suppressors section).
- Antenna is grounded

5

Commissioning the Base Station

This chapter highlights the procedure of bringing up the Base Station using initial CLI configuration and creating configuration files in Element Management System (EMS) and finally verifying operations.

This chapter covers the following topics:

- Summary of Configuration of Base Station
- Establishing an Ethernet Connection with Cat-5 Cable
- Establishing a Serial Connection to the Base Station
- Configuring DHCP
- Obtaining the MAC Address of the Base Station
- Selecting Management or Data Traffic
- Provisioning the Base Station with WaveCenter EMS
- Rebooting the Base Station
- Verifying Operations
- Ensuring Encryption
- Upgrading Base Station Manually

5.1 Summary of Configuration of Base Station

To summarize, following are the steps that users have go through in order to configure the Base Station:

- Make sure that Base Station is set up first (Chapter 2,3 and 4).
- Refer to network diagram Figure 1-4 on page 1-7 of Chapter 1.
- Configure the system by following the sections below

5.2 Establishing an Ethernet Connection with Cat-5 Cable

Before powering on the PM 5000, connect a Cat-5 cable from the Ethernet port on the PM 5000 to the network where the EMS server is on.

5.3 Establishing a Serial Connection to the Base Station

At first, connect your host computer to the PacketMax 5000 using a standard RS-232 serial cable included with the system PM 5000 Base Station. Then, connect the cable from your host computer's serial port to the Management RS-232 port on the PacketMax chassis. Now, power on the base station.

WARNING: Ensure the PM 5000 is powered down while connecting the host computer. Connecting the base station while the PM 5000 is powered up can permanently damage the base station or PM 5000 IDU.

Open a terminal emulation application (for example, HyperTerm) and configure the connection to support 38,400 baud, no parity, 8 data bits, 1 stop bit, and no flow control.

Follow the procedure below:

Step 1. Create a new serial connection to the com1.

See Figure 5-1.

Figure 5-1 Connection to the com1

1. Set COM1 settings to 38,400 baud, no parity, 8 data bits, 1 stop bit. (Figure 5-2).

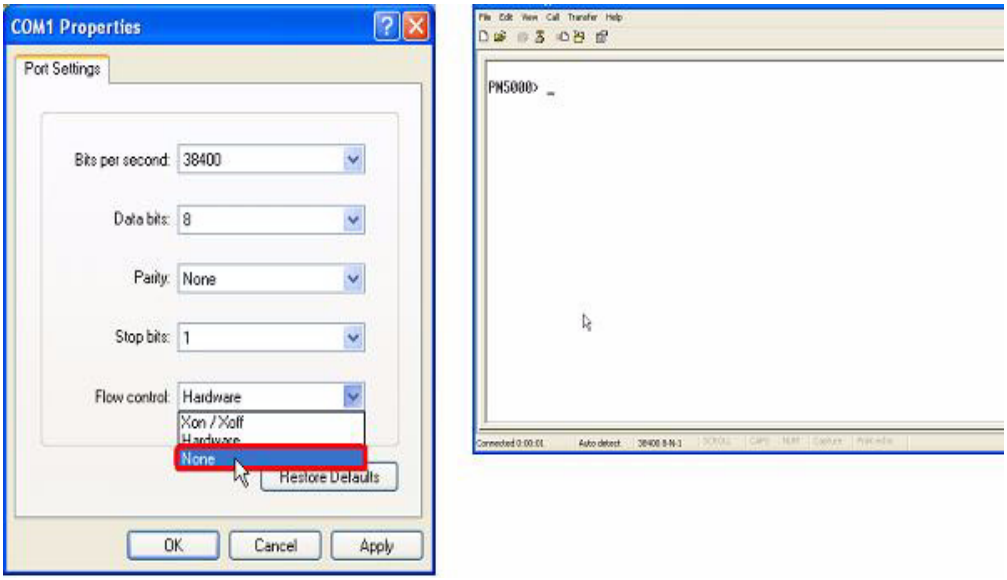


Figure 5-2 COM 1 settings

2. When the console appears, follow the steps below as seen in Figure 5-2:

   a. Login using,

   - User ID: **ISP**
   - Password: **isp** [Case Sensitive]

   b. Verify that the DHCP is in “Server” mode by typing **show dhcp** at the CLI prompt, as shown in the following screenshot:

```
CLI# show dhcp
CLI(show-dhcp)# params
Use DHCP Params from      :  Local(NVRAM)
IP/NetMask                :  10.226.0.15/255.255.255.0
Default Gateway           :  10.226.0.1
TFTP Primary Server       :  10.226.0.4
TFTP Secondary Server     :  Local (/tffs0)
SNTP Server               :  192.5.41.4
Config File Name          :  BS_00013b01e427.cfg
CLI(show-dhcp)# _
```

Figure 5-3 Verifying the Server mode

c. If the system is in “Local” mode, configure the DHCP by typing **config dhcp** at the CLI prompt. Follow the instruction in the next section to configure DHCP.

5.4 Configuring DHCP

Step 2. Configure in DHCP mode

While in Configure mode for DHCP, follow the steps below:

1. Enter **params** at the CLI command prompt, to start configuring DHCP. Two options, show up, 1 for Local mode and 2 for Server mode.

NOTE: For PacketMax, Local mode is not supported. The device gets the config files from the flash. In Server mode, the device gets the config files from TFTP Server via the DHCP server.

2. Select **2**, if not already selected, to obtain DHCP parameters from the Server. See the screenshot captured from the console, as displayed below.
3. Select the port from which DHCP/TFTP traffic will flow. In the screen below **1** has been selected.
4. Leave other options as they will be retrieved from the DHCP Server.

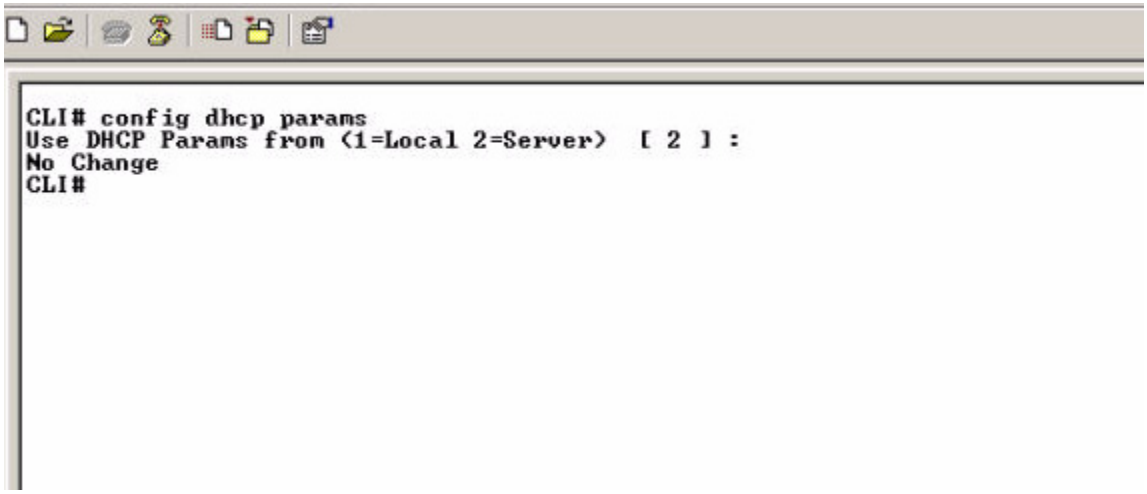


Figure 5-4 Configure DHCP

5.5 Obtaining the MAC Address of the Base Station

Step 3. Determine the MAC Address of the port used for DHCP/TFTP Management

Each Card will have 4 MAC Addresses. There are two ways to identify the MAC Address of the BS, as described below:

- On the label of the MSC Card, as shown in the label of Figure 5-5.

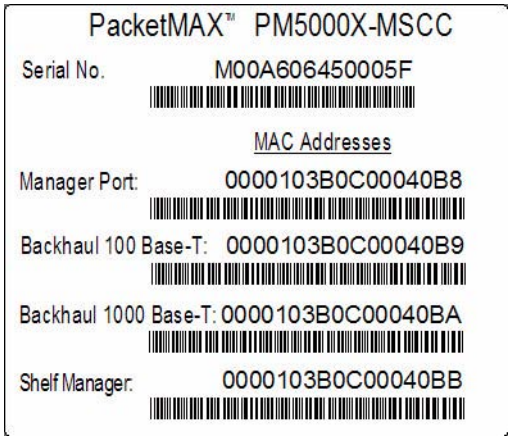


Figure 5-5 label on MSC Card

- Use the “show msc” command for this, as displayed in Figure 5-6.

You must select the one MAC Address that corresponds to the Interface.

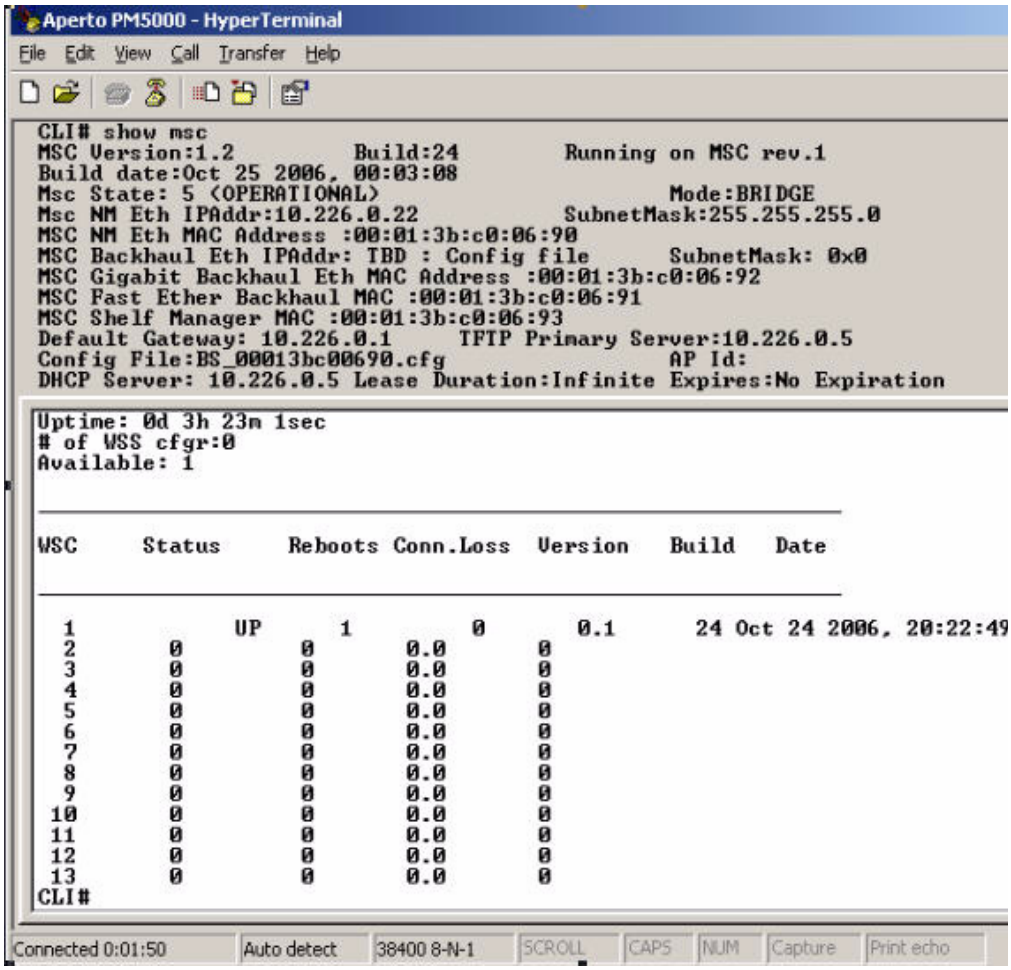


Figure 5-6 Determining the right MAC address

5.6 Selecting Management or Data Traffic

Step 4. Select Inband or Outband Management

1. To implement Base Station in VLAN mode, use Management port for EMS seperate.

Use the MAC ADDRESS for Commissioning on the EMS, as specified below.

- If you want inband management of the device, then connect the EMS server to one of the Backhaul ports.
- If you want outband management of the device, then connect the EMS server to communicate with the management port.

2. On the CLI prompt, type “config dhcp dhcp-tftp-on-backhaul” and select the mode desired as shown in the screenshot (Figure 5-7).

```
CLI# config dhcp dhcp-tftp-on-backhaul

AUTO SELECT           (1)
DHCP_ON_MGMT_PORT     (2)
DHCP_ON_GBE_BH_PORT   (3)
DHCP_ON_FE_BH_PORT    (4)
Enter choice :  1_
```

Figure 5-7 Port selection

Choosing Auto-select implies that the link of the port is detected and selected.

If data and dhcp is desired on Fast Ethernet, then select option number 3 or 4.

NOTE: If the users want the EMS Server and the data port to be connected to the same switch, Aperto Networks recommends not use the Management port for dhcp/tftp provisioning.

5.7 Provisioning the Base Station with WaveCenter EMS

Step 5. Use EMS to generate and provision config files for MSC, WSC and SS.

Please Refer to the *WaveCenter EMS User Manual* for further details on provisioning in EMS and generating config files.

NOTE: Auto-Provisioning feature is now available through WaveCenter Element Management System (EMS). Hence, the Subscriber Unit can be configured using the Auto-Provisioning feature in WaveCenter EMS. Please refer to Chapter 4 of the WaveCenter EMS User Manual for instructions on using the Auto-provisioning feature.

Step 6. Configure using EMS Server Configuration tool and generate base station configuration file in EMS.

A. EMS server is required to configure and manage the Base Station.

- In the EMS Server Configuration tool, check if the Primary & Standby BE server IP addresses are specified in EMS IPs page. Click on Update Setting once the Primary and Secondary server IP addresses are entered.
- Check IP address under cookies server on the ADHCP page. ADHCP option in Sever Configuration tool allows users to de-select the use of the Aperto DHCP server i.e. the user is given the option to use their own DHCP server.

NOTE: If users de-select using the APERTO DHCP server, it is their responsibility to set up their proprietary DHCP server correctly to work with Aperto devices in server mode.

Step 7. Generate Base Station Configuration file in EMS.

A. Generate the Base Station and Subscriber Unit configuration file using Configuration Manager in Element Management System (EMS). This configuration file should be either saved on the BS's TFTP server, or (for local configuration mode) is already saved on a disk and provided to the installer.

- Configure at least one Service Class in the Base Station configuration file.
- While configuring Subscriber Hosts, the host may be statically configured with an IP address, default gateway, and DNS server. If the Subscriber Unit is in bridge mode, the default gateway could be the IP address of the Base Station's Wireless Subsystem (WSS) that the Subscriber Unit connects to. Configure atleast one upstream and one downstream Service Flow in the Subscriber Unit Configuration file.

NOTE: In EMS, SS configuration System pane, check the configure DHCP box to switch to server mode. Refer to Chapter 4 in the WaveCenter User Manual for details on SS configuration.

Please refer to the *WaveCenter EMS User Manual* for detailed instructions on creating a BS config file.

There should be an ethernet connection between EMS and BS.

NOTE: Remember to manage the icons at the EMS end, after provisioning in EMS.

5.8 Rebooting the Base Station

Step 8. Reboot BS and verify that it received IP Address and Configuration Settings.

Verify with the "reboot msc" command as displayed in Figure 5-8.

```
CLI# reboot msc
Do You Want to Reboot MSC [Y/N] : Y

 System reboot.....

Reset MEs...

StartType=0x40000000
 Testing Xscale Scratchpad memory... PASS
 Testing I2C Interface... PASS
 Testing SDRAM memory... _
```

Figure 5-8 Rebooting BS

NOTE: The users can do a soft or hard reboot.

5.9 Verifying Operations

Verify operations as follows:

1. At the CLI prompt, enter **show msc** to verify that the base station received the correct IP Address and Configuration file. Figure 5-6 shows an example of **show msc** command.
2. Verify that the BS is operational. Follow the instruction below:
   a. Ping the EMS from the Base Station
   b. View System Configuration via EMS
   c. Check if BS appears Green in EMS
   d. Telnet to BS
   e. Check that the LEDs on the BS are correct (per *Table 2-A in Chapter 2*). This will verify if the BS is operational or not.

NOTE: There are a series of CLI commands that will enable you to check the status of the system and also configure the system. Please refer to the CLI Reference Manual, for further details.

5.10 Ensuring Encryption

When upgrading your system, to run encryption, make sure following (or newer) binary is loaded correctly. To do this, check the command, on the WSC and make sure that the binary date (in red) indicated in the following example is current.

```
PM5000-WSC-1> dumpArcCB
PSAP Interface Version 2.3+ Control Block.
----------------------------------------
Component ID: 0xec55aa01, Firmware ID: 0x00000001
ARC Feature List:-"BS|PSAP2.3+|EC001|Jun 22 2007|17:06:"
Station ID:(H)=0xc03b0101, (h)=0x00004001
Watermark Level Tx:0x00000100, Rx:0x00000800
ARC Op Mode :0x00000008
MAC TxHead:0x000007d6, TxTail:0x000007d6
MAC RxHead:0x00000260, RxTail:0x00000260
MAC TxCtrlHead:0x000000d0, TxCtrlTail:0x000000d0
MAC RxCtrlHead:0x000000c3, RxCtrlTail:0x000000c3
MAC RxStatHead:0x000001bd, RxStatTail:0x000001bd
DMC 0x00000000
MAC MBox Lock: 0x00000000
PSAP MBox Lock:0x00000000
CID Table Lock: 0x00000000
Arc Trailer=0xaaaaaaaa
----------------------------------------
value = 42 = 0x2a = '*'
```

5.11 Upgrading Base Station Manually

Currently, the base station can be upgraded manually and the procedure for the WSC upgrade and MSC upgrade is covered in details in the following sections.

NOTE: For Release 2.1, you can use the bulk upgrade utility to upgrade a BS.

5.11.1 WSC upgrade

To upgrade WSC,

1. Log on to the PM 5000 WSC card using a ftp server. For example, WS_FTP is used here. Enter the Profile Name, Host Name/Address and user name/password. The user name is “target: <wsc card number>”, for example, “target: 1”. Figure 5-9 shows the general session properties screen on WS_FTP. Click **OK**.

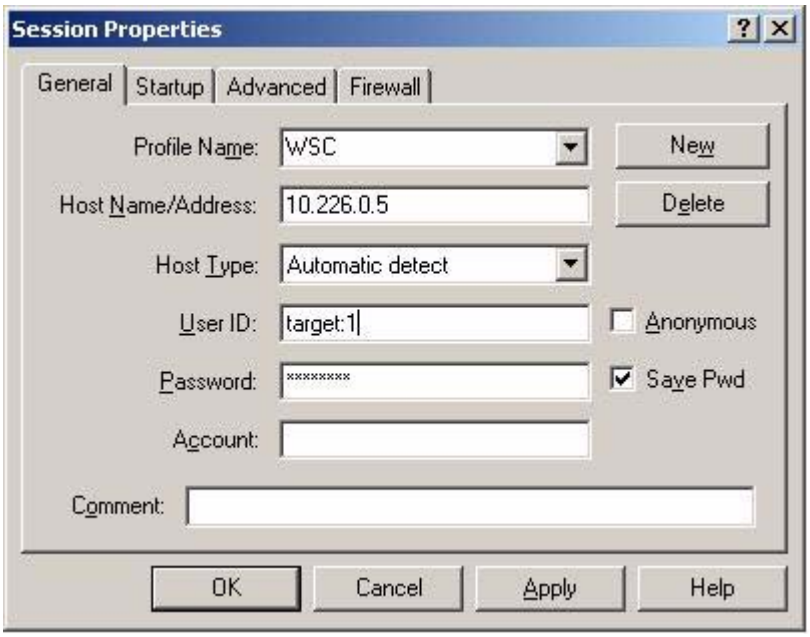


Figure 5-9 General session page - WSC upgrade

2. Copy the following new Build files to the PM 5000 WSC Card in “/tffs0” folder. Figure 5-10 displays this startup session page. Click on **OK**. The WS_FTP screen opens.

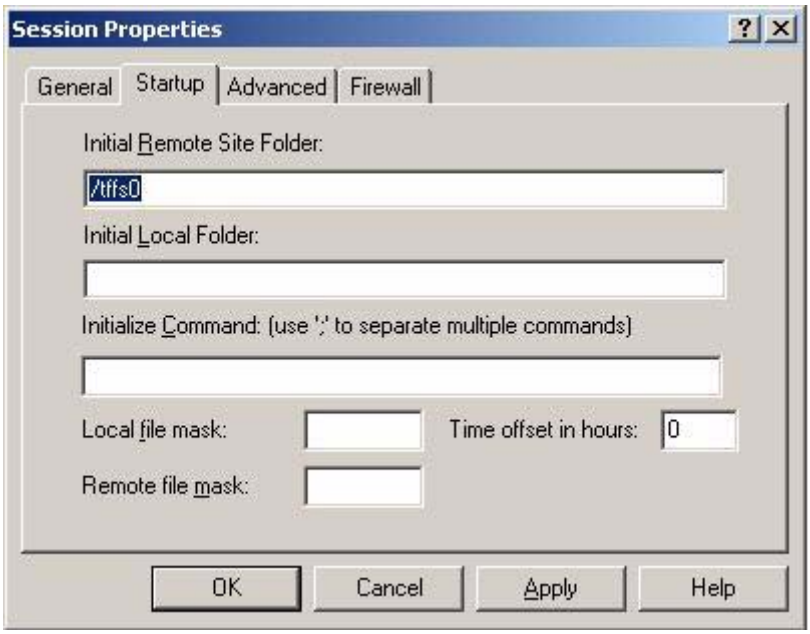


Figure 5-10 Startup session page - WSC upgrade

3. Select the Customer_CD\PacketMax directory, and click on the “ARC” folder and copy “bs.bin” file to the “ARC” folder in “/tffs0” of the WSC Card.
4. Go to the “bootrom” folder and copy “bootrom_wsc.bin” file to the “/tffs0” of the WSC Card. Figure 5-11 shows the ftp screen, once the transfer is done.
5. Click on the **Close** button and then click on the **Exit** button on the WS_FTP client.

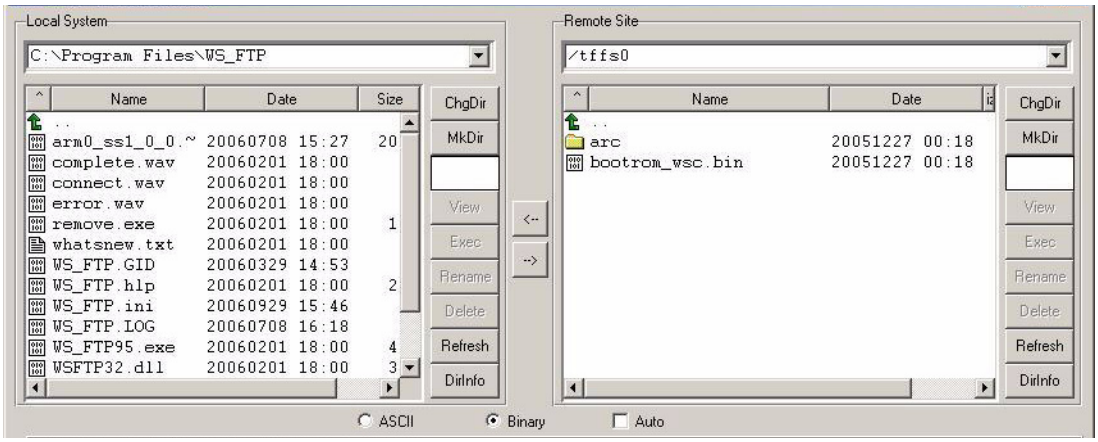


Figure 5-11 Ftp page - WSC upgrade

6. Open the telnet session, by going on command prompt, to the PM 5000 WSC card. Type “telnet Host Address”. For example, “telnet 10.226.0.5 5001” at the C:/prompt. Figure 5-12 displays the telnet session.
7. Click the **Enter** key. The vxWorks will prompt to enter the WSC card number and the Login prompt will appear. The Login is “target” and password is “pass-

word". The PM 5000-WSC-2 will show up at the command prompt, where 2 is the port number here.

8. Program the WSC bootrom by typing at the command prompt.:

"sysBootImangePut "tff0o/bootrom_wsc.bin"

9. **Exit** from the telnet session.
10. Repeat steps 1-9 for upgrading, all WSC cards.

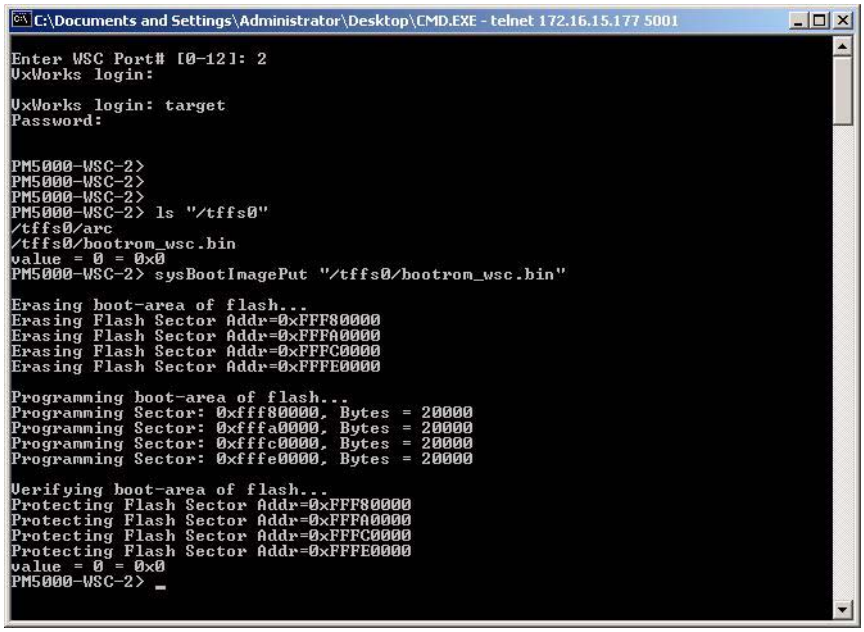


Figure 5-12 Telnet page - WSC upgrade

5.11.2 MSC Upgrade

To upgrade MSC,

1. Log on to the PM 5000 MSC card using a ftp server. For example, WS_FTP is used here. Enter the **Profile Name, Host Name/Address** and **User ID/Password**. The user name is "target". Figure 5-9 shows the general session properties screen on WS_FTP. Click **OK**.

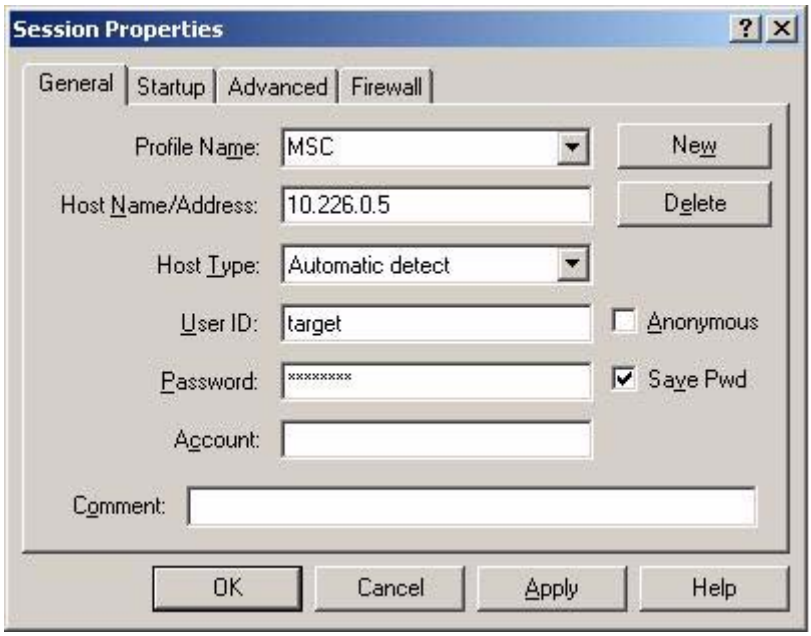


Figure 5-13 General session page - MSC upgrade

2. Copy the following new Build files to the PM 5000 MSC Card in “/tffs0” folder. Figure 5-14 displays this startup session page. Click on **OK**. The WS_FTP screen opens.

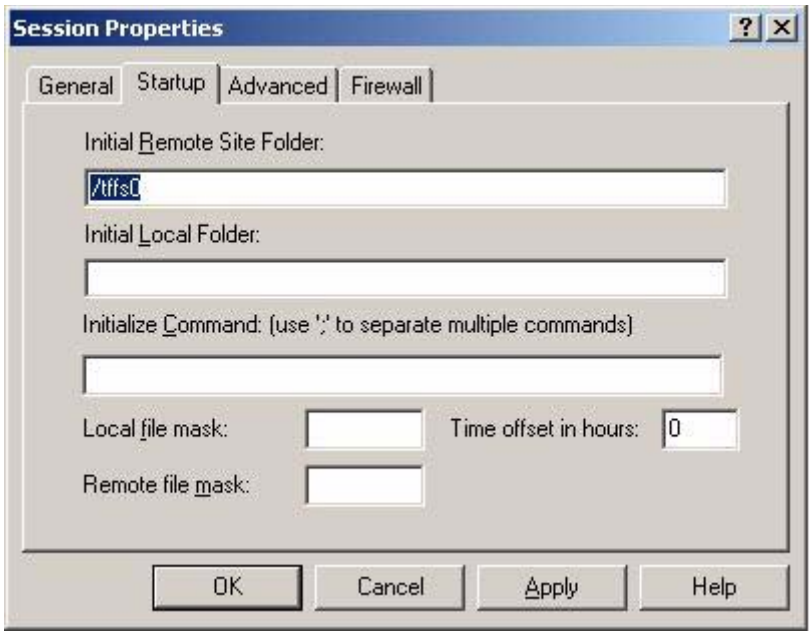


Figure 5-14 Startup session page - MSC upgrade

3. Select the Customer_CD\PacketMax directory, and click on the “bootrom” folder and copy “bootrom_msc.bin” file to the “/tffs0” of the MSC Card.
4. Go to the “msc” folder and copy “msc1_0_0.D” file to the “/tffs0” of the MSC Card.

5. Go to the “wsc” folder and copy “wsc1_0_0.D” file to the “/tffs0” of the MSC Card. Figure 5-15 shows the ftp screen, once the transfer is done.

6. Click on the **Close** button and then click on the **Exit** button on the WS_FTP client.

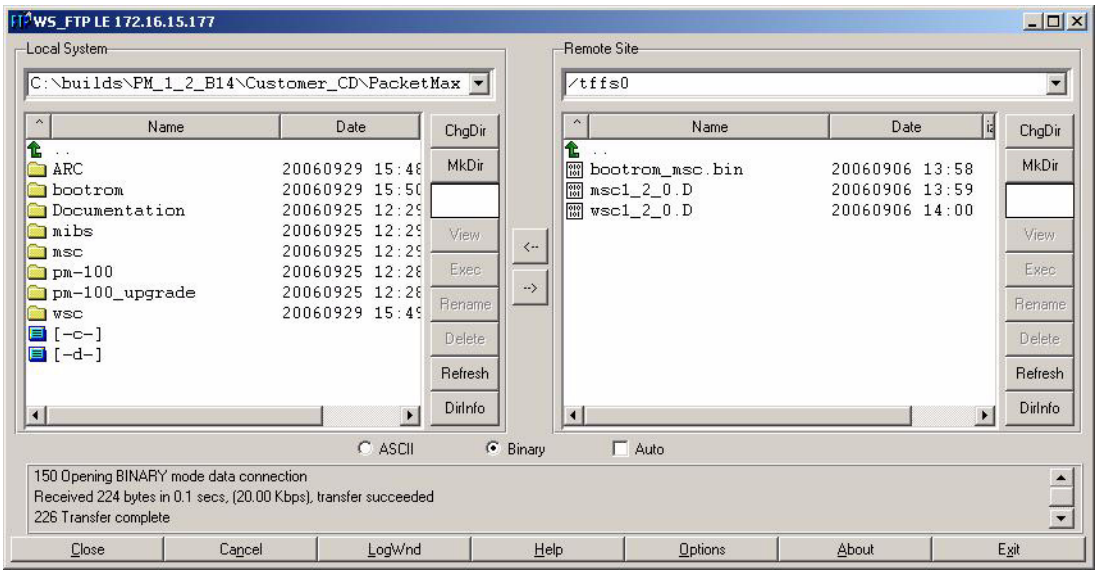


Figure 5-15 Ftp page - MSC upgrade

7. Open the telnet session, by going on command prompt, to the PM 5000 MSC card. Type “telnet Host Address”. For example, “telnet 10.226.0.5 5000” at the C:/prompt.

8. Click the **Enter** key. The vxWorks will prompt to enter the WSC card number and the Login prompt will appear. The Login is “isp” and password is “isp”. The **PM 5000>** command prompt will show up when login is successful.

9. Program the MSC bootrom by typing “sysBootImangePut “tffso/bootrom_wsc.bin” at the command prompt. The password prompted for is “otre-paotrepa”. Figure 5-16 displays the telnet session. A message shows “**Are you sure you want to continue (Y/N)**”. Type **Y**. It may take a few minutes before the process begins. Once its done, the command prompt PM5000> returns.

Verify that the MSC and WSC cards bootup using the appropriate software images that were FTPed to the “/tffs0” directory of the MSC card.

10. Type the command “nvramConfigChange”. Confirm that the “MSC Main” and “WSC Main” image file names match those that were FTPed using the above steps.

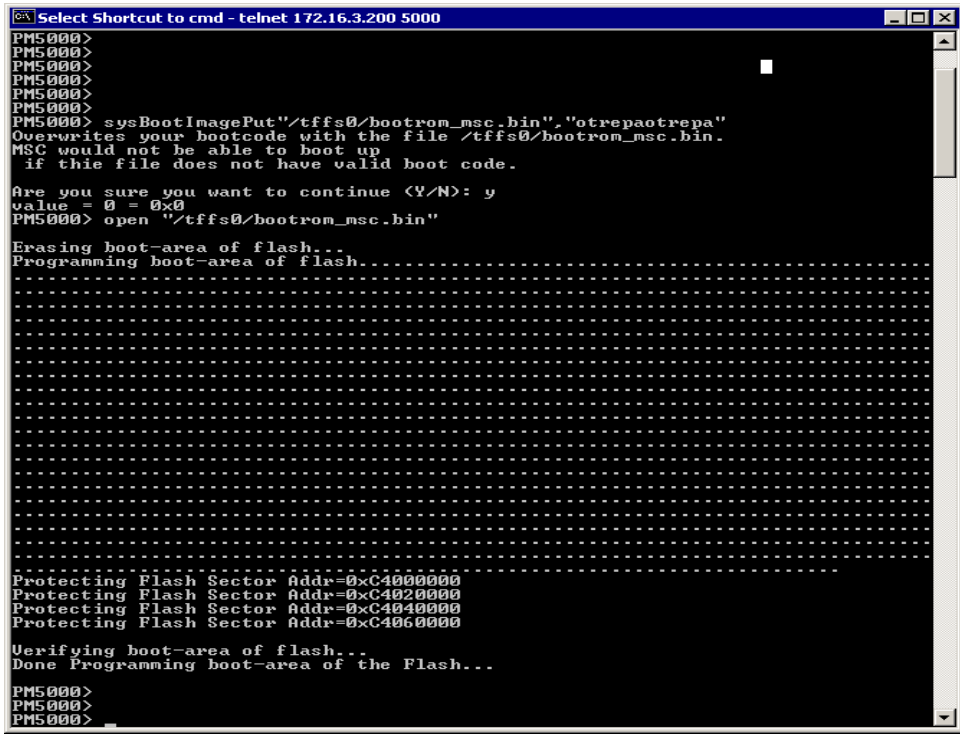


Figure 5-16 Telnet page - MSC upgrade

A

Event Reporting

The PacketMax equipment can be configured to report events by:

- E-mail event messages.
- SNMP traps.
- Logging to a Syslog server.

A.1 PacketMax 5000 Dry Relay (Telco Port) Alarms

The Telco alarm is for external alarm connectivity that consists of a distinct dry contact relay that corresponds to each alarm state. These are open or closed depending on the state and are entirely under software control. The default is, no alarm state. This includes both power off and power on, not the initialized state. Figure A-1 shows the telco port.

Figure A-1 Telco Port and Alarm port on the MSC Card

Following are the electrical specifications:

- The alarm signals are connected to a set of dry relays that should be capable of carrying up to 75 VDC or 1 A with a maximum rating of 30 W/30 VA.
- The reset inputs should be timed pulse inputs that are used to clear the minor and major alarm states. (There is no reset for the critical state.) These reset

inputs shall be optically isolated from the rest of the system. Reset is accomplished by asserting a voltage differential from 3.3 VDC to –48 VDC for between 200ms and 300ms.

- The supported voltage range shall be from 0 to –48VDC continuous, up to –60VDC at a 50% duty cycle, and up to –72VDC at a 30% duty cycle. The current drawn by this input may be as high as 12mA with no damage resulting from a reversal in polarity.

Table A-1 Pin Description of Telco

Pin	Description
1	Minor Reset+
2	Minor Reset+
3	Major Reset-
4	Major Reset-
5	Critical Alarm-NO
6	Critical Alarm-NC
7	Critical Alarm-Com
8	Minor Alarm-NO
9	Minor Alarm-NC
10	Minor Alarm-COM
11	Major Alarm-NO
12	Major Alarm-NC
13	Major Alarm-COM
14	Power Alarm-NO
15	Power Alarm-Com

A.2 PacketMax 5000 and PacketMax 100 Alarms

Table A-2 shows the MSC Alarms that are generated in the base station. Table A-3 shows the WSC Alarms that are generated in the base Station.

NOTE: Events are highlighted in brackets in the following tables.

Table A-2 MSC related Alarms/Events in PM 5000

Alarm Type	Alarm Message in EMS	Cause and Description	Resolution
Memory	/RAM0 Space Free: LOW /RAM0 Space Free: NOR-MAL	This indicates if there is a problem with the memory in the system.	Contact Aperto
Flash	/TFFS0 Space Free **[Event]** /TFFS0 FS State	This indicates that the flash has a problem.	Contact Aperto
Msc Power Change	MSC Operational MSC -<No> POn ..... MSC -<No> POff ..... WSC 1/Redundant MSC: Link Ok WSC 1/Redundant MSC: Link Down	Indicates that MSC/WSC Card is either inserted or removed	
Fan 1 Issue	EVENT: FAN-1 ShM:	This indicates Fan 1 is NOT working. Replace the Fan card.	Contact Aperto
Fan 2 Issue	EVENT: FAN-2 ShM:	This indicates that Fan 2 NOT working	Contact Aperto
Temperature Change	EVENT: ROOM TEMP CHANGE..... EVENT: CPU TEMP CHANGE....	Room or CPU Temperature is either above or below accept-able levels	
FTP Download Fail-ure	CPE Name: <name>, CPE Mac Addr: 0xAA:0xBB:0xCC:0xDD:0xEE:0xFF , CPE Id: <Id>: Cfg File Not Found CPE Name: <name>, CPE Mac Addr: 0xAA:0xBB:0xCC:0xDD:0xEE:0xFF , CPE Id: <Id>: CPE CFG File download failed MSC Cfg File Download Success MSC Cfg File Download Failure	System is not able to down-load configuration files from the TFTP server.	Check network topol-ogy

Table A-2 MSC related Alarms/Events in PM 5000

Cfg File Parse Error	CPE Name: <name>, CPE Mac Addr: 0xAA:0xBB:0xCC:0xDD:0xEE:0xFF , CPE Id: <Id>: CPE CFG File Parse Failed CPE Name: <name>, CPE Mac Addr: 0xAA:0xBB:0xCC:0xDD:0xEE:0xFF , CPE Id: <Id>: CPE CFG File successfully Parsed MSC Cfg File Successfully Parsed MSC Cfg File Parse Error	Version mismatch between EMS & Base Station	Upgrade either the device or EMS to match the version.
Task Suspend	Task SUSP System RAM: LOW	All Tasks are not working properly	Contact Aperto
MSC Mgmt Port Mode Change	Mgmt Port Link Status is UP Mgmt Port Link Status is DOWN Link Up, Mgmt Port Operating in Full Duplex Mode Link Up, Mgmt Port Operating in Full Duplex Mode Link Up, Mgmt Port Operating at 100 Mbps Link Up, Mgmt Port Operating at 10Mbps	One of the following on the management port has changed: - Speed - Mode - Duplex	If not indicated, check network
MSC Backhaul Port Mode Change	1G Backhaul Link Down 1G Backhaul Link Up 10/100 Backhaul Link Down 10/100 Backhaul Link Up	One of the following on the management port has changed: - Speed - Mode - Duplex	Check network
MSC-WSC Backplane Port Mode changes	WSC 1/Redundant MSC Link Down WSC 1/Redundant MSC Link Up WSC <Port No> Link Down WSC <Port No> Link Up	One of the following between the MSC-WSC has changed: - Speed - Mode - Duplex	Contact Aperto

Table A-3 WSC related Alarms/Events in PM5000

Alarm Type	Alarm Message in EMS	Cause	Resolution
WSC Card Status	WSC Port No <Port No> has NOT become operational WSC <Port No> Down WSC %d Connected **[Event]**	This alarm indicates that WSC Card is operational or Down. When the WSC becomes operational, an event will indicate this in the future release.	
WSC Power Change	WSC <Port No> : Info	WSC Card Power Change	
Cookie Mismatch	Config Frame Params COOKIE MISMATCH <Cookie Id> from WSC <Port No>	This happens when there is an image mismatch between components.	Image mismatch between the components. Reinstall Image
WSC Cfg File Download Error	WSC Cfg File Download Failure WSC Cfg File Download Success	Not able to download WSC configuration file from the TFTP server.	Check Network topology. Make sure that TFTP server is accessible from Base Station
WSC Cfg File Parse Status	WSC Cfg File Parse Failure WSC Cfg File Successfully Parsed	Config file is not generated correctly.	Re-check your configuration.
WSC Configured Card not Present	WSC Port No <Port No> is Configured but NOT Present	WSC card is not available in the chassis even though it has been configured from EMS.	Insert a WSC card.
Unconfigured WSC Card Present	Unconfigured WSC Port No <PortNo> is Powered Up	This shows that an unconfigured WSC Card is inserted	Configure WSC from EMS.
WSC Card Not Powered	Configured WSC Port No <Port No> is NOT Powered Up	WSC Card is not working properly	Hot Swap the WSC card by removing and re-inserting it back.
WSC Radio Link Status	Radio Link State is ON **[Event]** Radio Link State is OFF	This indicates the status of the Base Station Radio.	If Radio Link State is OFF, check the RF cable connection.

Table A-3 WSC related Alarms/Events in PM5000 (Continued)

Radio Cable Loss	Failed to initialize radio power control Initialized radio power control **[Event]** Unable to compute cable loss Computed cable loss Cable loss is too high Cable loss detected <No> dB Radio - Max Power not reachable Radio - Max power reachable **[Event]** Radio Not Reachable Radio Reachable **[Event]**	Cable Length is too long	Use shorter Cable Length
Radio Frequency Error	Radio Frequency Configuration Error Radio Frequency Properly Configured **[Event]**	Incorrect Frequency Programmed	Reconfigure the radio & check radio
SS Added	SS %d Added On WSC Port %d **[Event]**		
SS Removed	SS %d Removed On WSC Port %d	Users has powered off the SS or the SS cannot talk to the Base Station	Check SS configuration

Table A-4 SS related Alarms

Alarm Type	Alarm Message in EMS	Cause	Resolution
Ethernet Port Link Change	SS Uplink Ethernet Port Change	Change in Ethernet settings	Check Network connections
Radio Frequency Error	Radio Frequency Configuration Error Radio Frequency Properly Configured **[Event]**	Incorrect Frequency Programmed	Reconfigure the radio & check radio
Cfg File Parse Status	SS Cfg File Parse Failure SS Cfg File Successfully Parsed **[Event]**	Config file is not generated correctly.	Re-check your configuration.

A.3 PacketMax 100 Events

Table A-5 CPE ID and Description

CPE ID	Description
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	SS Cfg File Not Found
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Not able to get CPE configuration file
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Invalid CPE CFG File, <File Name>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	CPE CFG File download failed"<File Name>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	CPE CFG File successfully Parsed "<File Name>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	CPE CFG File Parse Failed "<File Name>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	SS Added On WSC Port <portNo>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	S Removed On WSC Port <portNo>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Uplink Burst Profile Changed, Old Value <Old Value>, New Value <New Value>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Ranging Aborted
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Downlink Burst Profile Change, Old Value: <Old Value>, New Value: <New Value>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	REG_RSP FAILED
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	REG_RSP SUCCESS
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Sent SF request
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Basic Capabilities Mismatch, <Addn Mismatch Str>
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Basic Capabilities Match between BS & SS

Table A-5 CPE ID and Description

CPE ID	Description
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	DSA_REQ MAX Retries exceeded
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	DSA_RSP Re-Sent
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	MAX DSA RSP retries exceeded
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Registration Timer Expired
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	SS Authorization & Key Exchange Timeout
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Wait for DSA, DSC, DSD Response Timer Expired,
CPE Mac Addr:<Mac Addr> CPE Id:<CpeId>	Wait for Trasaction End Timer Expired

Table A-6 CPE Mac address and Description

CPE Mac Addr	Description
CPE Mac Addr:<Mac Addr>	Wait for DSA/DSC Acknowledge Timer Expired
CPE Mac Addr:<Mac Addr>	Initial Ranging Success
CPE Mac Addr:<Mac Addr>	Ranging Aborted
CPE Mac Addr:<Mac Addr>	Re Range Request
CPE Mac Addr:<Mac Addr>	SS search for preamble Timer expired
CPE Mac Addr:<Mac Addr>	Wait for DCD Timer expired
CPE Mac Addr:<Mac Addr>	Wait for Broadcast Ranging Timer expired
CPE Mac Addr:<Mac Addr>	Wait for Ranging Response Reception Timer expired
CPE Mac Addr:<Mac Addr>	Wait for Unicast Ranging Opportunity Timer expired
CPE Mac Addr:<Mac Addr>	Wait for UCD descriptor Timer expired
CPE Mac Addr:<Mac Addr>	SS Wait for DL-MAP on given channel Timer expired
CPE Mac Addr:<Mac Addr>	DBPC-REQ retry Timer expired
CPE Mac Addr:<Mac Addr>	RNG-REQ/DBPC-REQ retry Timer expired

Table A-6 CPE Mac address and Description

CPE Mac Addr	Description
CPE Mac Addr:<Mac Addr>	DBPC-RSP reception Timer expired
CPE Mac Addr:<Mac Addr>	DSA_REQ MAX Retries exceeded
CPE Mac Addr:<Mac Addr>	DSA_RSP Re-Sent
CPE Mac Addr:<Mac Addr>	MAX DSA RSP retries exceeded
CPE Mac Addr:<Mac Addr>	SBC RSP received
CPE Mac Addr:<Mac Addr>	REG RSP received
CPE Mac Addr:<Mac Addr>	DSA REQ received
CPE Mac Addr:<Mac Addr>	DSA ACK received
CPE Mac Addr:<Mac Addr>	DSC REQ received
CPE Mac Addr:<Mac Addr>	DSC ACK received
CPE Mac Addr:<Mac Addr>	DSD REQ received
CPE Mac Addr:<Mac Addr>	DSD RSP received
CPE Mac Addr:<Mac Addr>	SBC REQ queued
CPE Mac Addr:<Mac Addr>	REG REQ queued
CPE Mac Addr:<Mac Addr>	Establishing provisioned connection
CPE Mac Addr:<Mac Addr>	Wait for DSA, DSC, DSD Response Timer Expired
CPE Mac Addr:<Mac Addr>	Wait for Trasaction End Timer Expired
CPE Mac Addr:<Mac Addr>	Wait for DSA/DSC Acknowledge Timer Expired
CPE Mac Addr:<Mac Addr>	Wait for Registration Response Timer Expired
CPE Mac Addr:<Mac Addr>	Wait for registration response Timer expited
CPE Mac Addr:<Mac Addr>	Wait for SBC-RSP Timer Expired
CPE Mac Addr:<Mac Addr>	Wait for SBC-RSP Timer Expired

B

Command Line Interface (CLI)

Each Base Station Unit includes a simple command line interface (CLI) accessible using Telnet via the RJ45 Connector and the front-panel RS-232 craft port. The CLI is intended primarily for troubleshooting and debug use under direction of Aperto personnel.

Please Refer to PacketMax CLI Reference Manual, Rev B for further information on the commands.

NOTE: CLI is not a supported management interface

B.1 Accessing the CLI

To access and use the Base Station Unit's command line interface:

1. Telnet to the Base Station Unit's IP address, or connect directly to the RS-232 craft port.
2. At the Login: prompt, enter ISP. (There is also a Debug logon level, which is re-served for Aperto use.

   NOTE: All CLI entries, including logon level and password, are case-sensitive.

3. At the Password: prompt, enter the correct password for the specified logon level.

   NOTE: The default password is isp (case-sensitive). Passwords can be changed via the WaveCenter Configuration Manager, SNMP, and the CLI.

4. When the **CLI#** prompt appears, you are in the CLI.
5. Figure B-1 shows sample CLI displays.

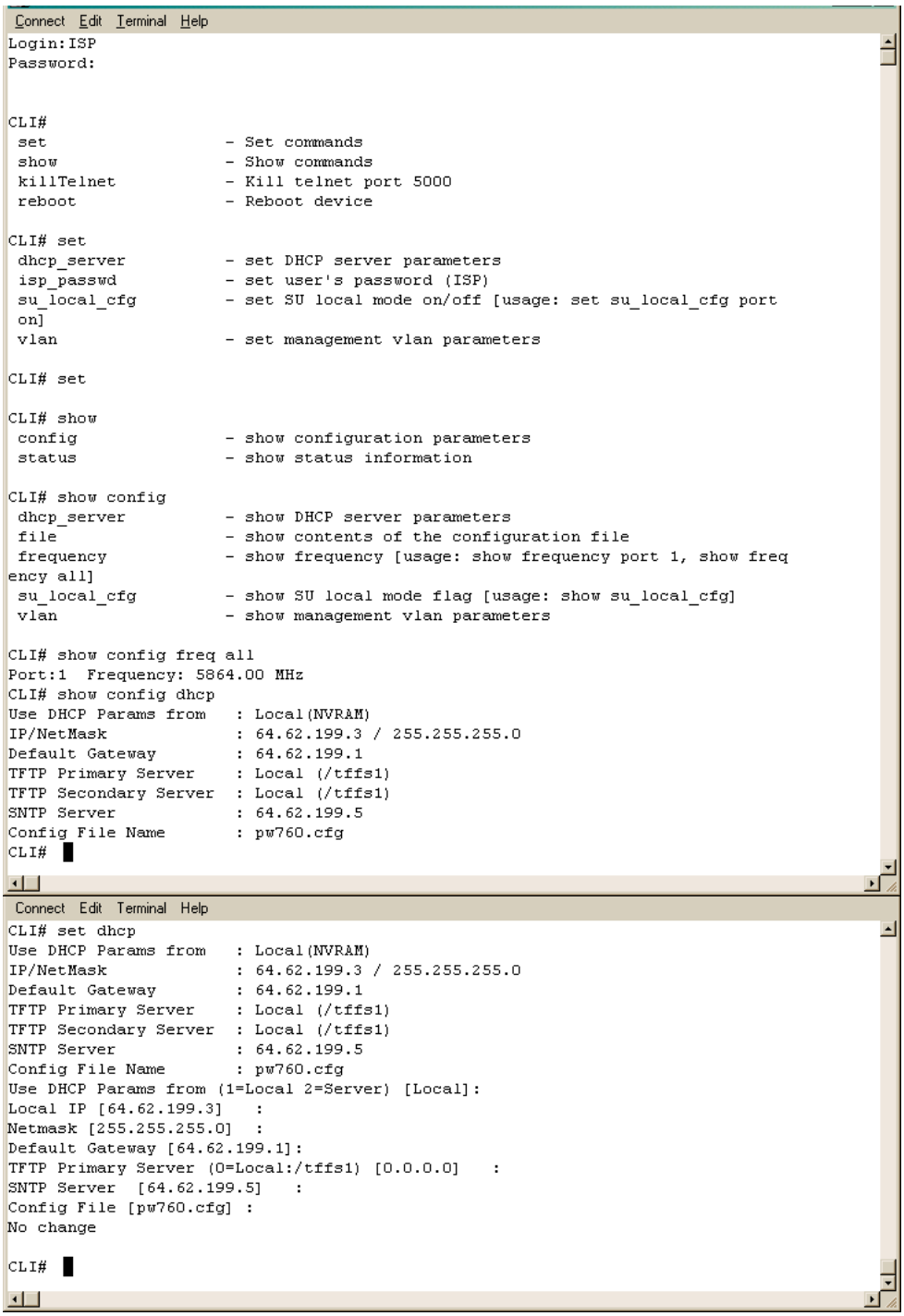


Figure B-1 Examples of BS Command Line Interface (CLI)

B.2 Commands

PacketMax 5000 CLI commands are defined in Table B-1. All commands are case-sensitive.

2.2.1 Command Help

The CLI provides command help as follows:

- For a list of commands, type **?** (the **?** will not appear on the screen; pressing [Enter] is not necessary). The CLI will respond with a list of the available command groups.
- To see the specific commands in a group, type the group name followed by **?** (again, the **?** will not appear, and pressing [Enter] is not necessary).
- To display information about the use of a specific commands, including command parameters, enter the command followed by **?**.

2.2.2 Command Entry

Commands can be entered all at once or in parts.

If a partial command is typed and [Enter] is pressed, the prompt will change to include that partial command in parentheses. For example:

```
CLI# show
CLI(show)#
```

If a partial command is typed and ? is pressed, options for the next part of the command will be listed, and the prompt will change to include that partial command following #. For example:

```
CLI# show ?
```

In either case, the user then enters the rest of the desired command.

NOTE: When the prompt includes part of a command, typing [ctrl-Z] returns the CLI to the top-level CLI# prompt.

Table B-1 Base Station Unit CLI Commands

Command	Function
config->dhcp> params	Configures DHCP params
config ->password	Configures the password
config ->mgmt ->vlan ->id	Configures the management VLAN ID
show ->dhcp ->params	Shows the DHCP params configured
show ->msc	Shows the status of the msc
show -> device->running-cfg- file -> msc/wsc/ss	This command doesn't shows the config file on the screen, But generates the config file in text format and stores in "/ram0" directory
Reboot	reboot -> msc

2.2.3 Error Messages

Error messages which may be returned by the BS CLI include the following:

- Error: Bad Command — command has been entered incorrectly.
- Error: Invalid Parameter — command parameter has been entered incorrectly.
- Not applicable for BS — command applies to SS CLI only.
- Passwords are not the same — when setting a password, two password entries do not match.

NOTE: The highest priority in Aperto Networks' system is passing of traffic. The command line interface will be slow to respond if all bandwidth on the ports is flooded. This will most likely happen in denial of service attacks from the users and at the same time in the infrastructure. If the infrastructure is clean from attacks, the CLI will be available.

C

Cables, Spares and Accessories

This appendix provides complete Base Station products, accessories and cable details for various PacketMax installation requirements.

C.1 PacketMax 5000 Products and Accessories

PacketMax Base Station IDU, cables, connector, Antennas and radio products and their Part numbers are listed in Table C-1 toTable C-8.

C.2 Cable Assembly and Testing Accessories

Table C-8 identifies accessories that will simplify cable installation.

Table C-1 PacketMax 5000 Multi-Sector Base Station IDU - Factory Integrated Build-to-order Systems

Part Number	Product Description
PM5000X-BASE-CHASSIS-DC2	PM 5000 CHASSIS - DC Power Option, NR Includes: ATCA Chassis, CD-ROM, Fan Unit
PM5000X-BASE-CHASSIS-AC	PM 5000 CHASSIS - AC Power Option, NR Includes: ATCA Chassis, CD-ROM, Fan Unit, 1 AC Power Supply
PM5000X-BASE-CHASSIS-AC2	PM 5000 CHASSIS - Dual AC Power Option, NR Includes: ATCA Chassis, CD-ROM, Fan Unit, 2 AC Power Supplies
PM5000X-MSCC	PM 5000 Main System Controller Card - GBE Copper Includes: Software License for 100 CPEs

Table C-1 PacketMax 5000 Multi-Sector Base Station IDU - Factory Integrated Build-to-order Systems

PM5000X-WSC-S-24	PM 5000 WSC - Wireless System Controller, 24 Volt
PM5000-WSC-48	PM 5000 WSC - Wireless System Controller for QWC, 48 Volt
PM5000-QWC	PM 5000 QWC - Quad Wireless Controller
PW-PWR-01	AC Power Cord, North American
PW-PWR-02	AC Power Cord, EU(FR,DE,PL)
PW-PWR-03	AC Power Cord, EU(CL,IT)
PW-PWR-04	AC Power Cord, EU(UK,IE)
PW-PWR-05	AC Power Cord, Australia
PW-PWR-06	AC Power Cord, South Africa

Table C-2 PacketMax 5000 Multi-Sector Base Station IDU - A-LA-CARTE-SPARES

Part Number	Product Description
PM5000X-MSCC-SPARE	PM 5000 MSC Card - GBE Copper (10/100/1000), NR, SPARE Includes: Software License for 100 CPEs
PM5000X-WSC-S-24-SPARE	PM 5000 WSC - Wireless System Controller, NR, SPARE
PA-FUSE-PM 5000	Replacement Fuse for PM 5000 IDU AC Chassis

Table C-3 PacketMax 5000 CPE Upgrade Licenses

Part Number	Product Description
CLK-PM5000-B	PM5000 Mode B, up to 200 CPE License
CLK-PM5000-C	PM5000 Mode C, up to 400 CPE License
CLK-PM5000-D	PM5000 Mode D, up to 800 CPE License
CLK-PM5000-E	PM5000 Mode E, up to 1200 CPE License
CLK-PM5000-F	PM5000 Mode F, up to product maximum CPE License
NOTE: Order the above CPE licenses along with the order for the IDU.	
CLK-PM5000-A-B	PM5000 Mode A (100) to B (200) CPE License Upgrade
CLK-PM5000-A-C	PM5000 Mode A (100) to C (400) CPE License Upgrade
CLK-PM5000-A-D	PM5000 Mode A (100) to D (800) CPE License Upgrade
CLK-PM5000-A-E	PM5000 Mode A (100) to E (1200) CPE License Upgrade
CLK-PM5000-A-F	PM5000 Mode A (100) to F (product max) CPE License Upgrade

Table C-3 PacketMax 5000 CPE Upgrade Licenses

Part Number	Product Description
CLK-PM5000-B-C	PM5000 Mode B (200) to C (400) CPE License Upgrade
CLK-PM5000-B-D	PM5000 Mode B (200) to D (800) CPE License Upgrade
CLK-PM5000-B-E	PM5000 Mode B (200) to E (1200) CPE License Upgrade
CLK-PM5000-B-F	PM5000 Mode B (200) to F (product max) CPE License Upgrade
CLK-PM5000-C-D	PM5000 Mode C (400) to D (800) CPE License Upgrade
CLK-PM5000-C-E	PM5000 Mode C (400) to E (1200) CPE License Upgrade
CLK-PM5000-C-F	PM5000 Mode C (400) to F (product maximum) CPE License Upgrade
CLK-PM5000-D-E	PM5000 Mode D (800) to E (1200) CPE License Upgrade
CLK-PM5000-D-F	PM5000 Mode D (800) to F (product maximum) CPE License Upgrade
CLK-PM5000-E-F	PM5000 Mode E (1200) to F (product maximum) CPE License Upgrade

NOTE: These CPE licenses are ordered after the IDU has shipped (and perhaps installed). Be sure to include the MAC address GBE Ethernet Backhaul Ethernet Port on the MSC Card.

Table C-4 PacketMax Base Station Radios (for PM5000)

Part Number	Product Description
PM-BSR-35X	PacketMAX 3.4-3.6GHz, Base Station Radio
PM-BSR-33X	PacketMAX 3.3-3.4GHz, Base Station Radio
PM-BSR-58	PacketMAX 5.8 GHz Base Station Radio

Table C-5 PacketMax Base Station Antennas

Part Number	Product Description
PWA3500D-60	3.4-3.7 GHz 16 Dbi, 60 Deg., Dual Polarization
PWA3500D-90	3.4-3.7 GHz 16 Dbi, 90 Deg., Dual Polarization
PWA3300D-60	3.3-3.8 GHz 16 Dbi, 60 Deg., Dual Polarization
PWA3300D-90	3.3-3.8 GHz 16 Dbi, 90 Deg., Dual Polarization
PWA3500V-360	3.4-3.7 GHz 10 Dbi, 360 Deg, Vertical Polarization
PWA3300V-360	3.3-3.6 GHz 10 Dbi, 360 Deg, Vertical Polarization
PWA3500V-90	3.3-3.8 GHz 16 dBi, 90 Deg., Vertical Polarization
PWA3500V-120	3.3-3.8 GHz 13 dBi, 120 Deg, Vertical Polarization
PWA5800D-60	5.15-5.875 GHz, 16 dBi, 60 Deg, Dual Polarization

Table C-5 PacketMax Base Station Antennas

Part Number	Product Description
PWA5800D-90	5.25-5.875 GHz, 16 dBi, 90 Deg, Dual Polarization
PWA5800V-360	5.725-5.875 GHz, 12 dBi, 360 Deg, Vertical Polarization

C.3 PacketMax Base Station Spares and Accessories

Table C-6 Cable Specs

Part Number	Product Description
PA-RFCABLE-03	RF Cable, BSR Radio to Antenna, Type N Male to N Male, LMR600, 36in Recommendation: Order one RF Cable Per Base Station Radio
PA-CABLE-LMR400-01	LMR 400-75 Cable, 1000ft reel
PA-CABLE SERIAL-RJ 11-DB9	Cable, Serial, RJ11 to DB 9, PacketMax 5000 IDU, MSC
PA-CONN-LMR400-F	Connector for LMR400-75 Cable, Female F Type
PA-TOOLS-LMR400	Cable Install Kit,LMR400-75 Crimp Tool, Cable Prep and Debugging Tool
PM-BSR-MOUNT	Pole mounting bracket for Base Station Radio.
PA-CABLE-LMR400-01	IF Cable, outdoor rated high quality coax, 1000 feet
PA-CONN-LMR400-F	F-Type Connectors, one connector, two needed for IF Cable

Table C-7 PacketMAX Surge Protectors

Part Number	Product Description
PA-SP-OUTDOOR-08	PacketMAX IF / Coax Surge Protector Kit (two needed), Protects BSR and IDU at IF Port Includes: 2 Surge Protectors and 2 Grounding Cables
PS-SP-OUTDOOR-09 Optional item (sold separately)	RF / Coax Surge Protector (one needed), Protects BSR at Antenna Port NOTE: RF Surge Protector required for OMNI Antenna.

Table C-8 PacketMAX 5000 IDU Spare Parts

Part Number	Product Description
PM5000-CHASSIS-AC	PM 5000 AC Chassis (with Fan Unit) Note: Does not include an AC power supply
PM5000-AC-220-1	PM 5000 AC Power Supply, SPARE
PM5000-FAN-1	PM 5000 Fan Unit Module (w/filter and filter carrier), SPARE
PM5000-FANFILTER-10PK	PM 5000 Fan Air Filter (10 pack)
PM5000-FRONTPANEL	PM 5000 Front Panel Filler Panel
PM5000-FRONTPANEL-5PK	PM 5000 Front Panel Filler Panel (5 pack)

D

System Specifications

This appendix provides complete system specifications, such as the following:

- Physical interfaces of PM 5000 - 12 sector
- Physical interfaces of PM 5000 - 4 sector
- QoS and Networking Parameters
- Dimensions and Weight
- Radio Specifications
- Transmit Output Power Regulations

D.1 Physical interfaces of PM 5000 - 12 sector

Table D-1 Specifications for Interfaces of PM 5000- 12 sector

Device	Interface Type	Interface Spec / Standard	Connector Type and Spec
PM 5000 Chassis	DC Power Input	DC Power Input Recommended Operating Range: -43 to -58 Volts Absolute Maximum Range: -36 to -72 Volts	Qty=2, 3-Pin Terminal Block
	AC Power Input	AC Power Input, 100 to 240V VAC Volts, 50 to 60Hz	IED 320 CONNEC-TOR
MSC Cop-per	Backhaul - Data “1000 Base-T”	1000 Base-T, Ethernet, IEEE 802.3, Auto Sense, MDI/MDI-X Maximum IP Packet Size: 1,600 bytes (including the Ethernet Header and excluding the FCS)	RJ45 (Shielded)
	Backhaul - Data “100 Base-T””	100 Base-T, Ethernet, IEEE 802.3 Maximum IP Packet Size: 1,600 bytes (including the Ethernet Header and excluding the FCS)	RJ45 (Shielded)
	Main Manage-ment “10/100 Base-T”	100/10 Base-T, Ethernet Maximum IP Packet Size: 1,548 bytes (including the Ethernet Header and excluding the FCS)	RJ45 (Shielded)
	Main Manage-ment “RS 232”	Serial RS232	RJ11
	SYNC "Main"	Main Sync Input, Pulse-Per-Second (PPS), 1 Hertz, TTL Voltage Levels	BNC, Input, Male, 50 Ohm
	SYNC "PW1000 Out"	Main Sync Output, Pulse-Per-Second (PPS), 1 Hertz, TTL Voltage Levels Use this port to Daisy Chain to Another PM5000 Unit or Future PM3000 device. Note: This port is also reserved for synchronization with PacketWave 1000/760 (future possible feature), Pulse Per Frame (PPF) format.	BNC, Output, Male, 50 Ohm
	EXT. CLK “IN”	10 MHz Clock Input, TTL Voltage Levels	BNC, Input, Male, 50 Ohm
	EXT. CLK “OUT”	10 MHz Clock Output, TTL Voltage Levels	BNC, Output Male, 50 Ohm
	SHELF MAN-AGER “TELCO”	Dry Relay Alarm Ports	Mini Sub-D, 15 Pin, Female
	SHELF MAN-AGER “10-Base T”	10 Base-T, Ethernet Not Supported, For Internal Use Only	RJ45 (Shielded)
	SHELF MAN-AGER “RS 232”	Serial RS232 Port Not Supported, For Internal Use Only	Audi Jack, Female, 3.5mm
MSCF Fiber Card	BACKHAUL “1000BaseFX”	1000 BaseFX, Ethernet Maximum IP Packet Size: 1,600 bytes (including the Ethernet Header and excluding the FCS)	LC-Type, Multi-Mode, 850 nm Maximum Fiber Cable Length: - 275 meters for 62.5/125 um fiber cable - 550 meters for 50/125 um fiber cable

Table D-1 Specifications for Interfaces of PM 5000- 12 sector

	MAIN MANAGEMENT "100-BaseT"	100/10 Base-T, Ethernet Maximum IP Packet Size: 1,548 bytes (including the Ethernet Header and excluding the FCS)	RJ45 (Shielded)
	MAIN MANAGEMENT "RS232"	Serial RS232	RJ11
	SYNC "Main"	Main Sync Input, Pulse-Per-Second (PPS), 1 Hertz, TTL Voltage Levels	BNC, Input, Male, 50 Ohm
	SYNC "PW1000 Out"	Main Sync Output, Pulse-Per-Second (PPS), 1 Hertz, TTL Voltage Levels Use this port to Daisy Chain to Another PM5000 Unit or Future PM3000 device.	BNC, Output, Male, 50 Ohm
	EXT. CLK "IN"	10 MHz External Clock Input, TTL Voltage Levels	BNC, Input, Male, 50 Ohm
	EXT. CLK "OUT"	10 MHz External Clock Output, TTL Voltage Levels	BNC, Output Male, 50 Ohm
	SHELF MANAGER "TELCO"	Dry Relay Alarm Ports	Mini Sub-D, 15 Pin, Female
	SHELF MANAGER "10-BaseT"	10 Base-T, Ethernet Not Supported, For Internal Use Only	RJ45 (Shielded)
	SHELF MANAGER "RS232"	Serial RS232 Port Not Supported, For Internal Use Only	Audio Jack, Female, 3.5mm
WSC-48	IF	IF Port for Connection to Base Station Radio 20 MHz Reference Signal 70 MHz IF Signal 260 and 420 MHz Telemetry 52 Volt DC Output Voltage	Type-F, Male, 75 Ohm **Maximum IF Cable Length:** LMR200-75 100 Meters LMR240-75 150 Meters LMR400-75 250 Meters LMR600-75 350 Meters "LMR" is a specific brand of cable
WSC-S-24	IF	IF Port for Connection to Base Station Radio 20 MHz Reference Signal 70 MHz IF Signal 260 and 420 MHz Telemetry 24 Volt DC Output Voltage	Type-F, Male, 75 Ohm **Maximum IF Cable Length:** LMR200-75 100 Meters LMR240-75 150 Meters LMR400-75 250 Meters LMR600-75 350 Meters "LMR" is a specific brand of cable

Table D-1 Specifications for Interfaces of PM 5000- 12 sector

Base Station Radio	Antenna	RF Antenna Port	Type-N, Female, 50 Ohm
	IF	IF Port (70 MHz IF Signal and 24 Volt DC Output Voltage)	Type-F, Male, 75 Ohm Maximum IF Cable Length: LMR600/Heliax 250 Meters LMR400 200 Meters
	Management	Serial Management Port Not Supported, For Internal Use Only	Mini Sub-D, 9 Pin

D.2 Physical interfaces of PM 5000 - 4 sector

Table D-2 Specifications for Interfaces of 4 Sector BS

Device	Interface Type	Interface Spec / Standard	Connector Type and Spec
PM 5000 Chassis	DC Power Input	**DC Power Input** Recommended Operating Range(1): -43 to -58 Volts Absolute Maximum Range(2): -36 to -72 Volts	Qty=2, 3-Pin Terminal Block
	AC Power Input	AC Power Input, 100 to 240V VAC Volts, 50 to 60 Hz	IED 320 CONNEC-TOR
PM 5000 MSC Card	Backhaul - Data “1000 Base-T”	1000 Base-T, Ethernet, IEEE 802.3, Auto Sense, MDI/MDI-X **Maximum IP Packet Size:** 1,600 bytes (including the Ethernet Header and excluding the FCS)	RJ45 (Shielded)
	Backhaul - Data “100 Base-T””	100 Base-T, Ethernet, IEEE 802.3 **Maximum IP Packet Size:** 1,600 bytes (including the Ethernet Header and excluding the FCS)	RJ45 (Shielded)
	Main Man-agement “10/100 Base-T”	100/10 Base-T, Ethernet **Maximum IP Packet Size:** 1,548 bytes (including the Ethernet Header and excluding the FCS)	RJ45 (Shielded)
	Main Man-agement “RS 232”	Serial RS232	RJ11
	SYNC "Main"	Main Sync Input, Pulse-Per-Second (PPS), 1 Hertz, TTL Voltage Levels	BNC, Input, Male, 50 Ohm
	SYNC "PW1000 Out"	Main Sync Output, Pulse-Per-Second (PPS), 1 Hertz, TTL Voltage Levels Use this port to Daisy Chain to Another PM5000 Unit or Future PM3000 device. Note: This port is also reserved for synchronization with PacketWave 1000/760 (future possible feature), Pulse Per Frame (PPF) format.	BNC, Output, Male, 50 Ohm
	EXT. CLK “IN”	10 MHz Clock Input, TTL Voltage Levels	BNC, Input, Male, 50 Ohm
	EXT. CLK “OUT”	10 MHz Clock Output, TTL Voltage Levels	BNC, Output Male, 50 Ohm
	SHELF MAN-AGER “TELCO”	Dry Relay Alarm Ports	Mini Sub-D, 15 Pin, Female
	SHELF MAN-AGER “10-Base T”	10 Base-T, Ethernet Not Supported, For Internal Use Only	RJ45 (Shielded)
	SHELF MAN-AGER “RS 232”	Serial RS232 Port Not Supported, For Internal Use Only	Audi Jack, Female, 3.5mm
WSC Card	IF	IF Port, 70 MHz 24 V Output Voltage	Type-F, Male, 75 Ohm

Table D-2 Specifications for Interfaces of 4 Sector BS (Continued)

Base Station Radio	Antenna	RF Antenna Port	Type-N, Female, 50 Ohm
	IF	IF Port (70 MHz IF Signal and 24 Volt DC Output Voltage)	Type-F, Male, 75 Ohm **Maximum IF Cable Length:** LMR600/Heliax 250 Meters LMR400 200 Meters
	Management	Serial Management Port Not Supported, For Internal Use Only	Mini Sub-D, 9 Pin

4.2.0.1 Operation

Table D-3 Operation Specifications

Data Rates	384 kbps to 10 Mbps; Bursts up to 20 Mbps
Frequency Bands	3.3 - 3.6 GHz
Duplexing Mode	Time Division Duplexing (TDD)
Error Control	Advanced MAC-layer ARQ; Reed Solomon FEC with variable block length and correction factor.

4.2.0.2 Power Requirements

AC Option: 100 to 240 V AC, 47 to 63 Hz

DC Option:

- Recommended Operating Range(1): -43 to -58 Volts
- Absolute Maximum Range(2): -36 to -72 Volts

Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Power consumption for the PacketMax 5000 base station is a function of the number of provisioned MSC cards (backhaul) as well as provisioned WSC (channel elements).

D.3 QoS and Networking Parameters

Table D-4 QoS Parameters

QoS Parameters	PM 5000	PM 100
Maximum CPE's Per BSU Wireless Sector	512	n/a (not applicable)
Maximum MAC Addresses (Bridging and VLAN)	128,000	5
Max Service Classes per BSU	1024	n/a
Max IP Filter Rules	896 64 rules for each of the 14 interfaces (12 wireless, 1 backhaul, 1 management)	64 32 rules for each interfaces (1 wireless, 1 ethernet)
Max User Service Flows (unidirectional) per SS Unmanaged SS	15	9
Max User Service Flows (unidirectional) per SS Managed SS	14	8
Max User Service Flows per Wireless Sector Unidirectional, Unmanaged	7,680	n/a
Max User Service Flows per Wireless Sector Unidirectional, Managed	7,168	n/a
Max QoS Classifiers per Wireless Sector (WSC)	8,000	n/a
Max QoS Classifiers per BSU	96,000	n/a
Max QoS Classifiers per SS - Downstream	16	n/a
Max QoS Classifiers per SS - Upstream	n/a	128
Max QoS Classifiers per Service Flow	16	16
Max # of VLANs Per BSU	4094 (1 to 4094 usable)	n/a
Max # of VLAN Classifier Rules Per SS	n/a	64
Max # of Concurrent VLAN's Per SS	n/a	16

4.3.0.1 Networking

Table D-5 Networking Parameters

Protocols	QoS	Service Classes	DHCP
- Variable-length Subnet Mask (VLSM) - Classless Internet Domain Routing (CIDR) - VLAN	ToS	- CBR (Constant bit rate) - CIR (Committed information rate) - BE (Best effort)	Client

4.3.0.2 Management

- Centralized management via Element Management System
- Embedded web agent supporting SNMP and CLI interfaces
- SNMP (RFC 1157), MIB II (RFC 1213), Aperto private MIB, Wimax-IF-MIB (objects for 802.16 based SS and BS)
- Software upgrades through TFTP

D.4 Dimensions and Weight

Table D-6 Dimensions and Weight

Base Station IDU and BSR Part Numbers	Weight (Lbs / Kg)	Dimensions (inches)	Dimensions (millimeters)
PM5000-BASE-CHASSIS-DC2	27 / 12.2	19 x 17 x 8.6	482 x 431 x 218
PM5000-BASE-CHASSIS-AC	30 / 13.6	19 x 17 x 8.6	482 x 431 x 218
PM5000-BASE-CHASSIS-AC2	33 / 15	19 x 17 x 8.6	482 x 431 x 218
PM5000-MSCC	5 / 2.3	12.6 x 11.75 x 1.3	320 x 298 x 33
PM5000-WSC-S-24	5 / 2.3	12.6 x 11.75 x 1.3	320 x 298 x 33
PM5000X-BASE-CHASSIS-DC2	27 / 12.2	19 x 17 x 8.6	482 x 431 x 218
PM5000X-BASE-CHASSIS-AC	30 / 13.6	19 x 17 x 8.6	482 x 431 x 218
PM5000X-BASE-CHASSIS-AC2	33 / 15	19 x 17 x 8.6	482 x 431 x 218
PM5000X-MSCC	5 / 2.3	12.6 x 11.75 x 1.3	320 x 298 x 33
PM5000-AC-220	3 / 1.4	11 x 5.5 x 1.6	279 x 140 x 41
PM-BSR-33 and PM-BSR-33X	10 / 4.5	11.75 x 11.75 x 2.75	298 x 298 x 70
PM-BSR-35 and PM-BSR-35X	10 / 4.5	11.75 x 11.75 x 2.75	298 x 298 x 70
PM-BSR-58	10 / 4.5	11.75 x 11.75 x 2.75	298 x 298 x 70

D.5 Environmental

Table D-7 Environmental Parameters

PacketMAX 5000 IDU	PacketMAX 5000 ODU
0 degC to 40 degC, 10% to 90% relative humidity	-45 degC to 60 degC, 0% to 100% relative humidity, Ingress Protection

D.6 Radio Specifications

4.6.1 PM-BSR-33 and PM-BSR-35 Radio Specifications

For Aperto Part Numbers PM-BSR-33(X) [3.3-3.4GHz Base Station Radio] and PM-BSR-35 (X) [3.4-3.6GHz, Base Station Radio] following are the detailed specifications.

4.6.1.1 General Specifications

Table D-8 BSR General Specifications

General Specifications	
Frequency Range	3.300 to 3.400 GHz and 3.400 to 3.600 GHz
Channel Bandwidth	3.0, 3.5, 5.0, 5.5, and 7.0 MHz
Antenna Port Return Loss	10 db
Access Method	TDD

4.6.1.2 Transmitter Specifications

Table D-9 Transmitter Specifications

Transmitter Specifications	
Output Power [Guaranteed (avg Pout)]	- QPSK3/4 - 20 dBm - 16 QAM3/4 - 20 dBm - 64 QAM3/4 - 20 dBm
Frequency Step Size	250kHz
Transmit Power Accuracy	+/-1dB @ Max output power +/-3dB over full range.
Manual SW TX Attenuation	30dB
Frequency Stability	+- 4 ppm
Phase noise	@ 10 KHz offset, -85 dBc/Hz @ 100 KHz offset, -100 dBc/Hz @ 1 MHz offset -105 dBc/Hz

4.6.1.3 Receiver Specifications

Receiver Specifications	
Rx Input Dynamic Range	65 dB
Max Rx Input Power, Operational	-30dBm
Max. Rx Input Power, No Damage	0dBm
Phase noise	@ 10 KHz offset, -85 dBc/Hz @ 100 KHz offset, -100 dBc/Hz @ 1 MHz offset -105 dBc/Hz
Rx Noise Figure	@ Hi signal input (-30 dBm) 36 dB @ Lo signal input (-70 dBm) 4.5 dB

4.6.1.4 Sensitivity (dBm @ BER 10-6)For 3.5 MHz, 5.5 MHz, and 7.0 MHz

Table D-10 Sensitivity

Sensitivity	3.5 MHz	5.5 MHz	7.0 MHz (Future)
QPSK-1/2	-92.1	-90.0	-89.0
QPSK-3/4	-89.6	-87.5	-86.5
16QAM-1/2	-86.6	-86.6	-83.5
16QAM-3/4	-83.1	-81.0	-80.0
64QAM-2/3	79.1	-77.0	-76.0
64QAM-3/4	-77.1	-76.0	-74.0

4.6.1.5 Minimum Interference Adjacent Channel Interference (ACI)

Table D-11 **Channel Interference**

	1st Adjacent Channel	2nd Adjacent Channel
16QAM-3/4	13dB	32dB
64QAM-3/4	6dB	25dB

4.6.1.6 Electrical and Mechanical

Table D-12 General Electrical and Mechanical Specifications

General Specifications	
Power Consumption	30 Watts
IF Frequency	70 MHz
Connectors (IF)	Female Type-F
Connectors (Antenna)	Female Type-N
Pole Mount Dimension (Max / Min)	2.5 inches to 4.5 inches

Table D-13 BSR Dimensions

Base Station IDU and BSR Part Numbers	Weight (Lbs / Kg)	Dimensions (inches)	Dimensions (millimeters)
PM-BSR-33 and PM-BSRX-33	10 / 4.5	11.75 x 11.75 x 2.75	298 x 298 x 70
PM-BSR-35 and PM-BSRX-35	10 / 4.5	11.75 x 11.75 x 2.75	298 x 298 x 70

4.6.1.7 Input DC Voltage Range

Table D-14 Input DC Voltage Range

BSR Part Number	Input DC Voltage Range
BSR-33X	18-36 VDC
BSR-35X	18-36 VDC
BSR- 35X-48	18-54 VDC
BSR-33	18-54 VDC
BSR-35	18-54 VDC

WARNING: The IF port on the PM 3000 outputs 52 Volts DC to power the base station radio. It is important that only the radios mentioned in the table are used with the PM 3000; because, these radios support the higher DC voltage input range. The usage of radios that only support up to

24 V DC input, like BSR-33X or BSR-35X, with the PM 3000 can result in severe damage to the radio.

4.6.1.8 Environment

Table D-15 Environment Specifications

Operating Temperature	-35 C TO 60 C
Storage Temperature	-40 C to 125C
Storage and Transit Altitude	ASTM D6653
Relative Humidity	0% - 100 %
Operating Altitude	10,000 feet
Wind	125mph
Water	IP65
Humidity	5 ~ 95%
Dust	IP65
Salt	MIL-STD-883E/3% @23C for 96hrs
Transit and Vibration	ASTM D3580
Spurrious Emissions	IAW CEPT/ERC/REC 74-01E
Safety Standards	EN 609501-1: 2002
EMI Standards	EN300 385[14], Class A

4.6.2 PM-BSR-58 Radio Specifications

For Aperto Part Numbers PM-BSR-58 [5.8 GHz Base Station Radio], following are the detailed specifications.

4.6.2.9 General Specifications

Table D-16 General Specifications

Frequency Range	5727 to 5848 MHz (FCC only devices) Note: World SKU of the BSR is 5725 to 5925 MHz.
Channel Bandwidth	3.5, 5.0, and 7.0 MHz
Antenna Port Return Loss	10 db
Access Method	TDD

4.6.2.10 Transmitter Specifications

Table D-17 Transmitter Specifications

Output Power [Guaranteed (avg Pout)]	- BPSK -20dBm - QPSK3/4 - 20 dBm - 16 QAM3/4 - 20 dBm - 64 QAM3/4 - 20 dBm
Frequency Step Size	500kHz
Transmit Power Accuracy	+/-1dB @ Max output power +/-3dB over full range.
Manual SW TX Attenuation	30dB
Frequency Stability	+- 4 ppm
Phase noise	@ 10 KHz offset, -82 dBc/Hz @ 100 KHz offset, -96 dBc/Hz @ 1 MHz offset -105 dBc/Hz

4.6.2.11 Receiver Specifications

Table D-18 Receiver Specifications

Receiver Specifications	
Rx Input Dynamic Range	60 dB
Max Rx Input Power, Operational	-35dBm
Max. Rx Input Power, No Damage	0dBm
Phase noise	@ 10 KHz offset, -85 dBc/Hz @ 100 KHz offset, -100 dBc/Hz @ 1 MHz offset -105 dBc/Hz
Rx Noise Figure	@ Hi signal input (-30 dBm) 36 dB @ Lo signal input (-70 dBm) 8 dB

4.6.2.12 Receiver Sensitivity (dBm @ BER 10-6): for 3.5 MHz, 5.5 MHz and 7.0 MHz

Table D-19 Receiver Sensitivity

Modulation	3.5 MHz	5.0 MHz	5.5 MHz	7.0 MHz
BPSK-1/2	-92	-98	-90.0	-94.0
QPSK-1/2	-89	-96.2	-87.0	-92.4
QPSK-3/4	-86	-94.3	-84.5	-89.1

Modulation	3.5 MHz	5.0 MHz	5.5 MHz	7.0 MHz
16QAM-1/2	-83	-90.5	-81.5	-86.6
16QAM-3/4	-80	-87.4	-78.0	-82.3
64QAM-2/3	-76	-83.6	-74.0	-78.2
64QAM-3/4	-74	-81.4	-73.0	-73.7

4.6.2.13 Minimum Interference Adjacent Channel Interference (ACI)

Table D-20 Channel Interference

	1st Adjacent Channel	2nd Adjacent Channel
16QAM-3/4	13dB	32dB
64QAM-3/4	6dB	25dB

4.6.2.14 Electrical and Mechanical

Table D-21 General Specifications

General Specifications	
Power Consumption	30 Watts
IF Port Frequencies	70 MHz Reference SIgnal, 30 MHz Signal, 280+420 Telemetry signal.
Connectors (IF)	Female Type-F
Connectors (Antenna)	Female Type-N
Pole Mount Dimension (Max / Min)	2.5 inches to 4.5 inches
Input DC Voltage Range	18-54 VDC

Table D-22 5.8 GHz BSR Dimensions

Base Station IDU and BSR Part Numbers	Weight (Lbs / Kg)	Dimensions (inches)	Dimensions (millimeters)
PM-BSR-58	10 / 4.5	11.75 x 11.75 x 2.75	298 x 298 x 70

WARNING: The IF port on the PM 3000 outputs 52 Volts DC to power the base station radio. It is important that only the radios mentioned in the table are used with the PM 3000; because, these radios support the higher

DC voltage input range. The usage of radios that only support up to 24 V DC input, like BSR-33X or BSR-35X, with the PM 3000 can result in severe damage to the radio.

4.6.2.15 Environmental

Table D-23 Environmental Specifications

Operating Temperature	-35 C TO 60 C
Storage Temperature	-40 C to 125C
Storage and Transit Altitude	ASTM D6653
Relative Humidity	0% - 100 %
Operating Altitude	10,000 feet
Wind	125mph
Water	IP65
Humidity	5 ~ 95%
Dust	IP65
Salt	MIL-STD-883E/3% @23C for 96hrs
Transit and Vibration	ASTM D3580
Spurrious Emissions	IAW CEPT/ERC/REC 74-01E
Safety Standards	EN 609501-1: 2002
EMI Standards	EN300 385[14], Class A

4.6.3 Antenna Specifications

Table D-24 Antenna Specifications

Part Numbers	Parameter	Specification
PWA3500V-90 (sector 90º)	Frequency range	3.3-3.8 GHz
	Nominal Gain	16dBi
	Beamwidth: Azimuth Elevation	 90º 7 º
	Polarization	Vertical
PWA3300D-60 (sector60º)	Frequency range	3.3-3.8 GHz
	Nominal Gain	16 dBi
	Beamwidth: Azimuth Elevation	 60º 8º
	Polarization	Dual
PWA3300D-90 (sector 90º)	Frequency range	3.3-3.8 GHz
	Nominal Gain	15.5 dBi
	Beamwidth: Azimuth Elevation	 90º 8º
	Polarization	Dual
	Country	US
PWA3500V-120 (sector 120º)	Frequency range	3.3-3.8 GHz
	Nominal Gain	13 dBi
	Beamwidth: Azimuth Elevation	 120º 7º
	Polarization	Vertical
PWA3500V-360 (sector 360º)	Frequency range	3.4-3.7 GHz
	Nominal Gain	10 dBi
	Beamwidth: Azimuth Elevation	 360º 9º
	Polarization	Vertical
PWA3300V-360 (sector 360º)	Frequency range	3.3-3.6 GHz
	Nominal Gain	10 dBi
	Beamwidth: Azimuth Elevation	 360º 9º
	Polarization	Vertical

Table D-24 Antenna Specifications

PWA5800D-60 (sector 60º)	Frequency range	5.725 - 5.875 GHz
	Maximum Gain	16 dBi (>17dBi typical)
	Beamwidth: Azimuth Elevation	 60º 10º
	Polarization	Dual
PWA5800D-90 (sector 90º)	Frequency range	5.725 - 5.875 GHz
	Maximum Gain	16 dBi (>17dBi typical)
	Beamwidth: Azimuth Elevation	 90º 8º
	Polarization	Dual
PWA5800V-360 (sector 360º)	Frequency range	5.725 - 5.875 GHz
	Maximum Gain	12 dBi
	Beamwidth: Azimuth Elevation	 360º 4.8º
	Polarization	Vertical

D.7 Antenna Types, Maximum Gains and Maximum Output Power Point to Multipoint Operation

Table D-25 Maximum Pout, Point to Multi-Point Operation

Antenna Type	Antenna Gain	3 and 5 MHz Channels	5 MHz Channels	7 MHz Channels
Omni	13 dBi	22 dBm	20.7 dBm	19.7 dBm
Panel	16.5 dBi	20 dBm	20 dBm	19.7 dBm
Parabolic Dish	31 dBi	5.5 dBm	5.5 dBm	5.5 dBm
60 Degree Sector	16.5 dBi	20.0 dBm	20.5 dBm	19.7 dBm
90 Degree Sector	16 dBi	20.5 dBm	20.5 dBm	19.7 dBm
120 Degree Sector	14 dBi	22 dBm	20.5 dBm	19.7 dBm

D.8 Transmit Output Power Regulations

While setting the transmit output power, professional must ensure that they do not exceed the maximum EIRP limit prevalent in the countries of their operation. Transmit Output Power can be adjusted via the **WSS Configuration** window of the Wave-Center EMS Pro. For more information on WSS configuration, refer to Configuring a Wireless Subscriber Sector (WSS) section of the *WaveCenter EMS Pro User Manual*.

The following table lists the EIRP limits for various countries:

EIRP Limit (dBm)		
Band	**US/Canada**	**EU**
902-928 MHz	36	NA
2.4 - 2.4835 GHz - Point-to-Multipoint	36	20
2.4 - 2.4835 GHz - Point-to-Point	When *G < 6:36* When $G \geq 6$, use the following equation: $36 - \frac{G-6}{3}$	20
5.15 - 5.25 GHz	23	23
5.25 - 5.35 GHz	30	23
5.47 - 5.725 GHz	30	30
5.725 - 5.850 GHz - Point-to-Multipoint	36	14
5.725 - 5.850 GHz - Point-to-Point	No Limit	14

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E

Certifications

E.1 PacketMax 5000 Wimax Forum Certificate

CERTIFICATION CERTIFICATE

WiMAX FORUM CERTIFIED

COMPANY NAME	Aperto
CERTIFICATION DATE	January 17, 2006

Air 1

PRODUCT NAME	PacketMAX 5000
PRODUCT MODEL	PM5000
DEVICE TYPE	Base Station
CERTIFICATION NUMBER	01- 0000000001
CERTIFICATION WAVE RELEASE	1.0
PROFILE	3.5GHz 3.5MHz TDD
HARDWARE VERSION	PM5000 WSC-S-24 Rev3 PM5000 MSC Rev7 PacketMax 3.5GHZ Radio Rev1
SOFTWARE VERSION	Build36 2005-12- 09
TESTED BY	CETECOM Laboratories, Malaga, Spain

Ron Resnick, President
WiMAX Forum

Ed Agis, Chair
Certification Working Group
WiMAX Forum

E.2 X509 Crypto License

/* crypto/x509/x509_vfy.c */
/* Copyright (C) 1995-1998 Eric Young (eay@cryptsoft.com)
 * All rights reserved.
 *
 * This package is an SSL implementation written
 * by Eric Young (eay@cryptsoft.com).
 * The implementation was written so as to conform with Netscapes SSL.
 *
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SUBSTITUTE GOODS
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INTERRUPTION)
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 * [including the GNU Public Licence.]
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F

Troubleshooting

F.1 Troubleshooting Issues and Tips

Table E-A lists symptoms/problems, the meaning of the problem, and any corrective action that should be taken.

Table F-1 Troubleshooting Problems and Corrective Actions

SYMPTOM/PROBLEM	WHAT IT MAY MEAN	WHAT TO DO
Subscriber Station		
Subscriber Station is having issues synching up with Base Station	Incorrect Frequency	Check AIM has the correct values for all these factors and if they are correct, then check the settings in WSS config file, in EMS.
	Incorrect Channel Width	
	Incorrect BS ID	
	BS wireless port is not operational.	
	The SS is out of range from the BS and is not able to receive any signal from the BS.	Move the SS to a different location and try again.
SS is not receiving IP address from the EMS server.	The EMS Server may not have the correct reservation for the SS.	Check the MAC address which might be wrong.
	The EMS Server may be not operational.	Check the EMS server on the machine on which it was installed and confirm if the process is running.

Table F-1 Troubleshooting Problems and Corrective Actions (Continued)

SS cannot register all its service flow.	If the number of SSs registering exceeds the number of supported SSs configure in the BS.	Move the SS to another sector.
	If the SS's configuration file specifies a larger number of Classifiers.	Reduce number of Classifiers.
	The SS's configuration file specifies Service Flows for which the BS does not have any reserved bandwidth.	Install more capacity or move the SS another sector.
Base Station		
MSC does not get an IP address from EMS.	Wrong Mac address	Check the Mac address of the port that you have connected to matches the Mac address in EMS. Verify the correct Mac address using the "showmsc" command (CLI Reference manual).
	Base Station and EMS are not on the same network.	Check the EMS and BS are on the same collision domain/same layer 2 subnet.
	More than one dhcp in the server.	Check dhcp and make sure that there is only one dhcp in the server.
Radio does not initialize	WSC and BSR are not connected properly.	Check to see if the cable is properly connected to the WSC and BSR. Check to see it meets the distance and cabling specifications listed in this manual. Use a known good WSC or BSR to isolate the failing portion.
TFTP failure	Config files are not in the right location and Backend Server is still running.	Point config files to the right location.
No DHCP entry	Using third party DHCP and TFTP and while adding SS and BS the DHCP entry will not be created.	Users have to manually create DHCP entry.
LED sequence unclear	Shelf Manager- WSC	
OOS LED - Does not indicate red	Indicates red, only when the system is out of service.	Wait till the OOS LED turns red. This implies the card is safe to remove.
Minor LED -Does not indicate orange color.	This LED indicates an orange color only when something is not working and there is a minor alarm.	
Link LED- Does not show solid green light.	This could imply that the WSC is not initialized	Check if WSC is initialized

Table F-1 Troubleshooting Problems and Corrective Actions (Continued)

LED sequence unclear	Synchronization- MSC	
Master LED- Does not show green	The card is not inserted fully or properly. Since there is one MSC now, this should always show green. When there are multiple Base Stations there would be a master and a slave. In that case, master card will be green and the slave will be blinking green.	Check if the card is inserted properly.
Sync LED - Green	There is no synchronization of base stations. Indicates OFF if MSC is not in sync and solid green if MSC is in sync. The Master mode and the standby mode is blinking green.	Check the sync cable connected to the cables.
Ext. Clk LED - Green	No external clk is connected. (OFF) Connects the external 10MHz reference source for PacketMax signalling. (ON)	Check that the external clock is up and running. Check cable connection between clock and sync port.
LED sequence unclear	Shelf Manager - MSC	
OOS LED - Red	The card is not safe to remove. Indicates red, only when the system is out of service. Out of service indicates red when the shelf manager detects that there is a problem. For example, the power is missing or the MSC card has functionality issues.	Remove the card only when OOS shows red. This indicates that the card it is safe to remove.
Minor LED - Does not indicate orange	This LED indicates an orange color only when something is not working and there is a minor alarm.	
Pwr LED - If the Power LED is not blinking green	This is Power LED. Green indicates normal power. Off indicates no power.	Check the power supply and look at the fault manager in EMS. This could also mean that the IF card is bad.
H/S LED - Does not show blue LED.	This LED indicates hot swap (blue in color).	Holding the ejectors at both ends of the cards will initiate a H/S LED to come on.
	Bootrom is at a higher version or is incompatible with the firmware.	Upgrade the bootrom after upgrading the firmware. BS should be operational with the new firmware, before programming the bootrom of the BS. Ensure the upgrade procedure of the Base Station is done properly, as in the Upgrade Base Station Instructions.