



**PACKETWAVE**

**Fixed Broadband Wireless Access System**

**PACKETWAVE 100 SERIES  
SUBSCRIBER EQUIPMENT**

Installation and Operation Manual

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## REGULATORY INFORMATION

### FCC PART 15

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- 1) this device may not cause harmful electromagnetic interference, and
- 2) this device must accept any interference received including interference that may cause undesired operations.

### FCC NOTICE: Radio and Television Interference

The PacketWave 100 Series Subscriber Equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used according to the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which is found by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment or device.
- Connect the equipment to an outlet other than the receiver's.
- Consult a dealer or an experienced radio/TV technician for assistance.

### RF Exposure Notice

The installer shall mount all transmit antennas so as to comply with the limits for human exposure to radio frequency (RF) fields per paragraph 1.1307 of FCC regulations. The FCC requirements incorporate limits for Maximum Permissible Exposure (MPE) in terms of electric field strength, magnetic field strength, and power density.

**CAUTION (5.8 GHz UNII)**

To comply with FCC RF exposure requirements, antennas used for this device must be installed to provide a separation distance of at least 1.5m from all persons to satisfy RF exposure compliance.

**CAUTION (2.5 GHz MMDS)**

To comply with FCC RF exposure requirements in section 1.1307, a minimum separation distance of 20 cm is required between this antenna and all persons.

<p>This Class <b>B</b> digital apparatus complies with Canadian ICES-003</p> <p>Cet appareil numérique de la classe <b>B</b> est conforme à la norme NMB-003 du Canada</p>
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This manual is part of the documentation for the PacketWave broadband wireless system for delivering high-speed subscriber services. The PacketWave documentation set includes:

- PacketWave 1000 Base Station Unit Installation, Configuration, and Operation Manual: *Part 070-20000340-01*
- PacketWave 100 Series Subscriber Equipment Installation and Operation Manual: *part 070-20000330-01*

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## SCOPE OF THIS MANUAL

This manual provides the following information:

- A *QuickStart* section for rapidly placing PacketWave subscriber equipment in operation.
- Descriptions of the PacketWave 100 Series hardware components, including the Indoor Unit (bridge/router) and the Outdoor Unit (radio/antenna).
- Complete site planning and installation instructions for PacketWave 100 Series subscriber equipment, including the indoor bridge/router unit and the outdoor radio/antenna unit.
- Descriptions of the PacketWave 100 Series software components, including the Web GUI and the CPE Installation Tool (antenna pointing utility), and instructions for using them.
- IP addressing guidelines for the local PC(s).
- Procedures for initializing the PacketWave 100 subscriber equipment.

Complete descriptions of the PacketWave System, its components, the installation of the cell site equipment, and overall system configuration and operation are provided in the *PacketWave 1000 Base Station Unit Installation, Configuration, and Operation* manual.

---

## CONVENTIONS USED IN THIS MANUAL

PacketWave 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>/bsu.htm* 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 sans serif font: for example, the **Control** connector.



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

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

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

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## INTENDED AUDIENCE FOR THIS MANUAL

This manual is intended primarily for subscriber equipment installers. It also includes information of use to subscribers, including a discussion of the Web GUI.

Installation of radio equipment involves numerous factors requiring considerable expertise. It is assumed that equipment installers are professionals with a full understanding of the principles and standard practices and procedures of cell site installation, with all relevant safety requirements, and with applicable local building codes.



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## GENERAL CAUTIONS AND WARNINGS

Observe the following when installing or operating any PacketWave 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 the Outdoor Unit. Contact with any of these objects could cause injury and fatality. Do not install the Outdoor Unit near power lines.*

*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 PacketWave 100 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.*

Because Aperto Networks 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.





## QUICKSTART GUIDE

This chapter outlines the basic procedure for installing PacketWave 100 Series Subscriber Equipment and putting it into operation. It identifies the minimal requirements for getting the equipment up and running, and assumes that configuration using DHCP and WaveCenter™ Configuration Manager has been performed as described in the *PacketWave 1000 Base Station Unit* manual.



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**WARNING:** This QuickStart Guide assumes that outdoor 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 non-standard practices and procedures could result in personal injury and/or damage to equipment.

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All of the instructions presented in this chapter are discussed in more detail in subsequent chapters of this manual.

### Step 1. Prepare for Installation

- A. Before visiting the subscriber's site:
  - i. Make sure that the necessary system configuration has taken place (as described in the *PacketWave 1000 Base Station Unit* manual).
  - ii. Make sure that the system's DHCP and TFTP servers are running.
  - iii. Verify that the subscriber configuration file has been created and saved on the TFTP server.
  - iv. Verify that the DHCP server has been configured with the subscriber's IP and MAC addresses and its configuration file name.

- B.** At the subscriber's site:
- i.** Identify the location for the Indoor Unit (bridge/router).
  - ii.** Identify an appropriate location for mounting the Outdoor Unit. In most cases, the unit should be pointed at the base station with the least possible obstruction
  - iii.** Determine the cable path between the Indoor Unit and the Outdoor Unit. Maximum cable length is 165 feet (50 m).

## Step 2. Install the Outdoor Unit (Radio/Antenna)

- A.** If a mounting pole or other support is to be employed, install it in the chosen location, following standard procedures and local building codes.



*The Outdoor Unit's mounting bracket accommodates diameters of 1.5 inches, 2 inches, or 5 cm.*

- B.** Mount the Outdoor Unit to the support or to the building.

## Step 3. Install the Indoor Unit (Bridge/Router)

- A.** For convenience, the Indoor Unit should be temporarily placed close to the Outdoor Unit to facilitate the antenna alignment process. When the installation of the Outdoor Unit is complete, move the Indoor Unit to its permanent location.




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**WARNING:** For proper cooling, the Indoor Unit must be installed in the upright position, with adequate air flow around and through it.

---



*Make sure the Indoor Unit is located near an electrical power outlet or power extension cord will be needed.*

- B.** Assuming that the Indoor Unit is located at a temporary location, run spare radio signal and control cables between the Outdoor and Indoor Units.
- Radio signal cable (quad shield coaxial, male F connectors) — **Radio RF** connectors on the Outdoor and Indoor Units.
  - Radio control cable (shielded outdoor Cat 5, male RJ45 connectors) — **Radio Control** connectors on the Outdoor and Indoor Units.



*The **Radio Control** interface on the Indoor Unit has the same physical appearance as the **10/100Base-T** interface. Make sure you connect to the right one.*

## Step 4. Initialize the Subscriber Equipment

- A. Connect the power cable between the Indoor Unit and a wall outlet.
- B. Perform antenna alignment procedure (see addendum on this subject).
- C. After the antenna is aligned, move the Indoor Unit to its permanent location.



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**WARNING:** For proper cooling, the Indoor Unit must be installed in the upright position, with adequate air flow around and through it.

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- D. Use the permanent radio signal and control cables to connect the Outdoor Unit to the Indoor Unit.
  - Radio signal cable (quad shield coaxial, male F connectors) — between **Radio RF** connectors on the Outdoor and Indoor Units.
  - Radio control cable (shielded outdoor Cat 5, male RJ45 connectors) — between **Radio Control** connectors on the Outdoor and Indoor Units.

## Step 5. Configure Subscriber Hosts

- A. Connect the subscriber's computer(s) to the 10/100Base-T interface on the Indoor Unit, using a straight Ethernet cable for connection to a hub or a crossover Ethernet cable for connection directly to a computer.
- B. Typically, the only other thing necessary to connect a subscriber host computer to the PacketWave network and beyond is to configure the host's TCP/IP to obtain its IP address using DHCP. Instructions should be available using the computer's online help





## OVERVIEW

As part of Aperto Networks' PacketWave Broadband Multiservice Wireless Access System, the PacketWave 100 Series Subscriber Equipment delivers high-speed, always-on Internet access to small businesses, small offices/home offices (SOHO), and residences.

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### SUBSCRIBER EQUIPMENT

PacketWave 100 Series subscriber equipment consists of an Outdoor Unit (radio/antenna), and an Indoor Unit (bridge/router), as shown in *Figure 2-1*.



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**Figure 2-1** PacketWave Subscriber Equipment

## Outdoor Unit

The outdoor portion of the subscriber equipment consists of a single unit containing the radio and antenna. Different models support various frequency bands:

- 2.5 GHz MMDS
- 3.5 GHz FWA
- 5.3 GHz
- 5.8 GHz U-NII

The radio/antenna unit installed at the subscriber site must match the frequency band employed at the base station.



**Figure 2-2**     **Subscriber Outdoor Units**

As shown in *Figure 2-2*, sizes of the antennas vary with the frequency band, from approximately 9 inches square to approximately 13 inches square. Outdoor units mount easily on a home or office roof, under the eave, or even in a properly-situated window.

The subscriber antennas are directional, with a beam width of 17° to 20° horizontally and vertically depending on frequency. The width of this beam, combined with the width of the base station antenna beam, means that only rough pointing of the antenna is needed for establishing a wireless link, though accurate pointing is important for maximum signal quality.

Depending on distance, a line-of-sight path may not be required for establishment of a wireless link between the subscriber and the base station. PacketWave's OptimaLink technology minimizes the effects of obstructions in the path between the subscriber's antenna and the base station antenna.



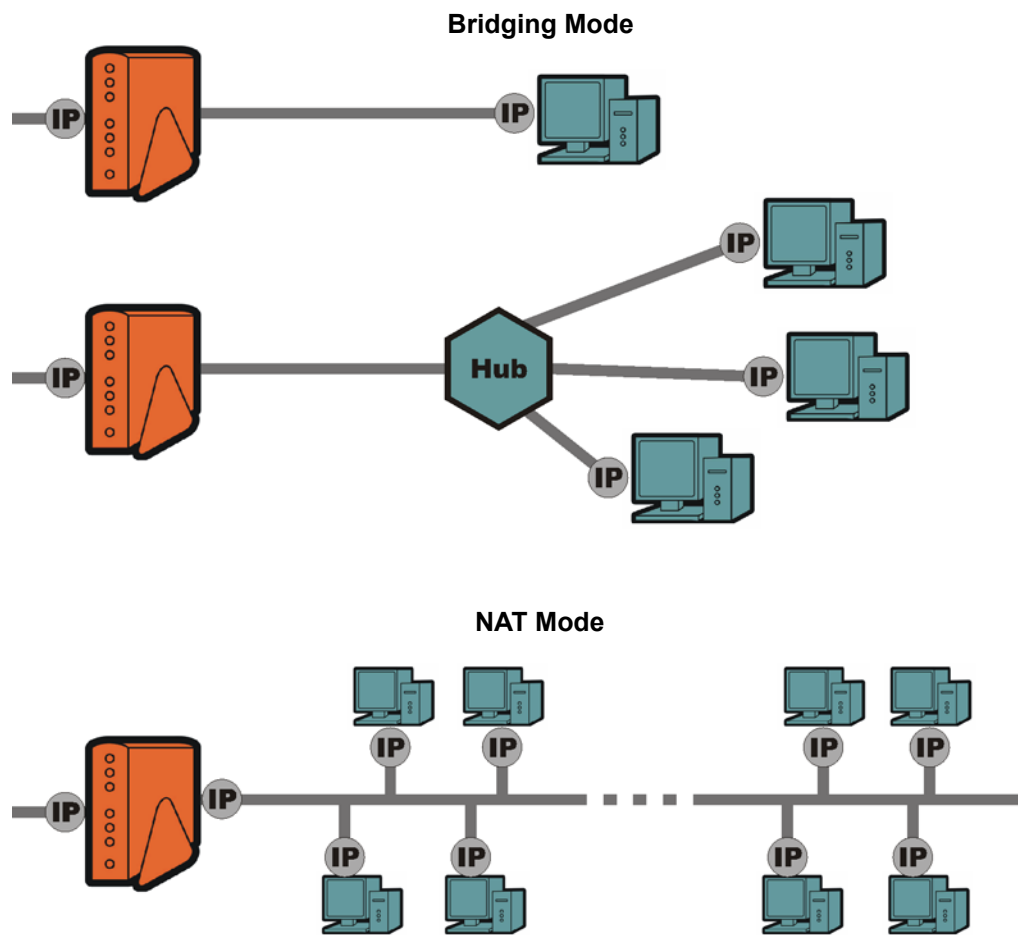
## Indoor Unit

The PacketWave 100 Series Indoor Unit is a bridge/router which, together with the Outdoor Unit, connects the subscriber's computer(s) to the wireless service. The first available model, the PacketWave 130 supports bridging and NAT modes, as shown in *Figure 2-3*. IP routing will be supported in the next major software release.

On the radio/antenna side, the Indoor Unit has two interfaces:

- A port for wireless traffic (which also provides power to the Outdoor Unit).
- A port for controlling the radio/antenna.

On the subscriber side, the Indoor Unit has an auto-negotiating 10/100Base-T Ethernet port. The Indoor Unit plugs into a standard ac wall plug (120 or 220 volts). A power cord with transformer is provided with the unit.



**Figure 2-3** PacketWave 130 Indoor Unit

## Software

Subscriber equipment is provisioned using the WaveCenter Configuration Manager, as described in the *PacketWave 1000 Base Station Unit Installation, Configuration, and Operation* manual. On boot-up, the indoor unit downloads its configuration from the base station's TFTP server. At the same time, it downloads address and host information from the base station's DHCP server.

The PacketWave 100 Series subscriber equipment includes the following management software:

- **CPE Installation Tool** — See addendum on antenna alignment procedure
- **Web GUI** — Each Indoor Unit includes a graphical user interface (GUI) which can be accessed via a standard Web browser, either directly or through the Base Station Unit's Web GUI. Use of the Web GUI is described in Chapter 7.
- **SNMP Agent** — Each Indoor Unit includes an SNMP agent which can be accessed via a standard SNMP manager, either directly or through the Base Station Unit's proxy agent. SNMP capability is described in Chapter 7.
- **Command Line Interface** — A limited command line interface (CLI) to the Indoor Unit can be accessed via telnet. Use of the CLI is described in Chapter 7.

PacketWave Indoor Units also include servers and other networking functionality:

- **DHCP Server** — PacketWave 130 Indoor Units include a Dynamic Host Configuration Protocol (DHCP) server for local address management.
- **NAT Server** — PacketWave 130 Indoor Units include a built-in NAT (Network Address Translation) server.



## SITE PLANNING

There are three basic site-planning issues which must be decided before you begin installation:

- Location of the Indoor Unit (bridge/router).
- Location and mounting method of the Outdoor Unit (radio/antenna).
- Cable path between the Indoor Unit and the Outdoor Unit.

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### LOCATION OF THE INDOOR UNIT (BRIDGE/ROUTER)

Typically, the Indoor Unit is located near the subscribers hub or computer. However, the Ethernet cable to the local computer or hub can be up to 330 ft (100 m) in length.



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**CAUTION:** Make sure that the Indoor Unit is installed in a room with temperature and humidity controls such that the temperature remains between 32 and 104 °F (0 and 40 °C) and the humidity remains between 10% and 90% noncondensing.

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## LOCATION OF THE OUTDOOR UNIT (RADIO/ANTENNA)

For optimal wireless channel performance, it is advantageous to locate the Outdoor Unit (radio/antenna) where it has the least-obstructed path to the base station antenna. If a line-of-site path is available, locate the Outdoor Unit where the path is least likely to be affected by such obstructions as blowing branches, seasonally changing foliage, etc. If a clear line-of-site path is not available, choose a path that minimizes obstructions.



*Fine-tuning of the antenna pointing is performed using the CPE Installation Tool software, as described in Chapter 6 of this manual.*

Other factors to consider when choosing a location for the Outdoor Unit include:

- **Distance to the Indoor Unit** — Locate the Outdoor Unit so that cables to the Indoor Unit will be no longer than 165 feet (50 m).
- **Cable routing** — Consider how cables from the Outdoor Unit cables will enter the building.
- **Accessibility** — If possible, choose a location that is relatively accessible, which will simplify installation and any adjustment or repair that might be necessary in the future.
- **Mounting method** — The antenna/receiver includes an adjustable bracket for mounting the unit on a pole that is 1.5 inch, 2 inches, or 5 cm in diameter. For other mounting options (under an eave or on a chimney, for example), mounting hardware may be adapted as desired. Any alternate mounting method should allow adequate adjusting of the antenna direction, both horizontally and vertically.

## CABLES AND CABLE PATH

For subscriber equipment installation, you will need the cables and connectors indicated in *Table 3-A*.

**Table 3-A**      **Subscriber Site Cable Requirements**

Connection — Qty	Cable Type	Max. Length	Connectors
Ethernet (1)	Cat 5	330 ft (100 m)	RJ45 male
Radio Signal (1)	Quad Shield Coaxial	165 ft. (50 m) *	Male F type
Radio Control (1)	Shielded Outdoor-rated Cat 5	165 ft. (50 m) *	RJ45 male
* These two cables run over the same path, and so will be of the same length.			

Choose the path along which the cables will run between the Indoor Unit and the Outdoor Unit, keeping in mind that a radio signal cable length should be less than 165 feet (50 m).

Carefully consider both the outdoor and indoor portions of the cable run. Decide how the cable run will be secured, how it will enter the building, and whether it will include wall jacks.

Consider all local building codes and standard construction practices when planning the cable path.

## SUBSCRIBER LAN/COMPUTER

If the Indoor Unit is functioning in NAT mode, addresses on the local subnet (i.e., LAN) will not be visible beyond the subscriber's subnet. The Indoor Unit will automatically become a DHCP server for the subscriber's subnet. In addition, in default setting, the Indoor Unit's DHCP server will use the DNS server address supplied by the system's DHCP server to resolve network addresses.



A large, white, stylized number "4" centered within a teal square. The square has a subtle pattern of curved lines.

## OUTDOOR UNIT INSTALLATION

In most cases, the installation of the Outdoor Unit should be performed before the installation of the Indoor Unit (see Chapter 5). For convenience during the installation of the Outdoor Unit, the Indoor Unit should be temporarily placed close to the Outdoor Unit to facilitate antenna alignment. When the installation of the Outdoor Unit is complete, the Indoor Unit can be moved to its permanent location.

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### INSTALLATION REQUIREMENTS

You will need the following tools and supplies when installing the Outdoor Unit:

- Drill (for cable entry through walls, etc.)
- Phillips screwdriver
- Wrench (7/16 inch)
- Cabling tools
- Spare radio signal and control cables with connectors (each 30 feet or longer)
- Cable ties, staples, or clamps for dressing cables
- Silicone sealant

You will also need the following cables and connectors:

- Coaxial cable (quad shield) and two male F connectors
- Shielded Cat 5 cable (outdoor rated) and two RJ45 male connectors
- Ethernet cable with RJ45 male connectors (straight-through for connection to hub, or crossover for connection to computer)

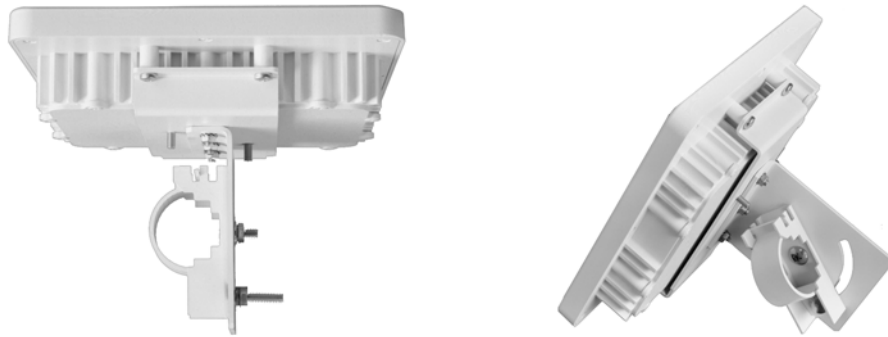
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## MOUNTING THE OUTDOOR UNIT (RADIO/ANTENNA)

Subscriber Outdoor Units are designed for mounting on a pole or antenna mast with a diameter of 1.5 inch, 2 inches, or 5 cm, using a rear-mounted bracket as shown in *Figure 4-1*.

To mount an Outdoor Unit on a pole:

1. Loosen the pole clamp bolt and open the pole clamp.
2. Close the pole clamp around the pole.
3. Adjust the azimuth and elevation orientation of the radio/antenna.
4. Tighten the pole clamp bolt until the Outdoor Unit is secured in position.



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**Figure 4-1**      **Outdoor Unit Mounting Bracket**

Other mounting options, such as under an eave or in a window, can also be employed. In such cases, appropriate mounting hardware must be obtained.

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## RUNNING CABLES BETWEEN OUTDOOR AND INDOOR UNITS

As described in Chapter 2, there are two cables that connect the Outdoor Unit to the Indoor Unit:

- A quad shield coaxial cable for the subscriber signal (which also provides ac power to the Outdoor Unit).
- A shielded Cat 5 cable for controlling the Outdoor Unit.

The connectors on the Outdoor Unit are located on the back, at the bottom of the radio enclosure, as shown in *Figure 4-2*.



These cables run from outdoors to indoors, so a suitable cable run and building entry point must be identified, as discussed in Chapter 3.



*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, or to use a pre-assembled cable. Also, cable dressing at various locations may be best performed at different points in the procedure. Therefore, the procedures given for these connections should be taken as a list of necessary steps and a suggested order, and modified as appropriate for your particular circumstances.*



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**CAUTION:** If the Indoor Unit has already been installed and connected as described in Chapter 5, be sure that power is disconnected from the Indoor Unit before attaching the cables from the Outdoor Unit.

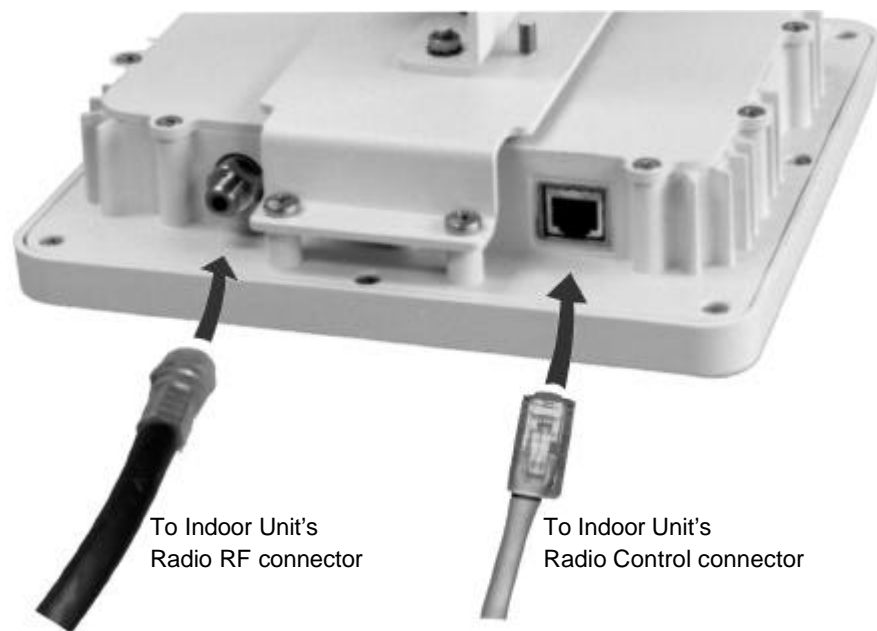
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## Signal Connection

The radio signal cable should be quad shield 75-ohm coaxial cable with a maximum length of 165 feet (50 m). The cable terminates with a male F connector at each end.

To install the radio signal cable, perform the following steps

1. Obtain an appropriate length of cable, and run it from the Indoor Unit to the Outdoor Unit. Include a service/drip loop as appropriate.
2. Install a male F connector at the radio/antenna end of the cable.
3. Attach the cable to the female F connector on the Outdoor Unit, as shown in *Figure 4-2*. Tighten the connector until the cable is firmly secured, but do not overtighten.
4. Dress the outdoor portion of the cable as appropriate.



**Figure 4-2** Connections to the Outdoor Unit (Radio/Antenna)

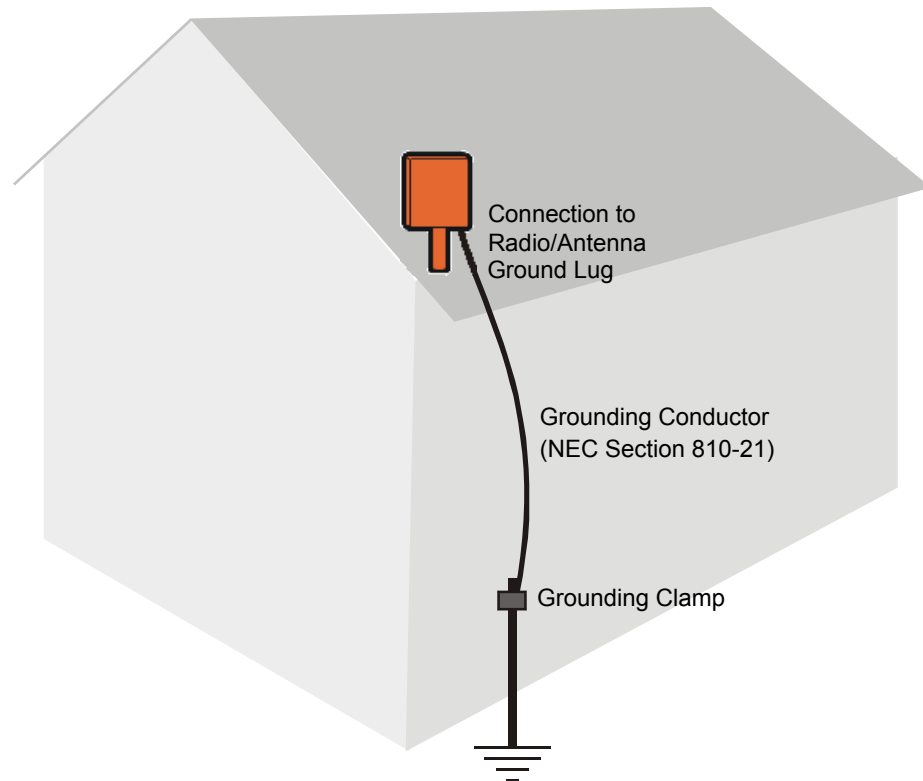
## Control Connection

The control cable should be shielded outdoor-rated Cat 5, terminating with an RJ45 male connector (plug) at each end. The cable should be outdoor-rated, and may be up to 165 feet (50 m) in length.

1. Obtain an appropriate length of cable, and run it from the Indoor Unit to the Outdoor Unit. Include a service/drip loop as appropriate.
2. Place the supplied rubber boot over the radio/antenna end of the cable.
3. Install an RJ45 male connector on the radio/antenna end of the cable.
4. Plug the cable into the RJ45 socket on the Outdoor Unit as shown in *Figure 4-2*.
5. Put the rubber boot in position to protect the R-J45 connection and secure it in place with a cable tie.
6. Dress the outdoor portion of the cable as appropriate.
7. Seal the entry of both cables to the building as appropriate.

## GROUNDING THE OUTDOOR UNIT

Grounding of the outdoor radio/antenna is an essential part of the installation process. A proper grounding circuit is illustrated in *Figure 4-3*.



**Figure 4-3** *Grounding the Outdoor Unit (Radio/Antenna)*



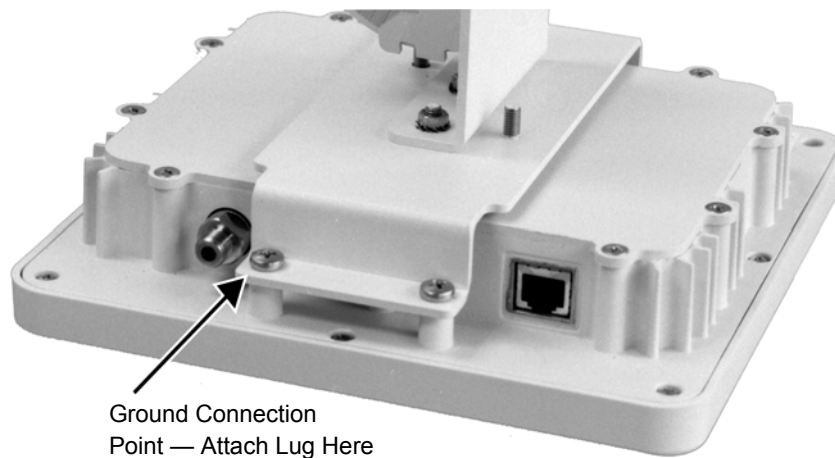
**WARNING:** *Make sure that the outdoor raio/antenna is grounded in accordance with local, state, federal, and National Electrical Code (NEC) requirements.*

To properly ground the Outdoor Unit:

1. Locate the ground point on the back of the Outdoor Unit. It is the screw in the lower left corner (the unpainted corner) of the mounting bracket support attached to the rear of the Outdoor Unit. (See *Figure 4-4*.)
2. Secure a lug to the grounding screw on the Outdoor Unit.
3. Provide a proper grounding conductor (NEC Section 810-21) long enough to reach from the Outdoor Unit to the earth ground.
4. Attach one end of the conductor to the lug installed in step 2.
5. Connect the other end of the grounding conductor to an appropriate earth ground using a grounding clamp.



*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 4-4** Location of Grounding Screws on Outdoor Unit (Radio/Antenna)



## INDOOR UNIT INSTALLATION

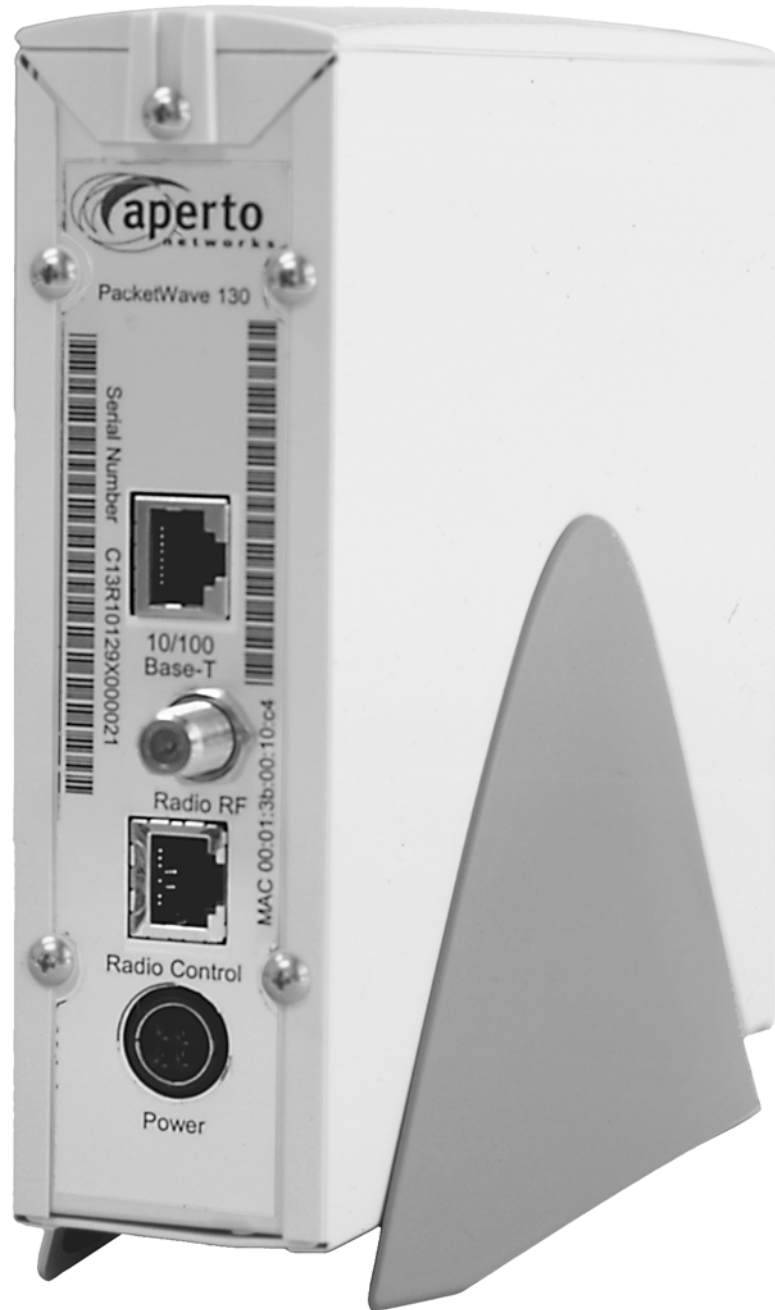
In most cases, the installation of the Outdoor Unit (see Chapter 4) should be performed before the installation of the Indoor Unit. For convenience during the installation of the Outdoor Unit, the Indoor Unit should be temporarily placed close to the Outdoor Unit to facilitate antenna alignment. When the installation of the Outdoor Unit is complete, the Indoor Unit can be moved to its permanent location.

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### INSTALLATION REQUIREMENTS

You will not need any tools to install the Indoor Unit. Cable and power connections are made to the Indoor Unit's rear panel, illustrated in *Figure 5-1*.

The subscriber must have either an Ethernet LAN or a computer with an Ethernet interface. You will need to supply an Ethernet cable of sufficient length, with an RJ45 plug on each end. Use a straight cable for connection to a hub or router, or a crossover cable for connection to a PC.



**Figure 5-1** Indoor Unit Rear Panel

## INSTALLATION PROCEDURE

Installation of the Indoor Unit involves placing the unit in the desired location, connecting radio/antenna and local Ethernet cables to the rear panel, and applying power.

Position the Indoor Unit as desired.



**WARNING:** For proper cooling, the Indoor Unit must be installed in the upright position, with adequate air flow around and through it.

### Connecting Radio/Antenna Cables

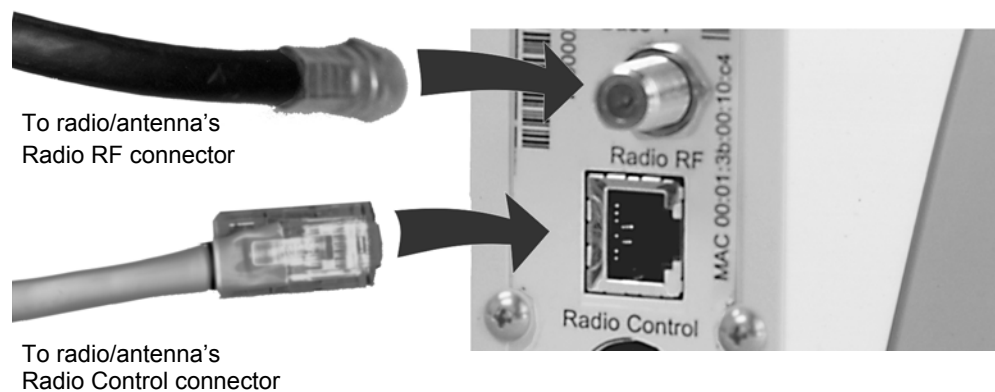
To connect the radio antenna to the Indoor Unit

1. Locate the radio signal cable. If the cable does not already have one, install a male F connector on the end of the cable.
2. Attach the cable to the **RADIO RF** connector on the Indoor Unit as illustrated in *Figure 5-2*.



*The Radio Control interface of the Indoor Unit has the same physical appearance as the 10/100Base-T interface. Make sure you connect to the right one.*

3. Locate the radio control cable. If does not already have one, install a male RJ45 connector (plug) on the end of the cable.
4. Attach the cable to the **RADIO Control** connector on the Indoor Unit as shown in *Figure 5-2*.
5. Dress the indoor portions of the radio cables as desired.

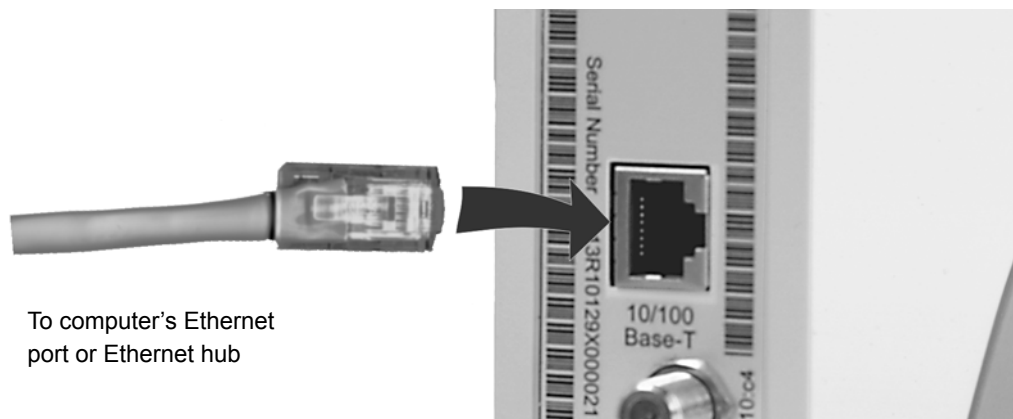


**Figure 5-2** Indoor Unit Connections from Outdoor Unit

## Connecting to the Local PC or LAN

To connect the Indoor Unit to subscriber's computers

1. Provide an appropriate Cat 5 Ethernet cable with an RJ45 male connector at each end. Use a straight-through cable for connection to a hub or router. Use a cross-over cable for connection directly to a computer. (See *Table 5-A* for pinouts.)
2. Plug one end of the Ethernet cable into the RJ45 socket labeled **10/100Base-T** on the Indoor Unit, as illustrated in *Figure 5-3*.
3. Plug the other end of the Ethernet cable into the socket on the local hub or computer.



**Figure 5-3**     *Subscriber Ethernet Connection*

**Table 5-A**     *Ethernet Cable Pinouts*

Straight Cable (to Hub or Router)		Crossover Cable (to PC)	
Pin 1: Tx+	Pin 1: Rc+	Pin 1: Rc+	Pin 3: Tx+
Pin 2: Tx-	Pin 2: Rc-	Pin 2: Rc-	Pin 6: Tx
Pin 3: Rc+	Pin 3: Tx+	Pin 3: Tx+	Pin 1: Rc+
Pin 6: Rc-	Pin 6: Tx-	Pin 6: Tx-	Pin 2: Rc-



## Powering Up the Indoor Unit




---

**WARNING:** *For the PacketWave 100 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 the specific application*

---

To apply power to the Indoor Unit:

1. Plug the power cord into the **POWER** connector on the Indoor Unit, as illustrated in *Figure 5-4*.
2. Plug the power cord/transformer into a surge-protected ac outlet.

The Indoor Unit does not have an on/off switch; to turn the unit off, disconnect power at the power outlet.

NOTE: The Outdoor Unit receives power from the Indoor Unit via the coaxial radio signal cable.



**Figure 5-4** Indoor Unit Power Connection



A large, bold, yellow number "6" centered on a teal square background. The number has a slight shadow effect.

## STARTING UP

Once you have completed the connections described in Chapters 4 and 5, there is one procedure you need to complete before the local computers can access the PacketWave network and the Internet. That procedure involves using the CPE Installation Tool software to optimize antenna pointing.



*When the Indoor Unit is first installed, its software knows that the antenna-pointing procedure has not been performed. It will not allow itself to access the PacketWave network until the procedure has been performed.*

*Once the antenna-pointing procedure has been executed, it should not be required again.*

---

### **RUNNING THE CPE INSTALLATION (ANTENNA ALIGNMENT) TOOL**

See the accompanying addendum for antenna alignment instructions.

## CONNECTION TO THE PACKETWAVE NETWORK

When the Indoor Unit reboots at the end of the installation/antenna alignment process described above, it performs an initialization procedure that brings it up as part of the PacketWave network. During this procedure:

- The Indoor Unit requests an IP address from the system's DHCP server. (The DHCP request is passed along by the BSU's DHCP relay agent.)
- The DHCP server responds with the IP address and other information, including the name of the Indoor Unit's configuration file. The Base Station Unit and the Indoor Unit both learn the new IP address.
- The Indoor Unit downloads its configuration file (as previously created using the WaveCenter Configuration Manager) from the TFTP server.

*Note: For information about the WaveCenter Configuration Manager software, see the PacketWave 1000 Base Station Unit Installation, Configuration, and Operation manual.*

- The Indoor Unit configures itself according to the received configuration file and activates for subscriber traffic.
- If the Indoor Unit is functioning in NAT mode, the IP addresses of its attached computers are obtained from the local DHCP server built into the Indoor Unit.

### Setting Up the Local Computer(s)

Whether the subscriber's computers are connected to a Indoor Unit functioning in bridge or NAT mode, each host needs an IP address. The simplest solution is to configure each computer to obtain its IP address using DHCP. It is also possible to manually enter the IP addresses. For larger subscriber LANs, a local DHCP server may be preferable.



## MANAGEMENT INTERFACES

The PacketWave 130 Indoor Unit includes several management interfaces which allow the installer and user to monitor the wireless and LAN connections, diagnose problems, and perform some local configuration changes.

These interfaces include:

- Front-panel LEDs.
- A Web-browser-accessed graphical user interface (GUI) for real-time monitoring and limited “on-the-fly” configuration changes.
- SNMP.
- A simple command line interface (CLI) for basic troubleshooting and debugging.

This chapter provides information about all of these interfaces.


---

### FRONT-PANEL LEDs

The LEDs on the Indoor Unit’s front panel provide operational information as described in *Table 7-A*.

NOTE: The **WIRELESS STATUS** LED shows the progress of initialization of the Indoor Unit, with slow and fast blinking indicating different phases of the initialization process.

**Table 7-A Front-Panel LEDs**

	LED	Indications
	LAN TX	<i>Blinks</i> on Ethernet transmit activity.
	RX	<i>Blinks</i> on Ethernet receive activity.
	LINK	<i>On</i> when Ethernet link is up; <i>Off</i> when it is down.
	WIRELESS TX	<i>Blinks</i> on wireless transmit activity.
	RX	<i>Blinks</i> on wireless receive activity.
	STATUS	<i>Off</i> : Indoor Unit is not operational. <i>Slow blink</i> : received wireless initialization signals. <i>Fast Blink</i> : in ranging process. <i>On</i> : configuration file received; Indoor Unit operational.
POWER	POWER	<i>On</i> when Indoor Unit is receiving power from ac source.

## WEB INTERFACE (GUI)

The Indoor Unit includes a Java-based graphical user interface (GUI) which runs on a standard Web browser (Netscape 4.74 or higher, or Internet Explorer 5.0). Functions of the Web GUI include:

- Viewing network topology.
- Monitoring status and performance.
- Reviewing configuration.
- Making basic configuration changes.
- Resetting Indoor Units.

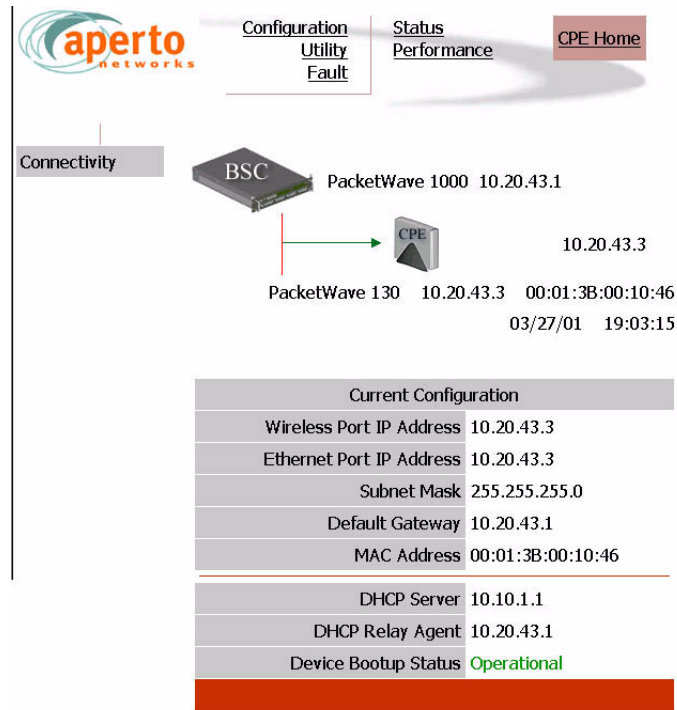
### Accessing the Web Interface

To access the graphical user interface:

1. Establish a connection and open your browser.
2. Enter the URL, *http://<Indoor Unit IP address>/cpe.htm*.
3. Respond to the user name prompt with **Aperto** and to the password prompt with **otrepa**.

NOTE: The user name and password are case-sensitive, so be sure to capitalize the **A** in **Aperto** when entering the user name.

4. If the browser prompts that it needs to load a plug-in, allow it to do so.
5. Wait for the Web interface home page to open, a shown in *Figure 7-1*.



**Figure 7-1** Web GUI Home Page

The Web interface pages share the basic elements identified in *Figure 7-2*.

## Home Page: Connectivity View

As shown in *Figure 7-1*, the home page provides a graphical representation of base station-to-subscriber connectivity. The arrow pointing to the Indoor Unit icon indicates wireless channel status: green if good or red if down.



*Status indications on the connectivity view are updated dynamically every 30 seconds.*

The screenshot shows the Aperto Networks web GUI. At the top, there is a main menu with options: Configuration, Utility, Fault, Status, Performance, and CPE Home. A submenu on the left lists System, SNMP, and NAT. The main content area displays system information: PacketWave 130, IP address 10.20.43.3, MAC address 00:01:3B:00:10:46, and date/time 03/27/01 19:06:10. Below this is a red header for 'System - Parameters are Read Only' followed by a table of system parameters.

System - Parameters are Read Only	
IP Address	10.20.43.3
Subnet Mask	255.255.255.0
Default Gateway	10.20.43.1
MAC Address	00:01:3B:00:10:46
DHCP Server	10.10.1.1

Annotations in the image point to: Main Menu, Submenu, Return-to-Home-Page Button, and Display Header (may include model, IP address, MAC address, date and time).

**Figure 7-2 Basic Elements of Web GUI**



## Configuration Pages

The Web GUI lets you check, and in some cases alter, the configuration of the Indoor Unit. There are four configuration pages which may be displayed, as indicated by the submenu at the left of the page; they are illustrated in *Figure 7-3* through *Figure 7-6*.

### System Configuration

As shown in *Figure 7-3*, the system configuration page provides an overview of the Indoor Unit's network and operating parameters. *These parameters are read-only*.

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Configuration Utility Fault

Status Performance CPE Home

PacketWave 130 10.20.43.3 00:01:3B:00:10:46  
03/27/01 19:06:10

System  
SNMP  
NAT

**System - Parameters are Read Only**

IP Address	10.20.43.3
Subnet Mask	255.255.255.0
Default Gateway	10.20.43.1
MAC Address	00:01:3B:00:10:46
DHCP Server	10.10.1.1
TFTP Server	192.168.1.230
DHCP Relay Agent	10.20.43.1
System Log Server	192.168.1.231
Channel Frequency (MHz)	52590000
CPE Allowed To Access Network	ON
Hosts Permitted	20
Maximum Number of Classifiers	2
CPE Mode	Bridge
DHCP Lease Duration	1d 0h 0m 0sec
Configuration File Name	QALabCpe110_00013b001046.cfg
CPE Image File	cpe0_5_0.D
Device Bootup Status	Operational

Refresh

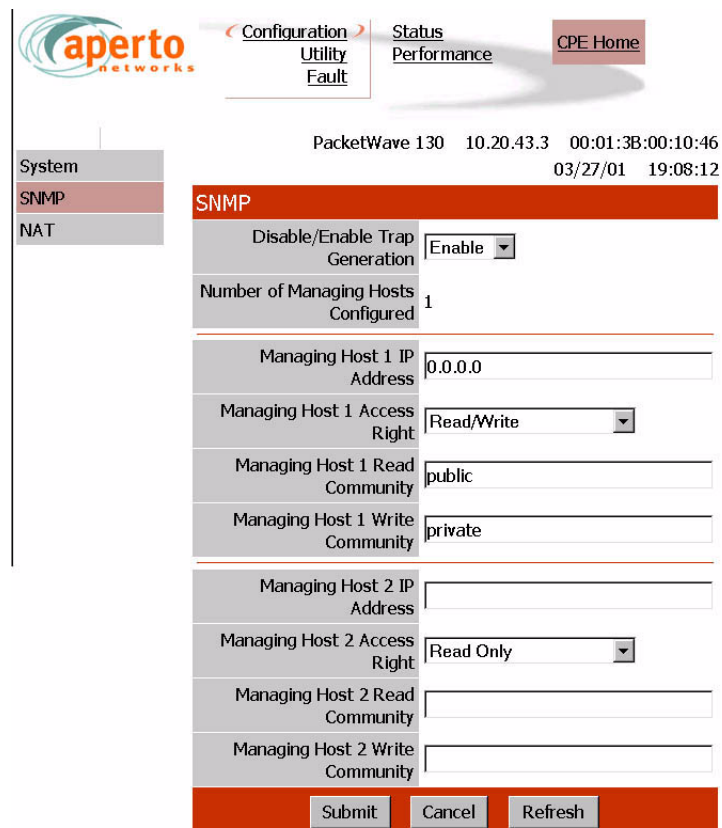
**Figure 7-3 System Configuration Page**

## SNMP Configuration

As shown in *Figure 7-4*, the SNMP configuration page allows the viewing and altering of SNMP parameters:

- Whether traps will be generated.
- What SNMP manager(s) will be recognized, and what level of access they will have.

Click on the **Submit** button to activate any changes made on this page.



The screenshot shows the SNMP Configuration page. At the top left is the Aperto Networks logo. To its right are navigation tabs: Configuration (selected), Utility, and Fault. Further right are Status, Performance, and CPE Home tabs. Below the tabs, system information is displayed: PacketWave 130, IP 10.20.43.3, MAC 00:01:3B:00:10:46, and date/time 03/27/01 19:08:12. A left sidebar contains a menu with System, SNMP (selected), and NAT. The main content area is titled 'SNMP' and contains the following configuration fields:

- Disable/Enable Trap Generation: Enable (dropdown)
- Number of Managing Hosts Configured: 1
- Managing Host 1 IP Address: 0.0.0.0
- Managing Host 1 Access Right: Read/Write (dropdown)
- Managing Host 1 Read Community: public
- Managing Host 1 Write Community: private
- Managing Host 2 IP Address: (empty)
- Managing Host 2 Access Right: Read Only (dropdown)
- Managing Host 2 Read Community: (empty)
- Managing Host 2 Write Community: (empty)

At the bottom of the form are three buttons: Submit, Cancel, and Refresh.

**Figure 7-4** SNMP Configuration Page

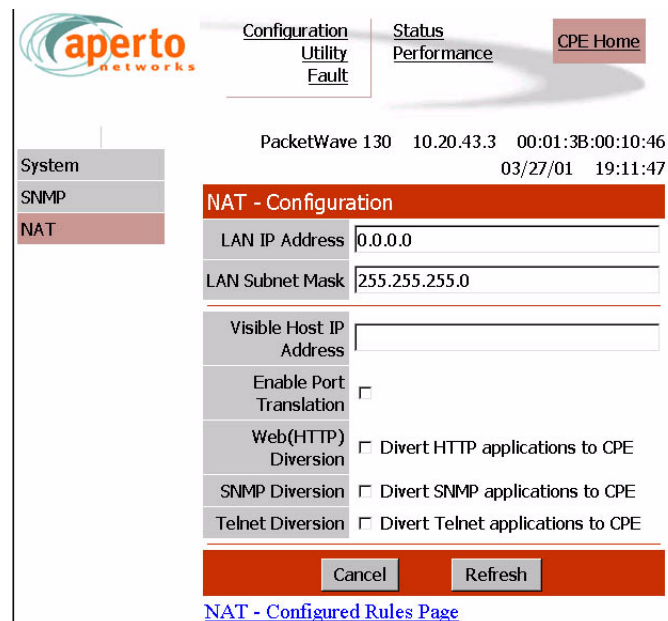
## NAT Configuration

As shown in *Figure 7-5* and *Figure 7-6*, there are two configuration pages related to NAT (Network Address Translation) routing. These read-only pages apply only when the Indoor Unit is in NAT mode.

To move between the two NAT configuration pages, click on the hyperlinks at the bottoms of the pages.



*NAT configuration should be performed by network administrator.*



Configuration Utility Fault | Status Performance | CPE Home

PacketWave 130 10.20.43.3 00:01:38:00:10:46  
03/27/01 19:11:47

System  
SNMP  
NAT

### NAT - Configuration

LAN IP Address

LAN Subnet Mask

Visible Host IP Address

Enable Port Translation

Web(HTTP) Diversion  Divert HTTP applications to CPE

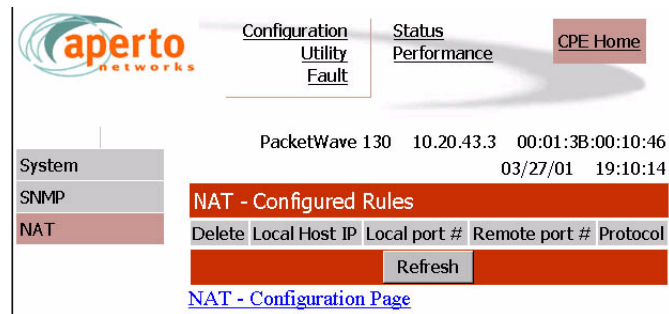
SNMP Diversion  Divert SNMP applications to CPE

Telnet Diversion  Divert Telnet applications to CPE

Cancel Refresh

[NAT - Configured Rules Page](#)

**Figure 7-5 NAT Configuration Page**



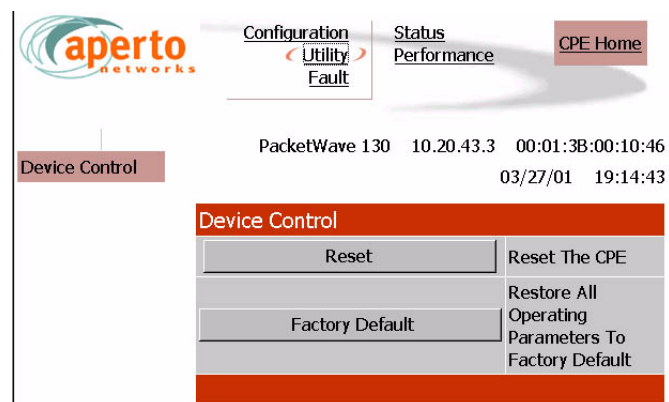
**Figure 7-6 NAT Configured Rules Page**

### Device Control Utilities

The device control page, illustrated in *Figure 7-7*, provides access to a pair of important functions:

- Resetting the Indoor Unit.
- Restoring factory defaults for *all* subscriber equipment configuration options.

The interface will prompt for confirmation before performing a selected function.



**Figure 7-7 Device Control Page**

## Fault Reporting

The subscriber fault reporting functions include an event log and email configuration, as shown in *Figure 7-8* and *Figure 7-9*.

### Event Log Page

The event log page, shown in *Figure 7-8*, includes all logable events reported by the Indoor Unit.

NOTE: The data base used to generate the log is updated in real time. However, the pages do not update dynamically; you must click on the **Refresh** button to see later status.

You can empty the log by clicking on the **Clear All Events** button.

Configuration Utility **Fault** Status Performance CPE Home

PacketWave 130 10.20.43.3 00:01:3B:00:10:46  
03/27/01 19:23:20

Event Logs  
E-mail

Event Name	Originated From	Severity	Time Stamp
Authentication Failed	CPE 00:01:3B:00:10:46	Major	03/27/01 19:01:32
Authentication Failed	CPE 00:01:3B:00:10:46	Major	03/27/01 18:54:25
Cold Start	CPE 00:01:3B:00:10:46	Informational	03/27/01 18:48:22
CPE Sync Acquired	CPE 00:01:3B:00:10:46	Minor	03/27/01 19:11:43
BSC Down	CPE 00:01:3B:00:10:46	Major	03/27/01 19:10:06
Authentication Failed	CPE 00:01:3B:00:10:46	Major	03/27/01 18:18:02
Authentication Failed	CPE 00:01:3B:00:10:46	Major	03/27/01 18:17:55
Cold Start	CPE 00:01:3B:00:10:46	Informational	03/27/01 18:16:59
CPE Sync Acquired	CPE 00:01:3B:00:10:46	Minor	03/27/01 18:28:25
BSC Down	CPE 00:01:3B:00:10:46	Major	03/27/01 18:26:47
Cold Start	CPE 00:01:3B:00:10:46	Informational	03/27/01 18:01:33
CPE Sync Acquired	CPE 00:01:3B:00:10:46	Minor	boot + 9 sec

Refresh Clear All Events


**Figure 7-8** Event Log Page

## E-mail Page

The E-mail configuration page, shown in *Figure 7-9*, allows the viewing and altering of Email event reporting parameters:

- The address of the SMTP server (may be configured here or in the subscriber configuration file).
- The E-mail domain name.
- Reply-to and receiver E-mail addresses.
- A test E-mail may be sent.
- Event reporting via E-mail may be turned on and off as desired.

Click on the **Submit** button to activate any changes made on this page.



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Configuration Utility Fault

Status Performance CPE Home

PacketWave 130 10.20.43.3 00:01:3B:00:10:46  
03/27/01 19:21:27

Event Logs  
E-mail

**E-mail**

SMTP Server IP Address 192.168.1.231

Domain Name

Reply To

Email Receiver 1

Email Receiver 2

Send a test e-mail on submit

Enable event report via email

Submit Cancel Refresh

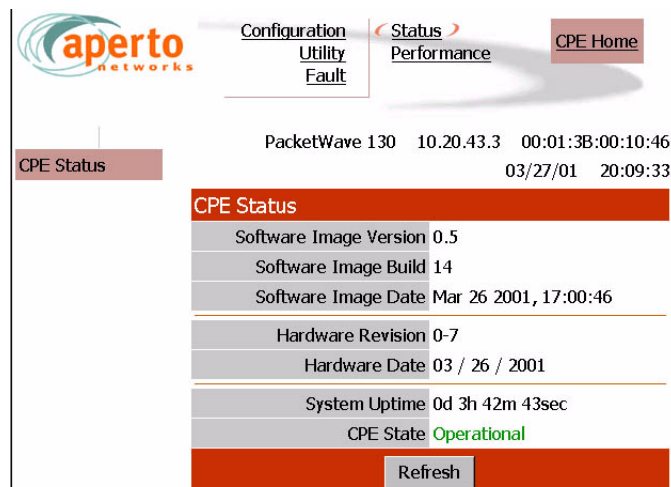
**Figure 7-9** Email Page

### Status and Performance Statistics

The status page, shown in *Figure 7-10*, identifies the Indoor Unit, its software and hardware, and its current operational status.

As shown in *Figure 7-11*, the performance page provides transmit and receive statistics in a table format.

NOTE: The data used to generate these pages is updated in real time. However, the pages do not update dynamically; you must click on the **Refresh** button to see new information. No configuration or other operation can be initiated from these pages.



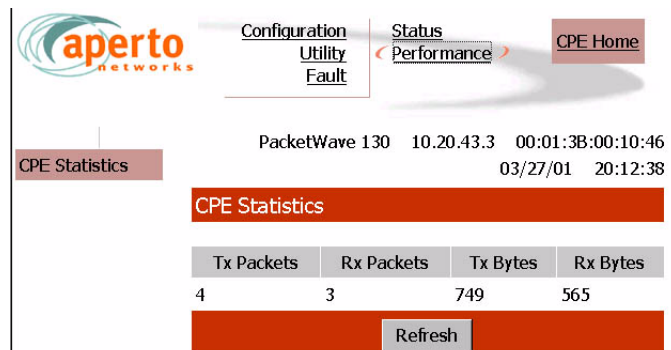
The screenshot shows the Aperto Networks management interface. At the top left is the Aperto Networks logo. A navigation menu includes 'Configuration', 'Utility', 'Fault', 'Status', 'Performance', and 'CPE Home'. The 'Status' menu is active, and 'Performance' is highlighted. Below the navigation, the page title is 'CPE Status'. The main content area displays the following information:

PacketWave 130 10.20.43.3 00:01:3B:00:10:46  
03/27/01 20:09:33

CPE Status	
Software Image Version	0.5
Software Image Build	14
Software Image Date	Mar 26 2001, 17:00:46
Hardware Revision	0-7
Hardware Date	03 / 26 / 2001
System Uptime	0d 3h 42m 43sec
CPE State	Operational

A 'Refresh' button is located at the bottom of the status information.

**Figure 7-10** Status Page



The screenshot shows the Aperto Networks management interface. At the top left is the Aperto Networks logo. A navigation menu includes 'Configuration', 'Utility', 'Fault', 'Status', 'Performance', and 'CPE Home'. The 'Performance' menu is active, and 'Status' is highlighted. Below the navigation, the page title is 'CPE Statistics'. The main content area displays the following information:

PacketWave 130 10.20.43.3 00:01:3B:00:10:46  
03/27/01 20:12:38

CPE Statistics			
Tx Packets	Rx Packets	Tx Bytes	Rx Bytes
4	3	749	565

A 'Refresh' button is located at the bottom of the statistics information.

**Figure 7-11** Performance Page

## SNMP

Each Indoor Unit includes an SNMP agent supporting the following MIBs:

- SNMP MIB (RFC 1157)
- MIB II (RFC 1213)
- Aperto private MIB

The complete MIBs provided on the PacketWave CD-ROM, and are available on the Aperto Web site, [www.apertonet.com](http://www.apertonet.com).

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

NOTE: All SNMP parameters are read-only in R1P1.

---

## SYSLOG

The Indoor Units support logging of event messages to a designated server according to the Syslog protocol. The Syslog server may be identified in the subscriber configuration files.



## COMMAND LINE INTERFACE (CLI)

Each Indoor Unit includes a simple command line interface (CLI) accessible via telnet.

To use the CLI:

1. Telnet to the Indoor Unit's IP address.
2. Enter the correct user name (**Aperto**) and password (**Aperto**) as prompted.
3. When the **CLI#** prompt appears, you are in the CLI. For a list of commands, type **?** (the **?** will not appear on the screen). The CLI will respond with a list of the available commands groups, as shown in *Figure 7-12*.
4. To see the specific commands in a group, type the group name followed by **?** (again, the **?** will not appear). *Figure 7-12* shows the commands in each group.
5. To display information about the use of a specific commands, including command parameters, enter the command followed by **?**.



```

Telnet - 10.10.1.10
Connect Edit Terminal Help
CLI#
reboot          - reboot device
set             - Set commands:
show           - Show commands:

CLI# reboot
reboot          - reboot device

CLI# show
config_file    - Show Contents of the Configuration File(usage:show confi
g_file)
dhcp           - Show DHCP IP Address [usage: show dhcp]
ethernet_ip    - Show Ethernet IP Address [usage: show ethernet_ip]
frequency      - Show Channel Frequency (frequency is in the unit of 100
Hz)(usage: show frequency port 1, show frequency all)
tftp           - Show TFTP IP Address [usage: show tftp]

CLI# set
frequency      - Set Channel Frequency [usage: Set frequency 52590000fi
port 1(frequency is in the unit of 100 Hz). For UNI band, the step size is 100
00Hz.

CLI# set frequency
Integer        - Integer
port           - Integer
    
```

**Figure 7-12** Example of Command Line Interface (CLI)

6. Use the CLI commands to show configuration data, set the channel frequency, and/or reboot the unit, as desired.

NOTE: The show config\_file command is not support in the current release.

7. If there is no activity on a connection for 30 minutes, the CLI will disconnect.
8. When you are finished with the CLI, disconnect.

---

## FAULT REPORTING

The PacketWave subscriber equipment can be configured to report events by several means:

- Email event messages.
- SNMP traps.
- Logging to a Syslog server.
- Event logs presented on request via SNMP or Web GUI.

Reportable events are identified in *Table 7-B*.

**Table 7-B**      **Events Reported**

Fault Event	Description
Cold Start	Indoor Unit has performed a full hardware boot.
Warm Start	BSU has performed a software reboot.
Authentication Failure	Invalid user name or password?
CPE Up	Indoor Unit has started communication with the BSU.
CPE Down	Indoor Unit has ceased communication with the BSU.
DHCP Failed	A failure has occurred in the retrieval of required data from the DHCP server.



## SPECIFICATIONS

---

### BRIDGE/ROUTER (INDOOR UNIT) SPECIFICATIONS

#### Models

PacketWave 130 — Bridging or NAT modes

#### Interfaces

10/100Base-T Ethernet — RJ-45 connector

Radio — F connector

Radio Control — shielded RJ-45 connector

Power Requirement — 100 to 240 V ac, 47 to 63 Hz

Power Consumption — 30 Watts for Indoor and Outdoor Unit

#### Networking and Protocols

Bridging

DHCP server and client

NAT

#### Management

##### Service Provider

Subscriber provisioning using Java-based WaveCenter Configuration

Manager on Windows 98/2000/Pro, Linux, and Sun Solaris 2.8

Embedded WaveCenter agent supporting SNMP and web browser

SNMP, MIB II (RFC 1213), Aperto Enterprise MIBs

Software updates via TFTP

**Subscriber**

Web-based interface for subscriber-side  
DHCP server and NAT configuration

**CPE Installation Tool**

Facilitates antenna alignment process

**LED Indicators**

Power

Wireless — Transmit, Receive, Status

LAN — Link, Transmit, Receive

**Environmental**

Operating Temperature — 32 to 104 °F (0 to 40 °C)

Humidity — 10 to 90%, noncondensing

**Dimensions and Weight**

W x H x D — 1.5 x 6.6 x 9.1 inches (3.8 x 16.8 x 23.1 cm)

Weight — 2.2 lbs (1.0 kg)

**Regulatory Approvals**

FCC Class B

CE, ETSI (in process)

---

**RADIO/ANTENNA (OUTDOOR UNIT) SPECIFICATIONS****RF**

Data Rates — from 64 kbps with burst mode up to 20 Mbps in a 6 MHz channel

Modulation — QPSK, 16 QAM

**Cables and Connectors**

Radio Signal — Quad shield coaxial cable; Male F-type connector

Radio Control — Shielded Cat 5 cable (outdoor rated); Male RJ45 connector

Cable Lengths — Up to 165 feet (50 m)

**Mounting**

Clamping bracket for pole with diameter of 1.5 inch, 2 inches, or 5 cm

Adjustable elevation

**Environmental**

Operating Temperature — -22 to 140 °F (-30 to 60 °C)

Storage Temperature — -40 to 257 °F (-40 to 125 °C)

Humidity — 0 to 100%

**2.5 GHz Outdoor Unit**

Frequency Range — 2500 to 2686 MHz; Maximum EIRP \* — 33 dBm

Dimensions: W x H x D — 12.6 x 12.6 x 1.9 inches (32.0 x 32.0 x 4.8 cm)

3 dB Beamwidth — Azimuth 20°; Elevation 20°

Polarization — Horizontal and vertical

**3.5 GHz Outdoor Unit**

Frequency Range — 3300 to 3800 MHz; Maximum EIRP \* — 38 dBm

Dimensions: W x H x D — 10.2 x 10.2 x 1.9 inches (25.9 x 25.9 x 4.8 cm)

3 dB Beamwidth — Azimuth 20°; Elevation 20°

Polarization — Horizontal and vertical

**5.3 GHz Outdoor Unit**

Frequency Range — 5250 to 5350 MHz; Maximum EIRP \* — 33 dBm

Dimensions: W x H x D — 8.1 x 8.1 x 1.9 inches (20.6 x 20.6 x 4.8 cm)

3 dB Beamwidth — Azimuth 17°; Elevation 17°

Polarization — Horizontal and vertical

**5.8 GHz Outdoor Unit**

Frequency Range — 5725 to 5875 MHz; Maximum EIRP \* — 33 dBm

Dimensions: W x H x D — 8.1 x 8.1 x 1.9 inches (20.6 x 20.6 x 4.8 cm)

3 dB Beamwidth — Azimuth 17°; Elevation 17°

Polarization — Horizontal and vertical

*\* The maximum EIRP varies depending on country regulations.  
Contact Aperto Networks sales for more information*

