



PTP 800 Licensed Ethernet Microwave

User Guide

System Release 800-03-10

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Important safety information

This section describes important safety guidelines that must be observed by personnel installing or operating PTP 800 equipment.

WARNING

To prevent loss of life or physical injury, observe the safety guidelines in this section.

Power lines

Exercise extreme care when installing antennas near power lines.

Working at heights

Exercise extreme care when working at heights.

Grounding and protective earth

The outdoor unit (ODU) and compact modem unit (CMU) for the PTP 800 must be properly grounded. It is the user's responsibility to install the equipment in accordance with national regulations. In the USA, follow Section 810 of the *National Electric Code, ANSI/NFPA No. 70-1984* (USA). In Canada, follow Section 54 of the *Canadian Electrical Code*. These codes describe correct installation procedures for grounding the ODU, CMU, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. Other regulations may apply in different countries and therefore it is recommended that installation of the outdoor unit be contracted to a professional installer.

The PTP 800 ODU and CMU must be grounded to a protective earth in accordance with the Local Electrical Regulations.

Electrical safety

The power cable connections must meet International Electrotechnical Commission (IEC) safety standards.

Always power down and unplug the equipment before servicing.

When using alternative DC supplies, such as battery-backed DC power source, the supply must be SELV rated.

Primary disconnect device

The power supply must include a primary disconnect device with appropriate fusing.

External cables

Safety may be compromised if outdoor rated cables are not used for connections that will be exposed to the weather.

RF exposure near the antenna

Strong radio frequency (RF) fields will be present close to the antenna when the transmitter is on. Always mute the transmitter before undertaking maintenance activities in front of the antenna.

Ensure that people cannot stand or walk in front of the antenna within ± 10 degrees of the antenna axis and within the minimum distances listed in [Table 4-130](#) (ETSI) or [Table 4-131](#) (FCC). The minimum distances in these tables have been calculated using worst-case assumptions. Reduced separation distances may be appropriate under some circumstances. Further details are provided in [Radiation hazard assessment](#) on page [4-96](#).

Thermal safety

The CMU may be hot to the touch when in operation. The CMU must not be operated in ambient temperatures exceeding 40 deg C unless mounted in a Restricted Access Location. For more information, see [Maximum operating ambient temperature for the CMU](#) on page [5-73](#).

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About This User Guide

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This guide describes the planning, installation and operation of the Motorola PTP 800. It is intended for use by the system designer, system installer and the system administrator.

Users of this guide should have knowledge of the following areas:

- Radio network design
- Outdoor radio equipment installation
- System installation, configuration, monitoring and fault finding

System designers should refer to the following chapters:

- [Chapter 1 Product description](#)
- [Chapter 2 Planning considerations](#)
- [Chapter 3 Legal information](#)
- [Chapter 4 Reference information](#)

Installers should refer to the following chapters:

- [Chapter 5 Installation](#)
- [Chapter 6 Configuration and alignment](#)
- [Chapter 8 Troubleshooting](#)

Operators should refer to the following chapters:

- [Chapter 1 Product description](#)
- [Chapter 6 Configuration and alignment](#)
- [Chapter 7 Operation](#)
- [Chapter 8 Troubleshooting](#)

Revision History

Version information

The following shows the issue status of this document since it was first released.

Document issue	Date of issue	Remarks
001v000	Oct 2009	System Release 800-01-00 (original)
002v000	Oct 2009	System Release 800-01-00 (revised)
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005v000	Apr 2010	System Release 800-02-00
006v000	May 2010	System Release 800-02-01
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010v000	Nov 2010	System Release 800-02-04 (revised)
011v000	Mar 2011	System Release 800-03-00
012v000	May 2011	System Release 800-03-10

General information

Purpose

Motorola Point-To-Point documents are intended to instruct and assist personnel in the operation, installation and maintenance of the Motorola Point-To-Point equipment and ancillary devices. It is recommended that all personnel engaged in such activities be properly trained.

Motorola disclaims all liability whatsoever, implied or express, for any risk of damage, loss or reduction in system performance arising directly or indirectly out of the failure of the customer, or anyone acting on the customer's behalf, to abide by the instructions, system parameters, or recommendations made in this document.

Cross references

References to external publications are shown in italics. Other cross references, emphasized in blue text in electronic versions, are active links to the references.

This document is divided into numbered chapters that are divided into sections. Sections are not numbered, but are individually named at the top of each page, and are listed in the table of contents.

Contacting Motorola

Feedback

We appreciate feedback from the users of our documents. This includes feedback on the structure, content, accuracy, or completeness of our documents. Send feedback to support.ptp@motorolasolutions.com.

Motorola Point-to-Point

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For full list of Motorola Wireless Broadband Support telephone numbers, see:
<http://www.motorola.com/ptp/support/contact>

Reporting problems

If any problems are encountered when installing or operating this equipment, follow this procedure to investigate and report:

1. Search this document and the software release notes of supported releases.
2. Visit the Motorola website at <http://www.motorola.com/ptp>.
3. Ask for assistance from the Motorola product supplier.
4. Gather information from affected units such as:
 - o The IP addresses and MAC addresses
 - o The software releases
 - o The configuration of software features
 - o Any available diagnostic downloads
5. Escalate the problem to Motorola as follows:
 - o Either: send e-mail to support.ptp@motorolasolutions.com
 - o Or: call Wireless Broadband Technical Support.

Repair and service

If unit failure is suspected, visit <http://www.motorola.com/ptp/support> for details of the Return Material Authorization (RMA) process.

Warranty

Motorola's standard hardware warranty is for one (1) year from date of shipment from Motorola or a Motorola Point-to-Point Distributor. Motorola warrants that hardware will conform to the relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Motorola shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

To register PTP products or activate warranties, visit <http://www.motorola.com/ptp/support>.

For warranty assistance, contact the reseller or distributor.



Using non-Motorola parts for repair could damage the equipment or void warranty. Contact Motorola Warranty and Repair for service and repair instructions.

 **CAUTION**

Portions of Motorola equipment may be damaged from exposure to electrostatic discharge. Use precautions to prevent damage.

Security advice

Motorola systems and equipment provide security parameters that can be configured by the operator based on their particular operating environment. Motorola recommends setting and using these parameters following industry recognized security practices. Security aspects to be considered are protecting the confidentiality, integrity, and availability of information and assets. Assets include the ability to communicate, information about the nature of the communications, and information about the parties involved.

In certain instances Motorola makes specific recommendations regarding security practices, however the implementation of these recommendations and final responsibility for the security of the system lies with the operator of the system.

Warnings, cautions, and notes

The following describes how warnings and cautions are used in this document and in all documents of this Motorola document set.

Warnings

Warnings precede instructions that contain potentially hazardous situations. Warnings are used to alert the reader to possible hazards that could cause loss of life or physical injury. A warning has the following format:



Warning text and consequence for not following the instructions in the warning.

Cautions

Cautions precede instructions and are used when there is a possibility of damage to systems, software, or individual items of equipment within a system. However, this damage presents no danger to personnel. A caution has the following format:



Caution text and consequence for not following the instructions in the caution.

Notes

A note means that there is a possibility of an undesirable situation or provides additional information to help the reader understand a topic or concept. A note has the following format:



Note text.

Caring for the environment

The following information describes national or regional requirements for the disposal of Motorola supplied equipment and for the approved disposal of surplus packaging.

In EU countries

The following information is provided to enable regulatory compliance with the European Union (EU) directives identified and any amendments made to these directives when using Motorola equipment in EU countries.



Disposal of Motorola equipment

European Union (EU) Directive 2002/96/EC Waste Electrical and Electronic Equipment (WEEE)

Do not dispose of Motorola equipment in landfill sites. In the EU, Motorola in conjunction with a recycling partner ensures that equipment is collected and recycled according to the requirements of EU environmental law.

Disposal of surplus packaging

Do not dispose of surplus packaging in landfill sites. In the EU, it is the individual recipient's responsibility to ensure that packaging materials are collected and recycled according to the requirements of EU environmental law.

In non-EU countries

In non-EU countries, dispose of Motorola equipment and all surplus packaging in accordance with national and regional regulations.

Licensing requirements

Operating license

This equipment operates in bands that require a license in most countries.



In most countries it is illegal to operate the PTP 800 without a license from the regional or local regulating authority.

United States of America

This device has been verified by Motorola as being in compliance with the requirements of the rules of the Federal Communications Commission (FCC), 47 C.F.R. Part 101, and may not be operated without a station license. In the United States such licenses are issued by the FCC to entities other than agencies of the United States government. Federal government agencies are licensed by the National Telecommunications and Information Administration (NTIA) acting upon the recommendation of the Interdepartment Radio Advisory Committee (IRAC).

Motorola license agreement

The PTP 800 must be operated in accordance with the Motorola Solutions, Inc. end user license agreement, as specified in [Chapter 3 Legal information](#).

Chapter 1 Product description

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This chapter provides a high level description of the PTP 800 product. It describes in general terms the function of the product, the main product variants and typical deployment. It also describes the main hardware components.

The following topics are described in this chapter:

- [Overview](#) on page 1-2: Introduces the key features, typical uses, product variants and components of the PTP 800.
- [Compact modem unit \(CMU\)](#) on page 1-6: Describes the CMU and its interfaces.
- [Outdoor unit \(ODU\)](#) on page 1-10: Describes the ODU and its components.
- [Antenna and antenna accessories](#) on page 1-13: Describes the antennas and accessories such as the remote mount kit and ODU coupler.
- [Cabling and lightning protection](#) on page 1-19: Describes the cabling and lightning protection components of a PTP 800 installation.
- [Wireless operation](#) on page 1-21: Describes how the PTP 800 wireless link is operated, including modulation modes, power control and security.
- [1+1 Hot Standby link protection](#) on page 1-25: Describes the 1+1 Hot Standby feature, which protects the PTP 800 link against hardware failure.
- [Ethernet bridging](#) on page 1-35: Describes how the PTP 800 controls Ethernet data, in both the customer data network and the system management network.
- [System management](#) on page 1-44: Introduces the PTP 800 management system, including the web interface, installation, configuration, alerts and upgrades.

Overview

Motorola PTP 800 Licensed Ethernet Microwave products are designed for Ethernet bridging over licensed point-to-point microwave links in selected licensed bands from 6 GHz to 38 GHz.

PTP 800 provides link capacity from 10 Mbit/s to 368 Mbit/s with configurable ETSI and FCC channel bandwidths from 7 to 56 MHz. With upgradeable link capacity limits from 10 Mbit/s to full capacity via software key, the system offers exceptional cost efficiency and scalability.

Key features

The key features of the PTP 800 include:

- Support for licensed bands from 6 GHz to 38 GHz, as listed in [Table 1-1](#)
- Configurable channel bandwidths from 7 to 56 MHz
- Fixed modulation modes QPSK to 256 QAM
- Up to 368 Mbit/s link capacity (full duplex)
- 1+1 Hot Standby link protection, with an option for support of one or two antennas
- Effective quality of service with QOS (802.1p) served by eight queues
- Progressive and asymmetric capacity options through purchase of software license keys
- Ultra-low latency, <115 us @ 368 Mbit/s with 64 byte frames
- Split mount architecture with a compact indoor unit
- In-band or out-of-band network management
- Optional FIPS-197 128/256bit AES encryption
- Link planning with the PTP LINKPlanner

Typical users

PTP 800 links may be used to provide high-performance Ethernet communication for:

- Enterprises
- Internet Service Providers (ISPs)
- Government agencies
- Cellular carriers
- Health care and hospitals
- Schools and universities
- Municipalities
- Public safety agencies

Typical applications

PTP 800 systems serve a wide variety of enterprise and carrier network applications, including:

- Building-to-building connectivity
- Leased-line replacement
- Video surveillance
- Network redundancy
- WiMAX, LTE and 3G backhaul
- Data overlay networks
- Last mile access and connection

System components

The main components of the PTP 800 are:

- **Compact modem unit (CMU):** The CMU is mounted indoors. It converts data signals between Ethernet frames and a modulated intermediate frequency (IF) carrier. The following CMU options are available:
 - Capacity upgrades
 - Security upgrades
 - Fiber data interface
 - CMU rack mount kit
- **Outdoor unit (ODU):** The ODU is mounted near the antenna. It converts signals between a modulated intermediate frequency (IF) and radio band frequencies.
- **Antenna and antenna accessories:** Motorola supplies high performance, low profile antennas for PTP 800 frequency bands in sizes from 0.3 m (1 ft) to 1.8 m (6 ft). The following antenna options are available:
 - Remote mount kit
 - Tapered transition
 - Coupler mounting kit (symmetric or asymmetric)
 - Flexible waveguide and waveguide hangers
- **Cabling and lightning protection:** The installation is connected using the following components:
 - CNT-400 coaxial cable (IF cable)
 - Lightning protection units (LPU)
 - Coaxial cable installation assembly kits
 - Cable grounding kits
- **1+1 Hot Standby protection components:**
 - Protection splitter – used with out-of-band management option.
 - Protection cable – used with customer data over redundant copper/fiber with in-band management option.

Typical PTP 800 site installations with grounding and lightning protection are shown schematically in [Figure 2-5](#) (on a mast) and [Figure 2-7](#) (on a building).

For inventories and specifications of system components, including part numbers, refer to [Chapter 4 Reference information](#).

Product variants

The product variants are listed in [Table 1-1](#).

Table 1-1 PTP 800 product variants

Licensed band	Regions	Frequency coverage
Lower 6 GHz	FCC, IC, ETSI	5.925 – 6.425 GHz
Upper 6 GHz	ETSI	6.425 – 7.125 GHz
7 GHz	ETSI	7.110 – 7.9 GHz
8 GHz	ETSI	7.725 – 8.5 GHz
11 GHz	FCC, IC, ETSI	10.7 – 11.7 GHz
13 GHz	ETSI	12.75 – 13.25 GHz
15 GHz	ETSI, Mexico, ANZ	14.4 GHz – 15.35 GHz
18 GHz	FCC, IC, ETSI, Brazil	17.7 – 19.7 GHz
23 GHz	FCC, IC, ETSI	21.2 – 23.6 GHz
26 GHz	FCC, ETSI	24.25 – 26.5 GHz
38 GHz	FCC, IC, ETSI	37 – 40 GHz

Compact modem unit (CMU)

CMU description

The PTP 800 compact modem unit (CMU) (Figure 1-1) is used as a component of a line-of-sight licensed-band microwave link to deliver a point-to-point Ethernet service between two locations. The CMU converts data signals between Ethernet frames and a modulated intermediate frequency (IF) carrier.

The CMU operates in indoor locations mounted on a shelf, on a wall (using the provided bracket), or in a standard 19 inch rack (using the optional 1U rack mounting kit). It is ideally suited to applications where space is limited.

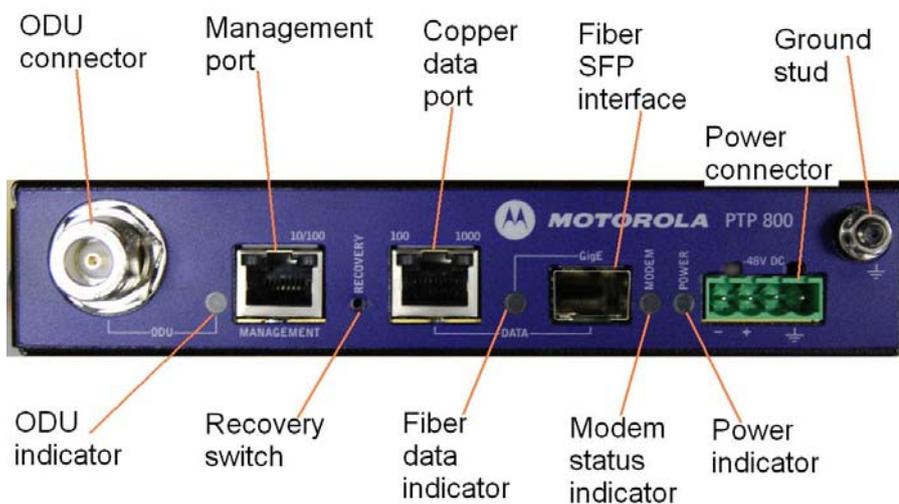
Figure 1-1 PTP 800 CMU



CMU interfaces

The CMU front panel interfaces are illustrated in Figure 1-2.

Figure 1-2 CMU front panel



ODU connector

The CMU is connected to the ODU using the IF cable. The ODU connector is a standard N-type female.

The IF cable carries the following multiplexed signals:

- Power supply –48 V dc
- Transmit signal at 350 MHz
- Receive signal at 140 MHz
- ODU control and status signals

CAUTION

Do not connect or disconnect the IF cable when the –48 V supply is applied to the CMU.

Management port

The PTP 800 system supports network management communications in two modes: “out-of-band” and “in-band”. In the “out-of-band” mode, the system is managed by connecting to the CMU through the management port.

The management port supports 10baseT and 100baseT Ethernet.

For more information on the Ethernet interfaces see [Wireless operation](#) on page 4-55.

For 1+1 Hot Standby protection, unused pins of the management port are utilised to provide the protection interface between the two CMUs at one end of a protected link. For more information see [1+1 Hot Standby link protection](#) on page 1-25.

Recovery switch

The recovery switch is used to start the CMU in recovery mode. Recovery mode provides a means to recover from serious configuration errors including lost or forgotten passwords and unknown IP addresses. For more information see [Recovery mode](#) on page 1-48.

Recovery mode also allows new main application software to be loaded even when the integrity of the existing main application software has been compromised.

Copper data port

The copper data port connects the customer traffic network.

In the “in-band” management mode, the system is managed through the data port, and management traffic is multiplexed with customer traffic.

The copper data port supports 100baseT or 1000baseT Ethernet. For more information on the Ethernet interfaces see [Wireless operation](#) on page 4-55.

Fiber SFP interface

The Fiber SFP interface is a standard small form-factor pluggable (SFP) gigabit interface that allows connection of an optional fiber-optic module. When a supported SFP module is present and is working, and the fiber carrier is present, the customer traffic network (and in-band management network, if enabled) connects through fiber, and the copper data port is not used. If the fiber link fails or loses the carrier signal, the Ethernet service falls back to the copper LAN connection.

The Fiber SFP interface is a Class 1 laser product, safe under all conditions of normal operation.

For more information on the Ethernet interfaces see [Wireless operation](#) on page 4-55.

Power connector

The CMU is powered from a standard -48 V dc telecommunications supply, with supply range -40.5 V to -60 V.

The 0 V (positive connection) is grounded at the CMU casing, IF cable outer shield and ODU casing.

Ground stud

The CMU must be grounded at this M5 ground stud using the supplied connector.

The ground cable must be fitted to a suitable low impedance ground point. This will ensure protection to personnel from hazardous voltages occurring in the event of lightning strikes and for the protection of the equipment.

For a protected link, both CMUs must be connected to a common ground. This must be installed prior to connecting the two CMUs with the protection interface.

Front panel indicators

The CMU front panel indicator LEDs and their functions are described in [Table 1-2](#).

Table 1-2 CMU indicator LEDs

Indicator	Function	Description
ODU indicator	Green steady	ODU is ready for use and transmitting
	Green slow blink	ODU is available for use and is muted, or is incompatible with the radio license configuration
	Red steady	No response from, or incompatible ODU
	Off	ODU not powered
Management port	Yellow steady	Ethernet link up, no traffic
	Yellow flash	Ethernet link up, traffic
	Off	Ethernet link down or not connected
Copper data port	Green steady	1000baseT Ethernet link up, no traffic
	Green flash	1000baseT Ethernet link up, traffic
	Yellow steady	100baseT Ethernet link up, no traffic
	Yellow flash	100baseT Ethernet link up, traffic
	Off	Ethernet link down or not connected
Fiber data indicator	Green steady	Fiber Ethernet link up, no traffic
	Green flash	Fiber Ethernet link up, traffic
	Off	Ethernet link down or not connected
Modem status indicator	Green steady	Normal operation
	Green slow blink	Wireless link down
	Yellow steady	CMU booting
	Red steady	Out of service
	Red slow blink	Recovery mode
	Off	Power supply fault (there may still be power to the CMU)
Power indicator	Green steady	Power okay
	Off	Power supply fault (there may still be power to the CMU)

Outdoor unit (ODU)

ODU description

The PTP 800 outdoor unit (ODU) ([Figure 1-3](#)) converts signals between a modulated intermediate frequency (IF) and radio band frequencies for transmission over a line-of-sight link.

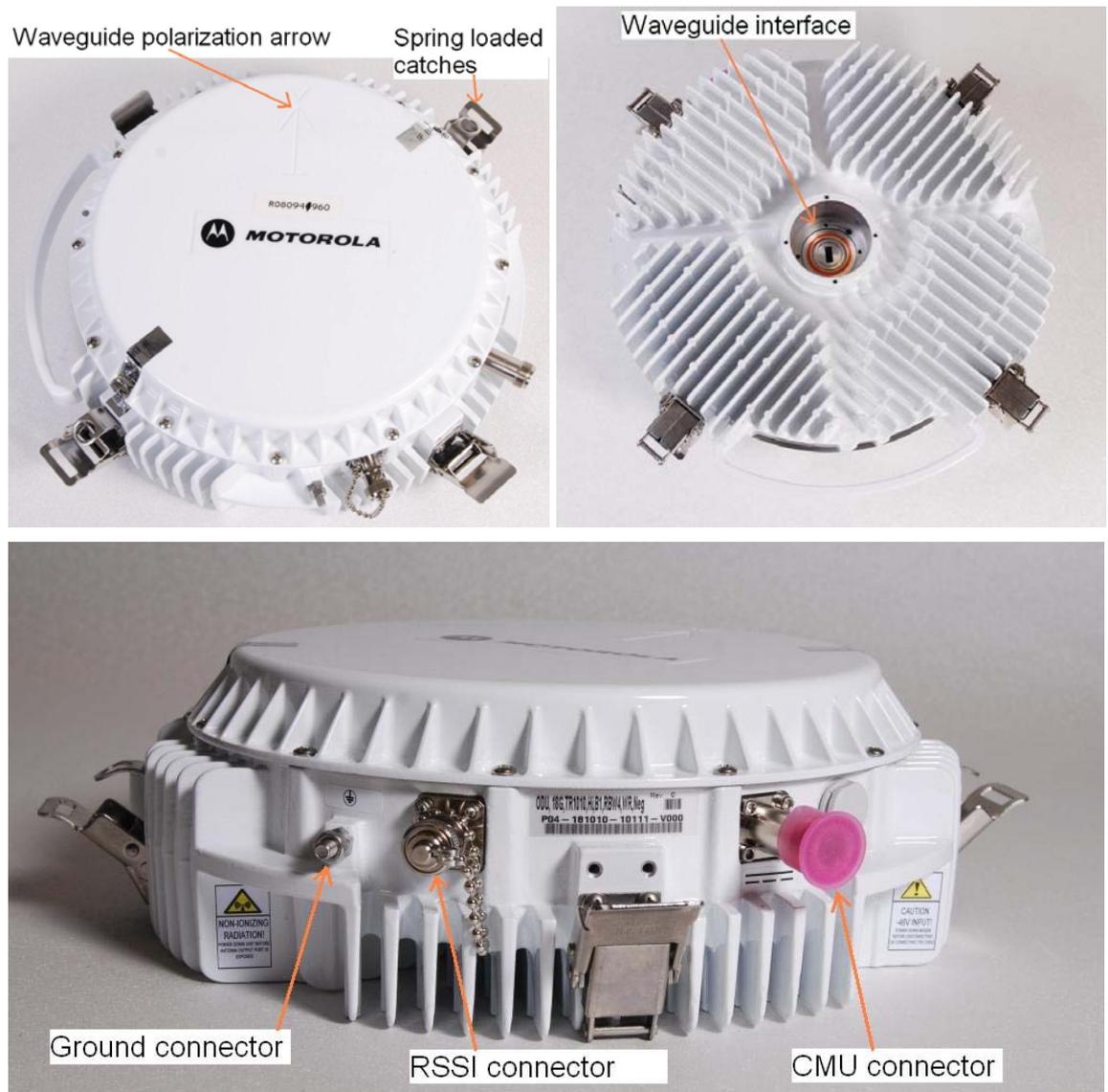
Figure 1-3 ODU



ODU interfaces

The ODU interfaces are illustrated in [Figure 1-4](#).

Figure 1-4 ODU (front, rear and side view)



Waveguide polarization arrow

The waveguide polarization arrow indicates the orientation of the waveguide interface. The arrow is parallel to the short dimension of the rectangular waveguide aperture.

Spring loaded latches

The ODU has four spring loaded latches. These are used to fasten the ODU to the antenna, remote mount kit or coupler.

Waveguide interface

The waveguide interface connects to a Motorola direct mount antenna, an ODU coupler kit, or a remote mount kit. The ODU is secured by means of the four spring-loaded latches.

Ground connector

This is used to ground the ODU by attaching it to the mast top lightning protection unit (LPU).

RSSI connector

The received signal strength indication (RSSI) connector is a standard BNC female connector that provides access to an analogue voltage proportional to the received power at the ODU input. A voltmeter is attached to the RSSI connector to measure the voltage when aligning the antenna. For more information, see [Step 6: Aligning antennas](#) on page 6-61.

CMU connector

This connects the ODU to the CMU. For more information, see [ODU connector](#) on page 1-7.

Antenna and antenna accessories

Antenna description

Motorola supplies high performance, low profile antennas for PTP 800 frequency bands in sizes from 0.3 m (1 ft) to 1.8 m (6 ft) (Figure 1-5). The antennas are available in three variants:

- Single polarization Motorola direct mount interface.
- Single polarization waveguide interface.
- Dual polarization waveguide interface.

Figure 1-5 Typical PTP 800 antenna (Motorola direct mount interface)



The Motorola direct mount interface (Figure 1-6) provides a reliable and convenient way of mounting the ODU directly to the antenna without the need for additional mounting brackets or waveguides. The ODU fits directly over the antenna's centrally positioned cylindrical transition and is secured in place using the integral spring loaded latches (Figure 1-7). There is no direct mount option for dual polarization configurations.

Figure 1-6 Direct mount mechanical interface**Figure 1-7** ODU clipped onto direct mount mechanical interface

The waveguide interface antennas ([Figure 1-8](#)) are used when the ODU must be mounted separately from the antenna. The ODU is fitted to an ODU remote mount kit (RMK). The antenna is connected to the RMK waveguide interface using a 0.9 m (35 inch) flexible waveguide supplied by Motorola.

Waveguide interface antennas are available as a dual polarization option in all frequency bands, the antenna providing one interface for V-feed and one interface for H-feed. This allows two ODUs operating on different frequencies within the same band to share the same antenna.

Motorola also supplies a single polarization option. This may be used for 1+1 protected links.

 **NOTE**

The 11 GHz waveguide interface antenna requires an extra component, the 11 GHz tapered transition. This is supplied by Motorola and is required to convert between the antenna interface and the waveguide flange.

Figure 1-8 Remote mount antenna waveguide interface

Remote mount kits

The purpose of the Remote Mount Kit (RMK) is to provide a means of mounting the ODU (or coupler) to the mast. The RMK provides an alternative to mounting the ODU directly onto a direct mount antenna. The RMK and antenna are connected together using Motorola's flexible waveguide.

The RMK has the following functions:

- The RMK provides a means of clamping to the mast.
- The RMK provides a cylindrical transition ([Figure 1-10](#)) onto which the ODU directly mounts. The other side of the transition ([Figure 1-9](#)) is then connected to the antenna via a flexible waveguide.
- The ODU is mechanically secured onto the RMK using the spring loaded latches and securing bolts.

The choice of remote mount kit depends upon the frequency variant. Refer to [ODU remote mount kit specifications](#) on page 4-30.

In each case, the RMK connects to a waveguide interface antenna using standard flexible waveguide. One RMK is required for each ODU.

The 11 GHz RMK is always used with a tapered transition between the antenna and the flexible waveguide.

Figure 1-9 Remote mount kit showing the waveguide interface

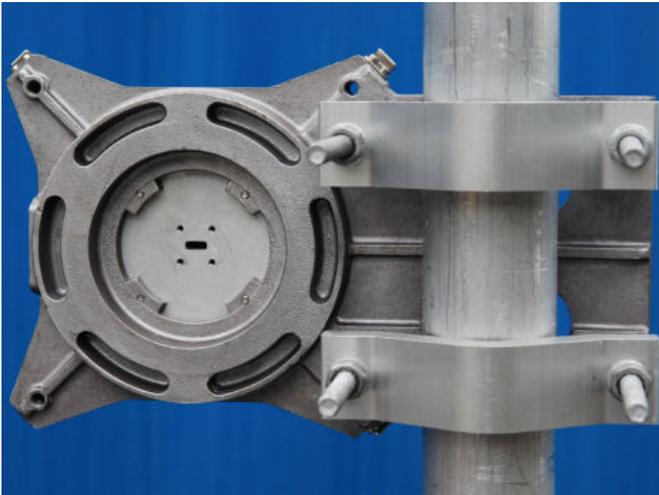


Figure 1-10 Remote mount kit showing the ODU interface



ODU coupler mounting kit

A coupler mounting kit ([Figure 1-11](#)) allows two ODUs to share the same antenna. It is required in the following configurations:

- To support two parallel and simultaneously transmitting links, each operating on a different frequency pair.
- To support a 1+1 Hot Standby protected interface, with only one ODU transmitting.

Couplers will increase system loss.

The coupler mounting kit provides an interface that is mechanically identical to that of a single ODU. It can therefore be used with either a direct mounted antenna ([Figure 1-12](#)) or a remote antenna via a remote mount kit.

The choice of coupler mounting kit depends on the frequency variant and on the coupler type required (symmetric or asymmetric). In protected links, asymmetric couplers allow the primary link to operate with optimum link budget, with the redundant link operating with reduced margin. Refer to [ODU coupler mounting specifications](#) on page 4-50.

Figure 1-11 ODU coupler mounting kit



Figure 1-12 Two ODUs and antenna mounted on a coupler



Cabling and lightning protection

The cabling and lightning protection components of a PTP 800 installation are:

- Coaxial cable (IF cable)
- Indoor Cat5e cable (screened or unshielded)
- Grounding cables
- Lightning protection units

Lightning protection requirements

The PTP 800 has been tested for compliance to the EMC immunity specifications identified in [EMC immunity compliance](#) on page 4-92.

The standard ODU for the PTP 800 is fitted with surge limiting circuits and other features to minimize the risk of damage due to nearby lightning strikes. To be fully effective, these standard features require some additional equipment to be configured as part of the system installation.

CAUTION

The PTP 800 Series is not designed to survive direct lightning strikes. For this reason the antenna and ODU should not be installed at the highest point in a localized area. See [Grounding and lightning protection](#) on page 2-7.

ODU to CMU connection

The ODU is connected to the LPUs and CMU using CNT-400 coaxial cable (IF cable).

CMU to the network connection

The CMU is connected to network equipment using either a copper data port (100baseT or 1000baseT Ethernet) or a fiber interface (1000BaseSX or 1000BaseLX).

Cable grounding kits

The installation must be grounded to the supporting structure at the points specified in [Grounding and lightning protection](#) on page 2-7. One cable grounding kit ([Figure 1-13](#)) is required at each grounding point.

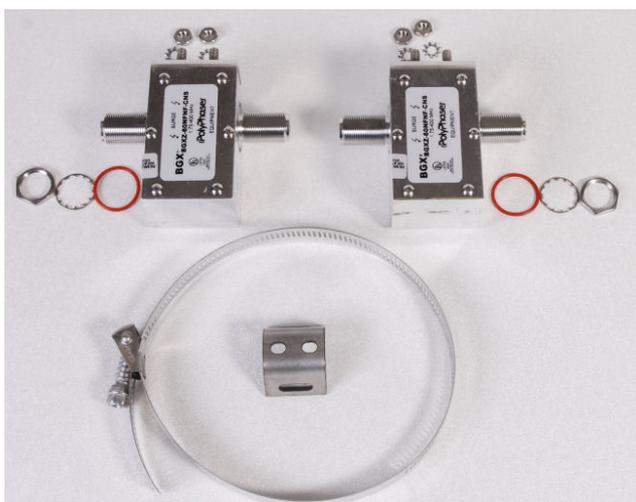
Figure 1-13 Cable grounding kit for 1/4" and 3/8" cable



Lightning protection units (LPUs)

The PTP 800 LPU end kit ([Figure 1-14](#)) is required for IF cables. One LPU is installed next to the ODU and the other is installed near the building entry point.

Figure 1-14 PTP 800 LPU end kit



Wireless operation

Channel bandwidth

The PTP 800 wireless link supports the following channel bandwidths:

- 7 MHz
- 10 MHz
- 13.75 MHz
- 14 MHz
- 20 MHz
- 27.5 MHz
- 28 MHz
- 29.65 MHz
- 30 MHz
- 40 MHz
- 50 MHz
- 55 MHz
- 56 MHz.

The available selection of channel bandwidths varies depending on band and region.

Modulation modes

The PTP 800 wireless link operates using single carrier modulation with the following fixed modulation modes:

- QPSK
- 8PSK
- 16QAM
- 32QAM
- 64QAM
- 128QAM
- 256QAM

The available selection of modulation modes varies depending on band, region and channel bandwidth.

PTP 800 uses Low Density Parity Check (LDPC) forward error correction (FEC) coding. The code rate is calculated as the ratio between the un-coded block size and the coded block size. FEC code rate in PTP 800 varies between 0.76 and 0.94 depending on channel bandwidth and modulation mode.

For more information, see [Capacity, transmit power and sensitivity](#) on page 4-58.

Adaptive coding and modulation

PTP 800 supports both Fixed Modulation and Adaptive Coding and Modulation (ACM) modes. In ACM mode, the PTP 800 selects the modulation mode according to the quality of the received signal. The selection criterion is to provide the highest link capacity that can be achieved while keeping the communication error free.

When compared with Fixed Modulation operation, ACM can increase either link availability, or average wireless link capacity, or both.

Wireless link capacity

The maximum data throughput capacity of the PTP 800 wireless link is the lower of the wireless link capacity and the data capacity limit set by the PTP 800 license key.

All PTP 800 CMUs are shipped with a factory-set 10 Mbit/s capacity limit, meaning that capacity is restricted to a maximum of 10 Mbit/s at the data port. Users can purchase capacity upgrades in nine steps between 20 Mbit/s and unlimited capacity. For more information, see [Capacity upgrades](#) on page 1-49.

NOTE

Purchasing a capacity upgrade will not necessarily lead to an increase in data capacity, as capacity also depends on channel bandwidth and modulation mode. For more information, see [Capacity, transmit power and sensitivity](#) on page 4-58.

Automatic transmitter power control

PTP 800 provides closed-loop automatic transmitter power control (ATPC). ATPC avoids overload of the receivers in links with low link loss by automatically adjusting transmitter power. The ATPC threshold is -40 dBm received power. ATPC has no effect in links where the received power is lower than the threshold.

Automatic adjustment of the transmitter can be enabled or disabled using the Automatic Transmitter Power Control attribute on the Configuration page of the web-based interface. This attribute must have the same setting at both ends of the link.

In some regions ATPC is a regulatory requirement and in these cases ATPC cannot be disabled.

The power control loop compensates for slow variations in received power and does not respond to fast fading that occurs in multipath channels.

In addition to its main function, ATPC includes a mechanism protecting against a lock up scenario. The mechanism is active regardless of the received power. This lock up occurs when the configured maximum transmit power causes the received power at both ends of the link to be too high to allow correct signal demodulation. In this situation, no communication can be established in either direction, causing the radios to wait forever for the remote end to appear.

The protection mechanism works as follows. Upon the link dropping for more than 10 seconds, ATPC drops the maximum transmit power of the end which has the lowest transmit frequency by 15 dB. This ensures the link will come up even if the maximum transmit power is set incorrectly. The delay prevents this mechanism from being triggered when the link drops briefly due to severe fading.

Maximum receive power

The maximum receive power is the maximum power at which a PTP 800 link should be operated to maintain error free communication. This maximum receive power for normal operation is -35 dBm. Automatic transmitter power control, if enabled, will reduce the installation receive level to a -40 dBm operating level if there is sufficient dynamic range available in the maximum transmit power. For example, a link installed at -35 dBm with a maximum transmit power set to at least 5 dB above the minimum power level will successfully operate at -40 dBm. Links operating without ATPC, or with less than 5 dB available dynamic range should ensure that the normal operating level does not exceed -35 dBm.

On very short links it may be necessary to use a fixed waveguide attenuator, which will require the use of a remote mount antenna, to keep the maximum receive power at an acceptable level.

Maximum transmit power

Maximum transmit power is the maximum power that the PTP 800 is permitted to generate at the waveguide interface assuming that ATPC is disabled, or the link loss is high enough such that ATPC is not activated. The equipment limit for maximum transmit power is defined by modulation mode, band, channel bandwidth and standards body or region. The spectrum license limit is determined by the maximum EIRP permitted by the individual license, the antenna gain and feeder loss. The maximum transmit power that can be configured for PTP 800 is limited by the more restrictive of the equipment limit and the spectrum license limit.

Maximum transmit power defaults to the maximum permitted as described above, but can be reduced if necessary using Step 3 of the Installation Wizard, or the Configuration page of the web-based interface.

Security

PTP 800 provides optional 128-bit and 256-bit encryption using the Advanced Encryption Standard (AES). The implementation in PTP 800 has been validated against Federal Information Processing Standard Publication 197 (FIPS-197) in the Cryptographic Algorithm Validation Program (CAVP) of the US National Institute of Standards and Technology (NIST).

AES encryption protects all traffic over the wireless link, including in-band and out-of-band network management traffic. Each CMU behaves as a cryptographic device in which the Ethernet interfaces transmit and receive plain text data, and the IF interface transmits and receives cipher text data. The IF cable and ODUs are outside the cryptographic boundary.

1 + 1 Hot Standby link protection

The 1+1 Hot Standby feature provides an option for protecting a PTP 800 link against hardware failure. In the event of failure of a single piece of equipment, a protected link can be automatically returned to operation with minimal delay. This feature also enables system maintenance to be carried out with minimum impact on traffic.

Concept of a protected link

An 'unprotected' PTP 800 link comprises one CMU, one ODU and one antenna at each end. This provides no protection against equipment failure.

A 'protected' PTP 800 link comprises an Ethernet switch, two CMUs, two ODUs and either one or two antennas at each end.

A protected end consists of two 'neighbors':

- If antenna protection is not implemented ([Figure 1-15](#)), each neighbor consists of one CMU connected to one ODU. The two ODUs are connected to one antenna via a coupler. The link provides CMU and ODU protection, but not antenna protection.
- If antenna protection is implemented ([Figure 1-16](#)), each neighbor consists of one CMU connected to one ODU connected to one antenna (without a coupler). The link provides CMU, ODU and antenna protection.

One neighbor is labelled 'Primary' and the other 'Secondary'. The two neighbors operate as a pair. If a component of one of the neighbors fails then the other neighbor takes over the link operation.

The two CMUs are normally connected to the same Ethernet switch because this allows communication of management information to the inactive unit when management access is across the wireless link. The protection interface is used for communicating protection status information, including faults, between two CMUs.

NOTE

[Figure 1-15](#) and [Figure 1-16](#) show the network connections for in-band management. The connections are different if out-of-band management is implemented.

Figure 1-15 Protected end without antenna protection

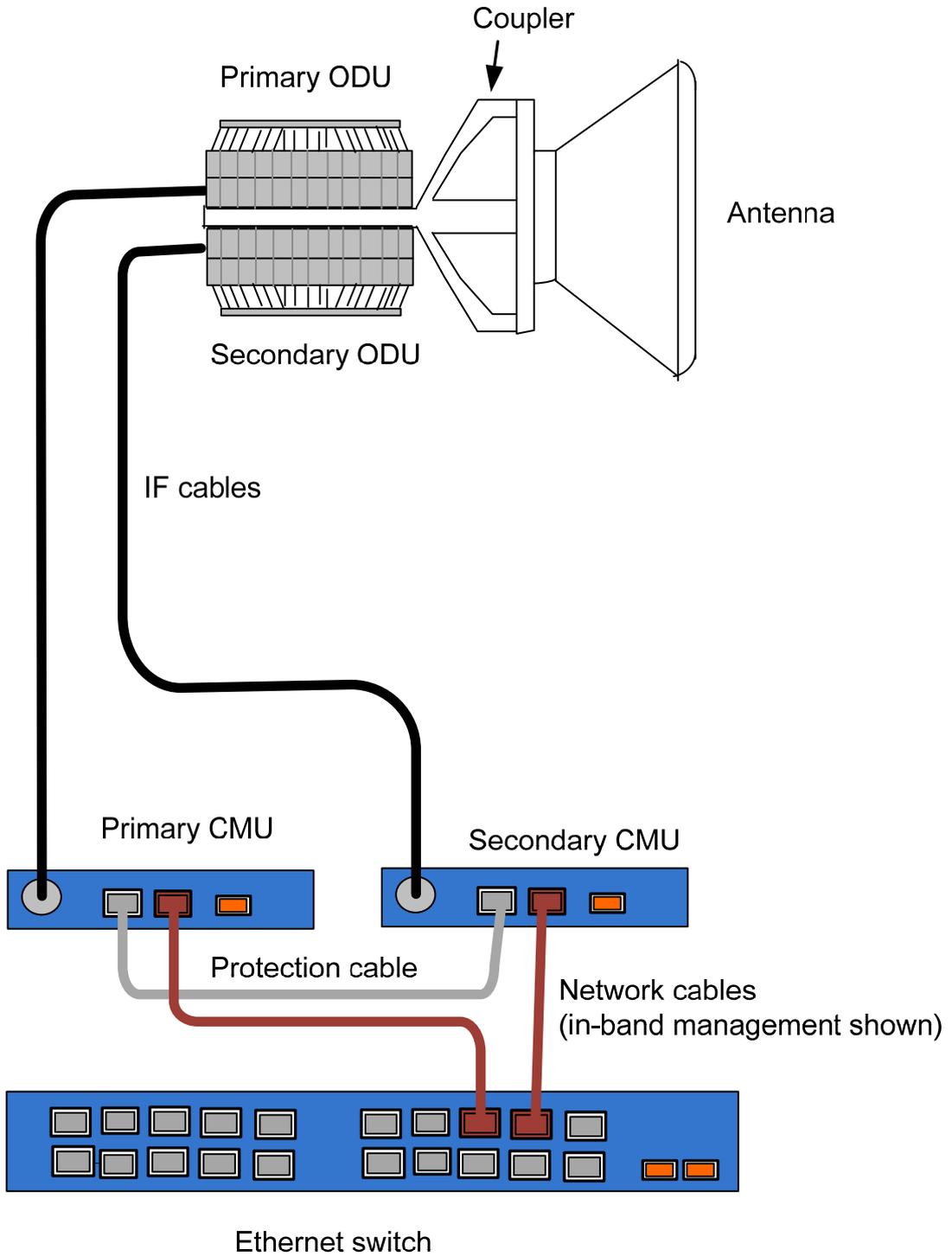
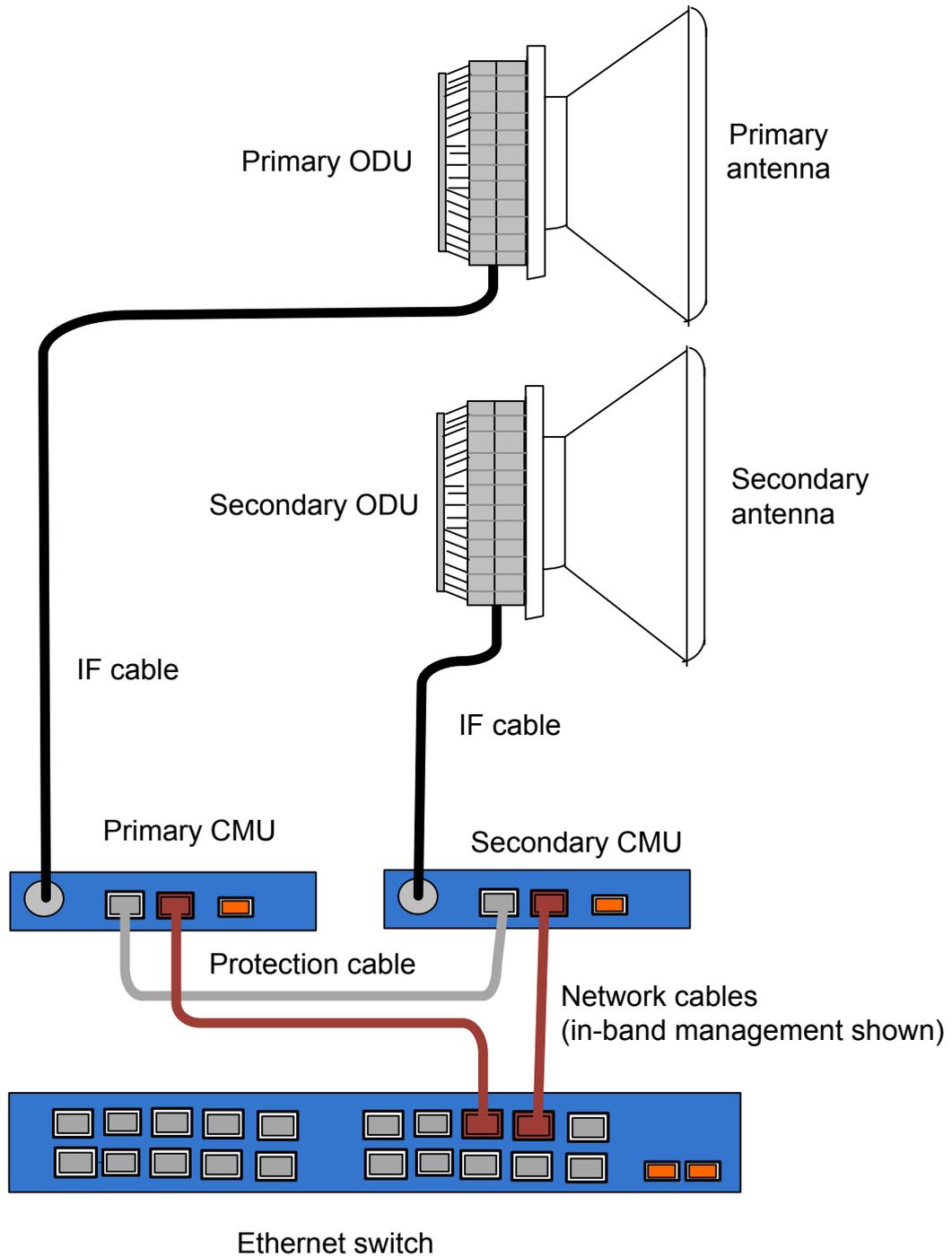


Figure 1-16 Protected end with antenna protection



Operation of a protected link

To configure protection (typically during installation), use the Protection page (see [Task 9: Configuring protection interface](#) on page 6-42). One neighbor must be configured as 'Primary', the other neighbor as 'Secondary'.

At each end, only one neighbor is active at any one time. The other neighbor is inactive. The inactive neighbor monitors traffic from the other end of the radio link. A fault on the active neighbor will cause a protection switch if the inactive neighbor is fault free. A protection switch may occur on one end independently of the other end.

On boot up, assuming no fault occurs, the Primary becomes active. If the Primary develops a fault, the Secondary becomes active. If the Secondary boots up first, it waits an extra two minutes in the inactive state to confirm that the Primary boots up. If the Primary is not detected in this period, the Secondary becomes Active.

Protected link antenna interfaces

Links without antenna protection

Links without antenna protection ([Figure 1-15](#)) require antenna couplers that may be either symmetric or asymmetric. The asymmetric coupler provides the highest link margin (lower path loss) for the primary path, as this is usually the active path, except in a fault condition or during certain maintenance operations. For more information, see [ODU coupler mounting specifications](#) on page 4-50.

If the coupler is asymmetric, the Primary ODU must be mounted on the coupler arm labeled 'Main' and the Secondary ODU must be mounted on the coupler arm labeled 'Standby'. This provides a better quality wireless signal when operating Primary to Primary.

If the coupler is symmetric, the same convention can be followed for convenience (Primary to 'Main' and Secondary to 'Standby'), but this makes no difference to wireless signal quality.

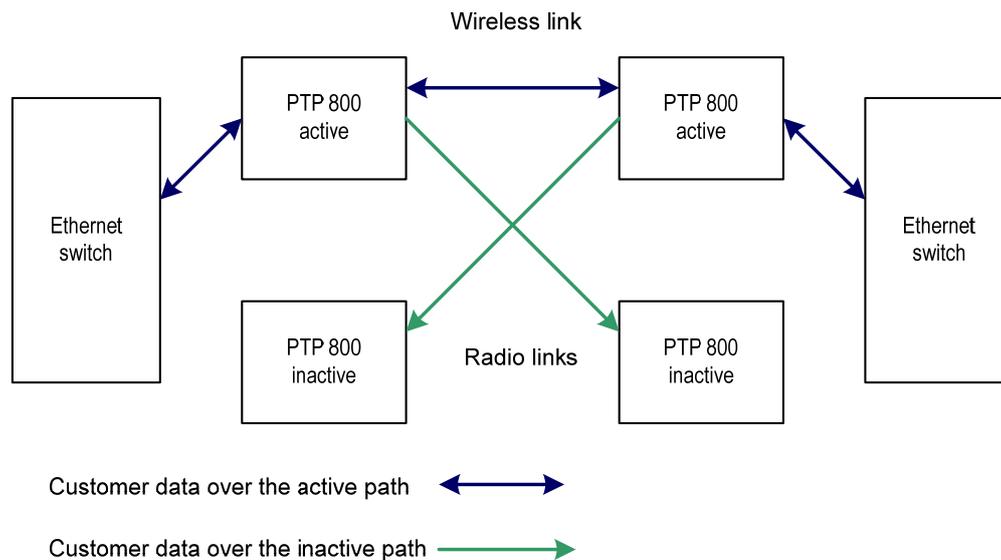
Links with antenna protection

Links with antenna protection ([Figure 1-16](#)) require two antennas at each end. These may be of the same type or of different types. If the antennas are of different types, the antenna that is predicted to provide the better quality link should be designated the Primary neighbor at that end of the link.

Protected link network interfaces

The two neighbors at an end must normally connect to the network via the same Ethernet switch. The Ethernet switch routes traffic to the active neighbor ([Figure 1-17](#)). Both the active and inactive neighbors at the other end of the link receive the wireless signal but only the active neighbor forwards this data to the Ethernet switch.

Figure 1-17 Active and inactive customer data paths in a protected link



NOTE

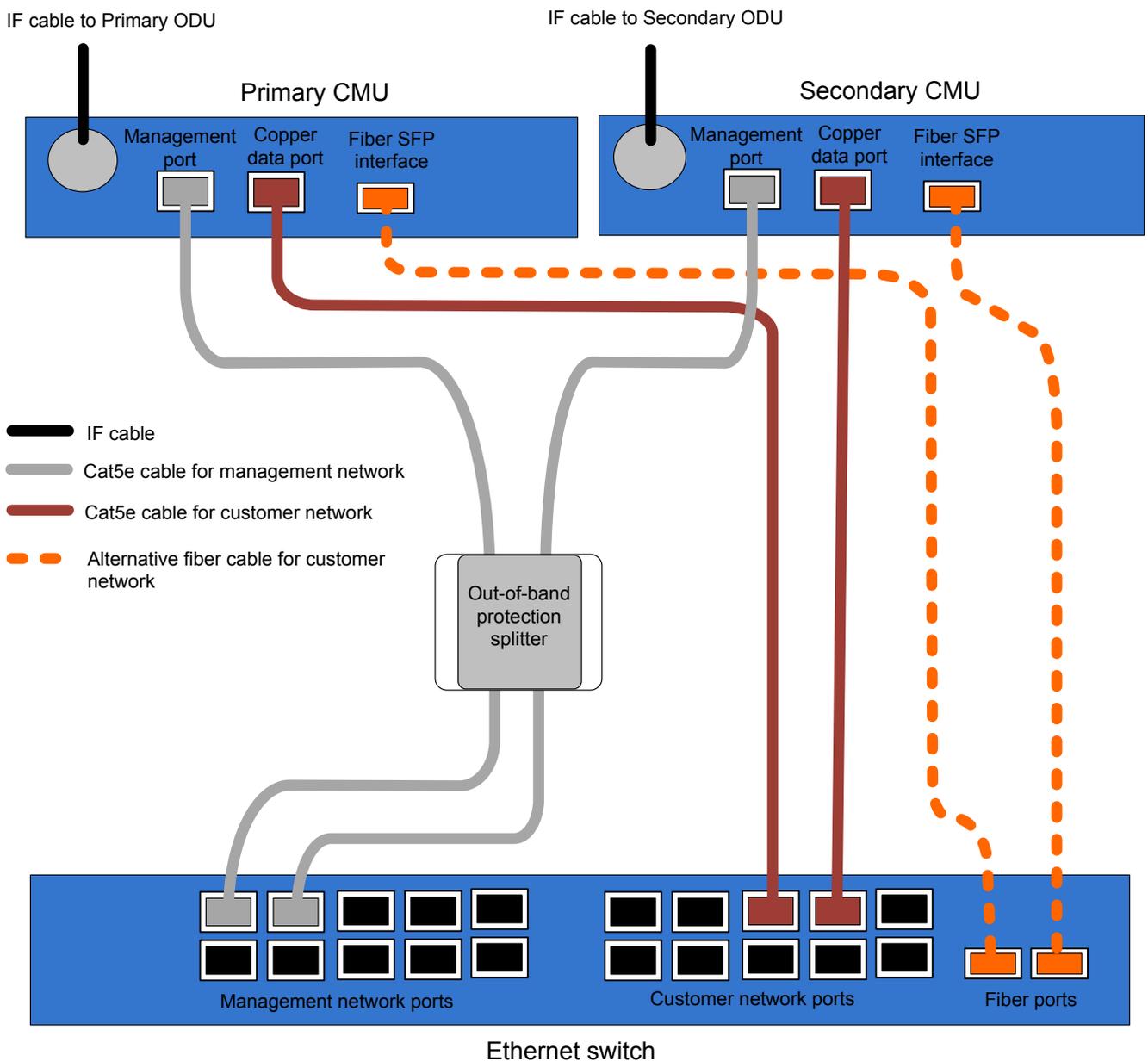
The Ethernet switch must be able to do address learning, and to flush its filter database promptly on a link down alert. Many inexpensive unmanaged switches will fail to meet these requirements. For more information, see [Planning link protection](#) on page 2-5.

Protected links may be configured for either out-of-band or in-band management. For definitions of these management modes, see [Management network](#) on page 1-37. For details of the Ethernet switch connections in protected ends, see [Protected link with out-of-band management](#) on page 1-30 and [Protected link with in-band management](#) on page 1-33.

Protected link with out-of-band management

The Data port and Management ports of both CMUs connect to the Ethernet switch (Figure 1-18). The customer data connections may be both copper, both fiber, or one copper and one fiber. Only the active CUM forwards traffic between the customer network and the wireless interface.

Figure 1-18 Out-of-band management connections for a protected end



Protection splitter

The protection interface shares the CMU Management port with the management network connection. Therefore, if out-of-band management is required, the protection and management interfaces must be connected via the out-of-band protection splitter.

Detection of link failure

In the event of a protection switch, the network equipment must learn the new active path. To signal the need for this, the currently active CMU disables all configured copper or fiber Ethernet ports for a period of between 0.5 and 1 second. This causes the Ethernet switch to detect link failure and learn new routing for traffic via the newly active PTP 800.

NOTE

Ensure that the Ethernet switch has the ability to recognize this signal and learn the new traffic routing.

Management connectivity

Management connectivity uses the out-of-band management mode, in which the management agent can be reached from the management port of the CMU.

The management port in the inactive CMU can be accessed for remote management either via the active PTP 800 and the Ethernet switch or via a separate management network.

Last hop

A 'Last hop' protected end is one that is at the edge of the network, where access to the management network is not available.

A 'last hop' arrangement can be provided in one of the following ways:

- Connect the Management ports of neighboring CMUs using a crossed protection cable of maximum length 2 meters ([Figure 1-19](#)). In this arrangement the protection cable provides both protection and a data connection for remote management of the inactive unit. If local access is required (for example during maintenance), the protection cable can be removed from the Management port of the CMU.
- Connect the two LAN ports of the out-of-band protection splitter using either a straight-through or a crossed Ethernet cable ([Figure 1-20](#)). If local access is required, a connection can be made via the protection splitter LAN port without effecting the protection interface.

Figure 1-19 Last hop protected end with protection cable

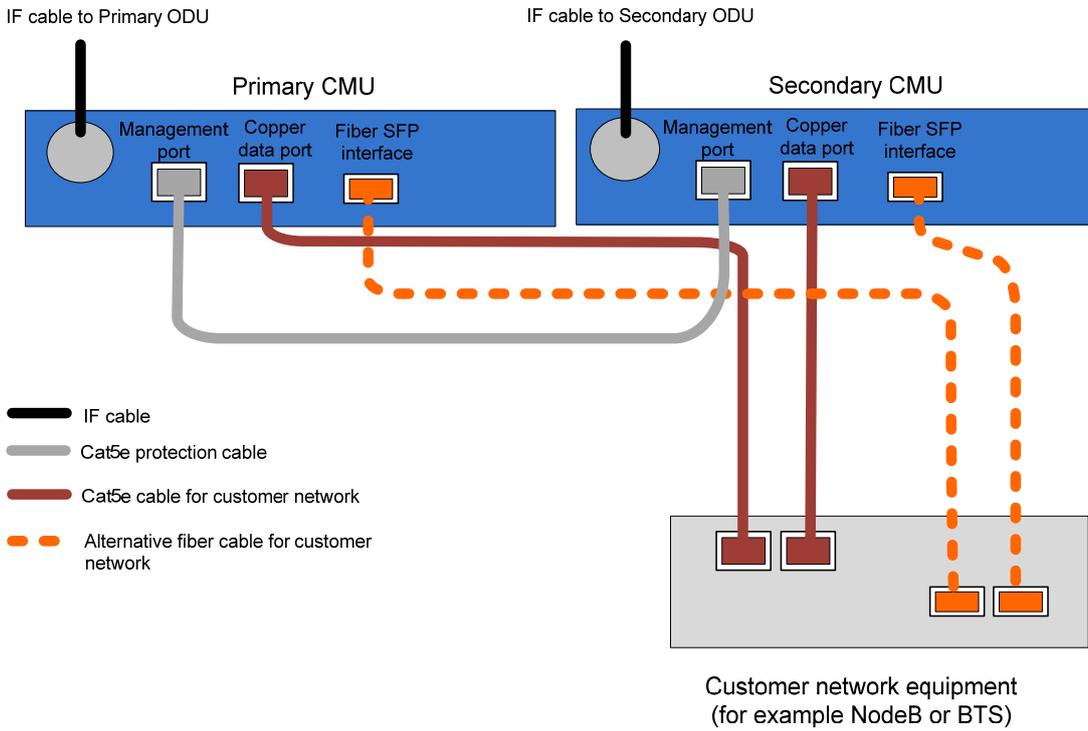
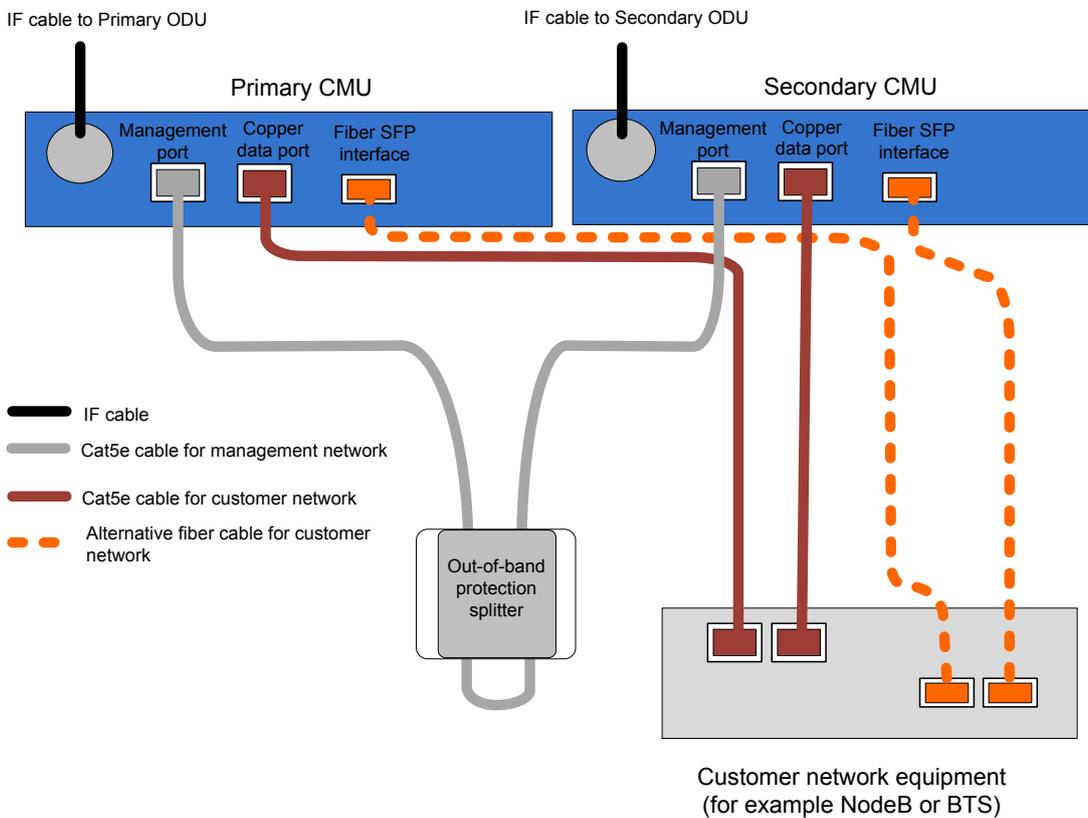


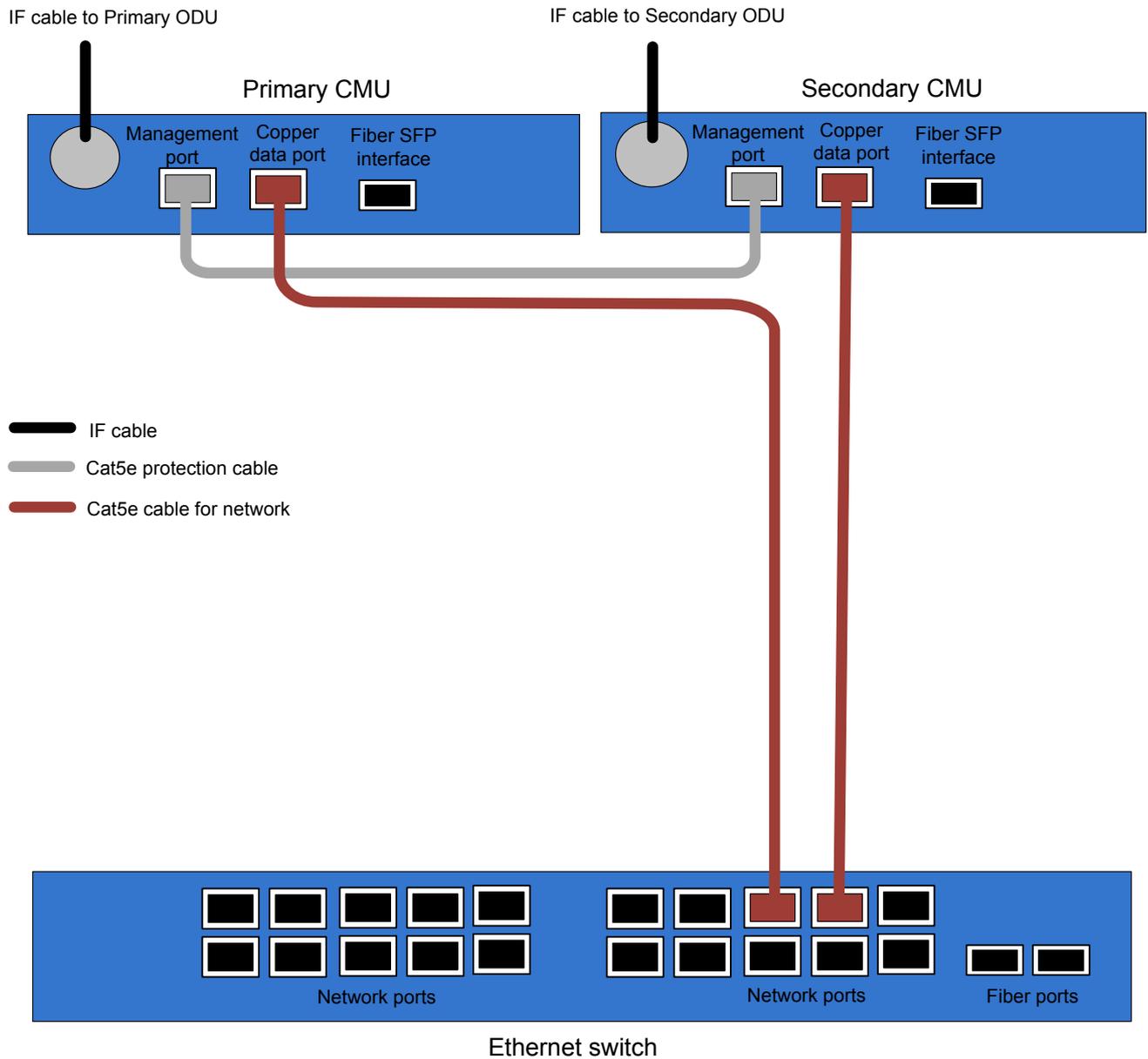
Figure 1-20 Last hop protected end with splitter



Protected link with in-band management

The Data ports of both CMUs are connected to the Ethernet switch (Figure 1-21). The network connections may both be copper (as illustrated), or one or both connections may be fiber.

Figure 1-21 In-band management connections for a protected end



Protection cable

To allow the neighboring CMUs to exchange status information, they are connected together using a protection cable as shown in [Figure 1-21](#). The protection interface uses the four spare pins of the CMU Management port, as described in [Protection cable](#) on page 4-54.

Detection of link failure

In the event of a protection switch the network equipment must learn the new active path. To signal the need for this, the currently active CMU disables all configured copper or fiber Ethernet ports for a period of between 0.5 and 1 second. This causes the Ethernet switch to detect link failure and learn new routing for traffic via the newly active PTP 800.

NOTE

Ensure that the Ethernet switch has the ability to recognize this signal and learn the new traffic routing.

Management connectivity

Management connectivity uses in-band management and the management agent is reached via the Data port of the CMU and the customer network.

Local management from the Management port is not possible in this mode.

Grounding and lightning protection for protected ends

The grounding and lightning protection requirements for a protected end are illustrated in [Figure 2-6](#).

Ethernet bridging

Customer network

Transparent Ethernet service

The PTP 800 Series provides an Ethernet service between the data port at a local CMU and the data port at an associated remote CMU. The Ethernet service is based on conventional layer two transparent bridging, and is equivalent to the Ethernet Private Line (EPL) service defined by the Metro Ethernet Forum (MEF).

The service is transparent to untagged frames, standard VLAN frames, priority-tagged frames, provider bridged frames, and provider backbone bridged frames. In each case, the service preserves MAC addresses, VLAN ID, Ethernet priority and Ethernet payload in the forwarded frame. The maximum frame size for bridged frames in the customer network is 9600 octets.

Layer two control protocols

The PTP 800 Series is transparent to layer two control protocols (L2CP) including:

- Spanning tree protocol (STP), rapid spanning tree protocol (RSTP)
- Multiple spanning tree protocol (MSTP)
- Link aggregation control protocol (LACP)
- Link OAM, IEEE 802.3ah
- Port authentication, IEEE 802.1X
- Ethernet local management interface (E-LMI), ITU-T Q.933.
- Link layer discovery protocol (LLDP)
- Multiple registration protocol (MRP)
- Generic attribute registration protocol (GARP)

PTP 800 handles IEEE 802.3 Pause frames as a special case; each CMU can be configured to either forward (tunnel) or discard Pause frames received at the Data port. PTP 800 discards all Pause frames received at the Management port.

The PTP 800 Series does not generate or respond to any L2CP traffic.

Quality of service for bridged Ethernet traffic

The PTP 800 Series supports eight traffic classes for Ethernet frames queued for transmission over the wireless interface. Scheduling is by strict priority in that a frame will not be transmitted if there is a frame with a higher class already queued. In order of highest priority first, the classes are labeled Q7, Q6, Q5, Q4, Q3, Q2, Q1 and Q0.

Classification by Priority Code Point

PTP 800 provides a configurable mapping between traffic class and the Ethernet Priority Code Point (PCP) of the outer most VLAN tag. Each PCP value can be assigned to any of the eight traffic classes Q0 to Q7. Untagged frames can also be assigned to any of the eight classes.

Classification by Layer 2 Control Protocol

PTP 800 provides a method for classifying Ethernet frames that contain an IEEE 802.1 bridge protocol (including STP, RSTP, PAUSE) or the Generic Attribute Registration Protocol (GARP).

Bridge frames have destination addresses in the range 01-80-c2-00-00-00 to 01-80-c2-00-00-0f.

GARP frames have destination addresses in the range 01-80-c2-00-00-20 to 01-80-c2-00-00-2f.

Bridge frames and GARP frames can be separately classified into any of the eight traffic class from Q0 to Q7.

Bridge frames and Garp frames which are tagged will not be classified by the Priority Code Point.

Fragmentation

The PTP 800 Series minimizes latency and jitter for high-priority Ethernet traffic by fragmenting Ethernet frames before transmission over the wireless link. The fragment size is selected automatically according to channel bandwidth and modulation mode of the wireless link. Fragments are reassembled on reception, and incomplete Ethernet frames are discarded. Traffic is not fragmented in the highest priority traffic class.

Management network

IP interface

Each PTP 800 CMU contains an embedded management agent with a single IP interface. Network management communication is exclusively based on IP and associated higher layer transport and application protocols. The default IP address of the management agent is 169.254.1.1. The PTP 800 does not require use of supplementary serial interfaces.

In a 1+1 protection scheme, each CMU contains a separate management agent.

MAC address

The management agent end-station MAC address is recorded on the underside of the enclosure. The MAC address is not configurable by the user.

VLAN membership

The management agent can be configured to transmit and receive either untagged, priority-tagged, C-tagged (IEEE 802.1Q) or S-tagged (IEEE 801.ad) frames. S-tagged frames must be single tagged, in other words, an S-tag with no encapsulated C-tag. The VLAN ID can be 0 (priority tagged) or in the range 1 to 4094.

Out-of-band management

PTP 800 supports an end-to-end out-of-band management mode in which the management agent can be reached from the management port at the local CMU, and (assuming that the wireless link is established) the management port at the remote CMU. This management mode allows communication from the CMU management port to Ethernet end stations reached through the remote CMU, supporting construction of an extended management network that is isolated from the customer network.

End-to-end out-of-band management is possible only when the network management mode is configured to “out-of-band” at every CMU.

Out-of-band quality of service

Out-of-band management traffic is forwarded over the wireless link using a dedicated channel. The management channel represents a single traffic class, and the same quality of service is afforded to all management frames. Traffic in the management channel is fragmented for transmission over the wireless link to minimize the jitter imposed on high priority traffic in the customer network.

The management channel has higher priority than traffic in the customer network, subject to a configurable committed information rate (CIR) with a range between 200 Kbit/s and 2 Mbit/s. Committed capacity that remains unused by management traffic is available for customer traffic.

Out-of-band local management

The out-of-band local management mode is similar to the standard out-of-band mode, except that management frames are not forwarded over the wireless link. Connection to the management agent is solely through the management port of the local CMU. The management channel CIR control is disabled in out-of-band local mode.

Out-of-band local management is the default management mode.

If the management port is not accessible remotely, this mode should be changed to permit remote management.

In-band management

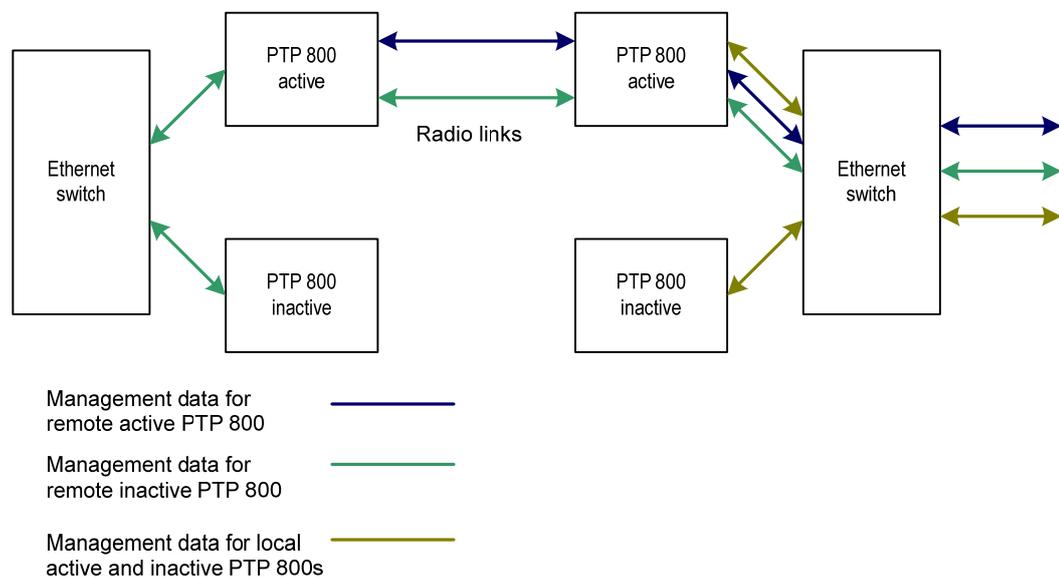
In the in-band management mode, the management agent can be reached from the data port at the local CMU, and (assuming that the wireless link is established) the data port at the remote CMU. In this mode, the management port is disabled.

Management frames in the customer network are processed by the management agent if (a) destination MAC address in the frame matches the CMU MAC address, and (b) the VLAN ID in the frame matches the VLAN configuration of the management agent.

If Local Packet Filtering is enabled, unicast frames forwarded to the management agent are filtered, that is, not forwarded in the customer network.

For the active CMU at a protected end, remote management traffic is routed via the wireless link as shown in [Figure 1-22](#).

For the inactive CMU at the remote end of a protected link, remote management traffic is routed via the wireless link, the active CMU and the data network as shown in [Figure 1-22](#).

Figure 1-22 In-band management data paths (protected links)

Status information about neighboring CMU/ODUs is transferred across the wireless link by the active CMU and received by both the active and the inactive CMU.

In-band quality of service

Frames generated within the management agent may be assigned a configured Ethernet priority in the same way as for out-of-band management. PTP 800 provides a dedicated management channel over the wireless link for locally-generated management traffic similar to the out-of-band management mode. Ethernet frames received at the Data port are classified into eight traffic classes (one of which is assigned to management traffic) for transmission at the wireless port.

Source address learning

If Local Packet Filtering is enabled, the management agent learns the location of end stations from the source addresses in received management frames. The agent filters transmitted management frames to ensure that the frame is transmitted at the Ethernet (data or management) port, or over the wireless link as appropriate. If the end station address is unknown, then management traffic is transmitted at the Ethernet port and over the wireless link.

In out-of-band local management mode, management frames are not transmitted over the wireless link, and so address learning is not active.

Wireless link down alert

The PTP 800 Series provides an optional indication of failure of the wireless link by means of a brief disconnection of the Copper data port or the Fiber data port. The Ethernet disconnection occurs at both ends of the link, even for a unidirectional loss of the wireless link. The Ethernet disconnection normally occurs within 50 ms of loss of the wireless link.

The Wireless link down alert can be used to trigger protection switching by Spanning Tree Protocol (STP) or Ethernet Automatic Protection Switching (EAPS) in a redundant network.

Protocol model

Ethernet bridging behavior at each end of the wireless link is equivalent to a three-port, managed, transparent MAC bridge where the three ports are:

- Ethernet Management Port
- Ethernet Data Port
- Wireless Port

Frames are transmitted at the Wireless port over a proprietary point-to-point circuit-mode link layer between ends of the PTP 800 link. For a single CMU configuration or the active CMU in a 1+1 Hot Standby configuration, Ethernet frames received at the data or management ports, or generated internally within the management agent, are encapsulated within a lightweight MAC layer for transmission over the wireless link.

For the inactive CMU at a protected end no traffic is transmitted over the wireless link. Any management traffic generated is transmitted towards the management port (for out-of-band management) or the traffic port (for in-band management).

Forwarding behavior

In out-of-band local mode ([Figure 1-23](#)) and out-of-band mode ([Figure 1-24](#)), the management network (shown in red) is isolated from the customer data network (shown in blue). In out-of-band mode, the management network is isolated from the customer data at the wireless port by use of a separate service access point and associated dedicated logical channel. Ethernet frames will not leak between management and data networks, even in the presence of configuration errors.

In in-band mode ([Figure 1-25](#)), the management and customer data networks are not isolated, and the Management port is not used.

Figure 1-23 Forwarding behavior in out-of-band local management mode

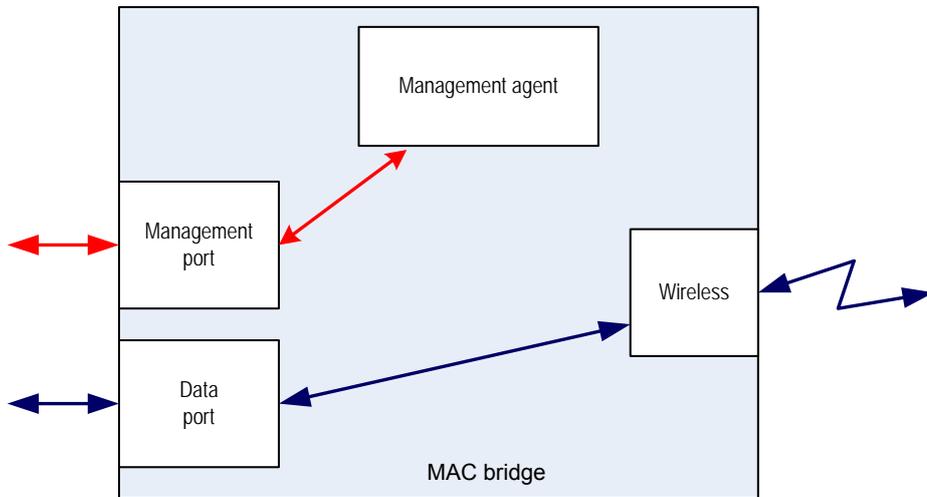


Figure 1-24 Forwarding behavior in out-of-band management mode

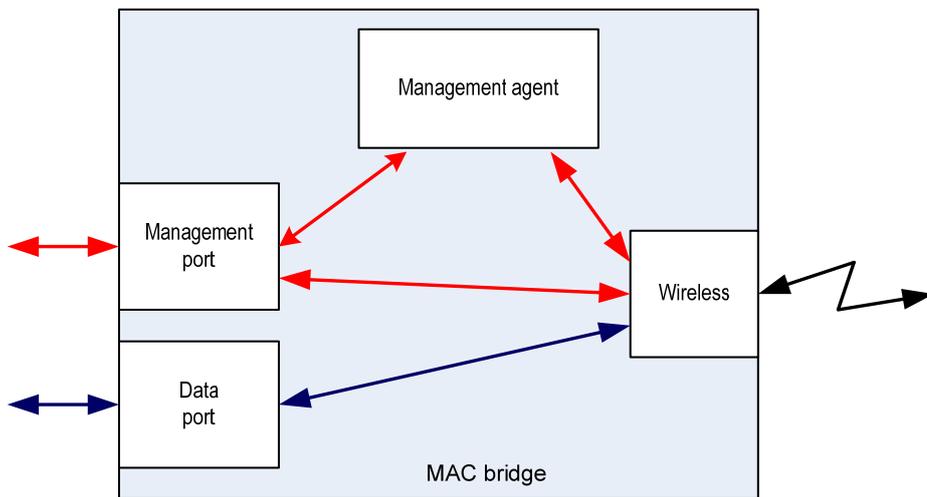
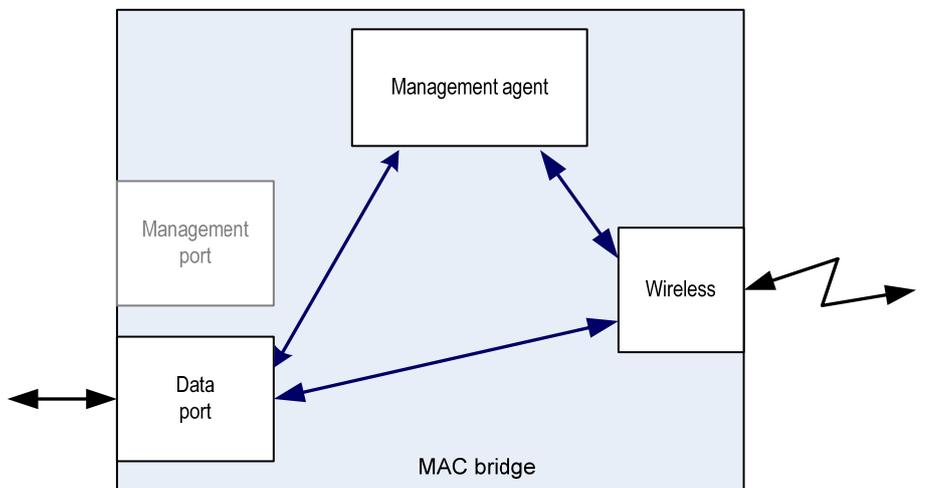


Figure 1-25 Forwarding behavior in in-band mode



Forwarding behavior for protected links

Forwarding behavior for the active CMU is as for a non-protected link.

Forwarding behavior for the inactive CMU in a protected link requires management data to be routed to the Ethernet management port (Figure 1-26) or data port (Figure 1-27), depending on the management mode. Only status information from the remote CMU is forwarded at the wireless interface.

Figure 1-26 Inactive unit frame forwarding – out-of-band management

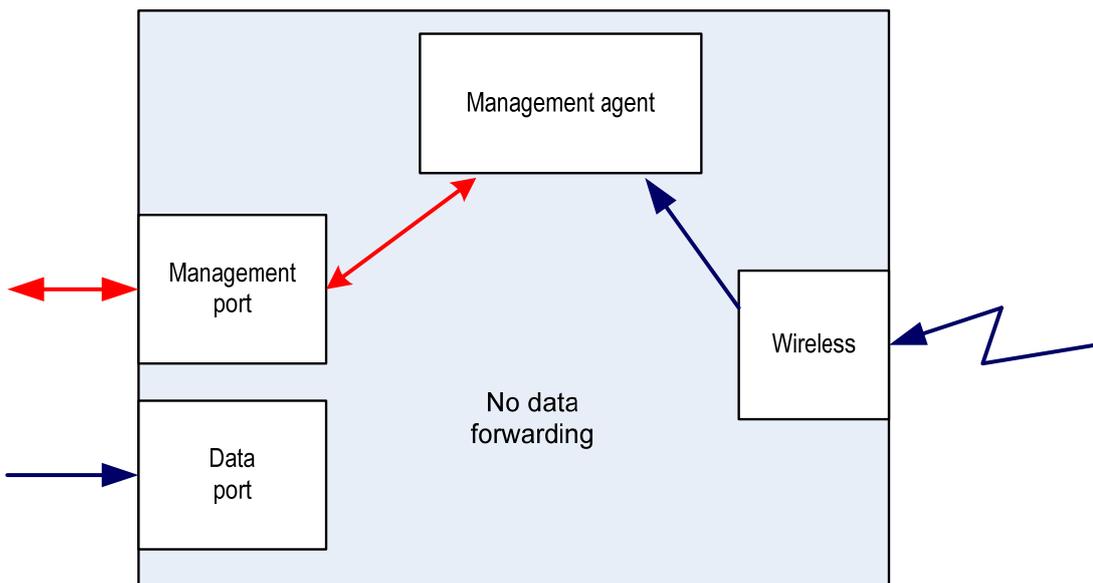
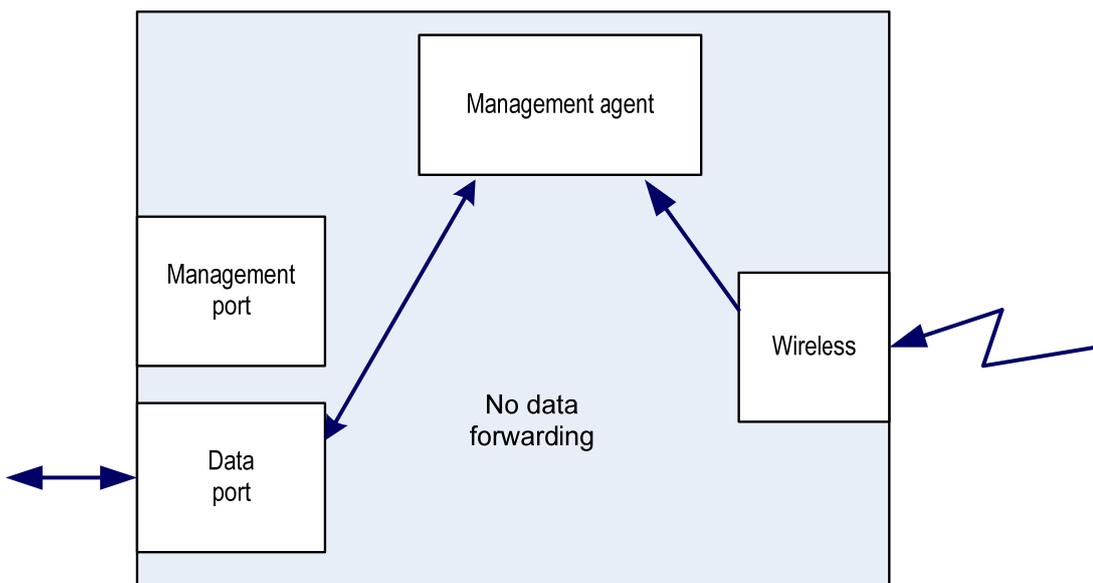


Figure 1-27 Inactive unit frame forwarding – in-band management



Protocol layers

Protocol layers involved in bridging between Ethernet and wireless interfaces are shown in [Figure 1-28](#). Protocol layers involved in bridging between external interfaces and the management agent are shown in [Figure 1-29](#). In these figures, the layers have the meanings defined in IEEE 802.1Q-2005.

Figure 1-28 Protocol layers between Ethernet and wireless interfaces

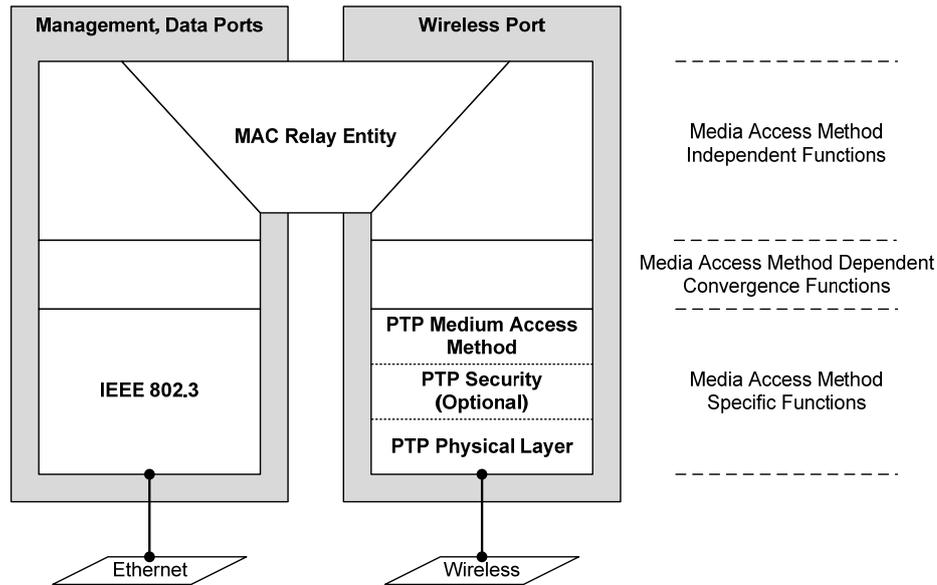
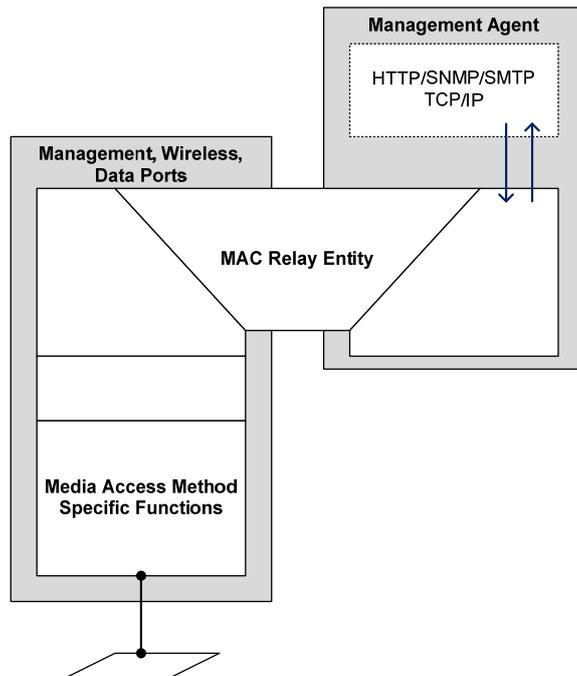


Figure 1-29 Protocol layers between external interfaces and the management agent



System management

This section is an overview of how the PTP 800 system is managed.

Management agent

PTP 800 equipment is managed through an embedded management agent. Management workstations, network management systems or PCs can be connected to this agent using an in-band mode, or a choice of two out-of-band modes. These modes are described in detail in [Management network](#) on page 1-37.

Web interface

The PTP 800 management agent contains a web server. The management agent provides comprehensive web-based fault, configuration, performance and security management functions. Web-based management offers a convenient way to manage the PTP 800 equipment from a locally connected computer or from a network management workstation connected through a management network, without requiring any special management software. The web-based interface is the only interface supported for installation of PTP 800, and for the majority of PTP 800 configuration management tasks.

Management tasks using the web-based management interface are described in detail in [Chapter 7 Operation](#).

Installation wizard

The web-based interface includes an Installation wizard. This feature simplifies the process of entering initial configuration details, setting the system into alignment mode, achieving the lowest possible link loss through correct antenna alignment, and reporting on the performance of the installed link. The process handles the important configuration settings that must be set to comply with individual license conditions. These important settings are not normally modified in an operating link, and cannot be changed in PTP 800 except through use of the Installation wizard.

Configuration pages

The web-based interface includes a number of configuration pages. These pages allow for modification of the system configuration of an installed link. In general, configuration changes can be completed without a reboot. Configuration pages include controls relating to the management agent IP interface, the Ethernet interfaces, quality of service at the wireless interface, security passwords and AES keys.

SNMP

The management agent supports fault and performance management by means of an SNMP interface. The management agent is compatible with SNMP v1 and SNMP v2c, using the following MIBs:

- PTP 800 enterprise MIB
- The system group and the interfaces group from MIB-II, RFC-1213
- The interfaces group and the ifXTable from RFC-2233
- The dot1dBase group and the dot1dBasePortTable group from the Bridge MIB, RFC-1493.

The PTP 800 enterprise MIB is available for download in the application software package from <http://www.motorola.com/ptp/software>.

SNMP must be enabled for use by means of the SNMP State attribute in the web-based interface. Activation of SNMP in PTP 800 requires a reboot of the CMU.

The web-based interface must be used to configure the destination IP address for SNMP notifications, and to enable or disable generation of each supported SNMP notification. Supported notifications are as follows:

- Cold start
- Link up
- Link down
- Link name mismatch
- Alignment mode
- Unit out of calibration
- Encryption enabled mismatch
- Data port disabled warning
- Data port fiber status
- Data port configuration mismatch
- SNTP sync
- Management port disabled warning
- ODU status
- Management port configuration mismatch
- Wireless link status
- Protection interface status
- Byte error ratio status
- Code word error ratio status
- Wireless receive status
- Licensed transmit capacity

- Wireless receive mismatch
- Data port Ethernet speed mismatch
- Management port Ethernet speed mismatch

SNMP notifications are described in [Managing alarms and events](#) on page 7-13.

Email alerts

The management agent can be configured to generate alerts by electronic mail when any of the following events occur:

- Wireless link up
- Wireless link down
- Data port up
- Data port down
- Management port up
- Management port down
- Link name mismatch
- Alignment mode
- Unit out of calibration
- Encryption enabled mismatch
- Data port disabled warning
- Data port fiber status
- Data port configuration mismatch
- SNTP sync
- Management port disabled warning
- ODU status
- Management port configuration mismatch
- Wireless link status
- Protection interface status
- Byte error ratio status
- Code word error ratio status

Email alerts are described in [Managing alarms and events](#) on page 7-13.

Software upgrade

The management agent supports application software upgrade using the web-based interface.

PTP 800 software images are digitally signed, and the CMU will accept only images that contain a valid Motorola PTP digital signature. The CMU always requires a reboot to complete a software upgrade.

The CMU application software image contains an embedded software image for the ODU. If a CMU software upgrade introduces a new ODU software version, then the ODU software is upgraded automatically following reboot of the CMU.

NOTE

Obtain the application software and this user guide from the support website BEFORE warranty expires.

NOTE

CMU software version must be the same at both ends of the link. Limited operation may sometimes be possible with dissimilar software version, but such operation is not supported by Motorola.

The management process for software upgrade is described in detail in [Task 5: Upgrading software version](#) on page 6-24.

Software can be downgraded using Recovery mode as described in [Downgrading PTP 800 software](#) on page 7-56.

Recovery mode

The PTP 800 recovery mode provides a means to recover from serious configuration errors including lost or forgotten passwords and unknown IP addresses.

Recovery mode also allows new main application software to be loaded even when the integrity of the existing main application software image has been compromised. The most likely cause of an integrity problem with the installed main application software is where the power supply has been interrupted during an earlier software upgrade.

The CMU operates in recovery mode in the following circumstances:

- When a checksum error occurs for the main application software image.
- When the CMU front panel recovery button is pressed at the same time as the CMU is rebooted or power cycled.
- When the Short Power Cycle for Recovery is enabled, and CMU is power cycled, and the “off” period is between one and five seconds.

Options in recovery mode are as follows:

- Load new main application software.
- Reset all configuration data to factory default. This option resets IP and Ethernet configuration, and erases (zeroizes) critical security parameters.
- Reset IP and Ethernet configuration to factory default.
- Erase (zeroize) critical security parameters.
- Reboot with existing software and configuration.

NOTE

If recovery mode has been entered either because of a checksum error or Short Power Cycle, by default the CMU will reboot with existing software and configuration following a 30 second wait.

The recovery software image is installed during manufacture of the CMU and cannot be upgraded by operators.

For detailed instructions on using the recovery mode, see [Using recovery mode](#) on page 7-50.

Security

PTP 800 provides optional 128-bit and 256-bit encryption using the Advanced Encryption Standard (AES).

AES upgrades are supplied as an access key. The access key authorizes the generation of a new license key that will enable AES operation for one CMU. Two access keys are needed to operate AES on a link. The upgrade is applied by entering an access key together with the MAC address of the target CMU into the PTP License Key Generator web page, which may be accessed from <http://www.motorola.com/ptp/support>.

This web page generates a new license key that must be installed on the CMU. When the license key is installed, the CMU must be rebooted before AES can be enabled. Once applied, the AES upgrade is bound to a single CMU and is not transferrable.

AES encryption in PTP 800 is based on pre-shared keys. An identical key must be entered at each end of the link.

For more information, see:

- [Task 6: Configuring security](#) on page 6-31
- [Restoring the operational configuration](#) on page 7-57

Capacity upgrades

All PTP 800 CMUs are shipped with a factory-set 10 Mbit/s capacity limit, meaning that capacity is restricted to a maximum of 10 Mbit/s at the data port. When requiring additional capacity, users can purchase upgrades. Upgrades are applied through the CMU license key, without any change to the hardware. Capacity may be different for different directions.

NOTE

Purchasing a capacity upgrade will not necessarily lead to an increase in data capacity, as capacity also depends on channel bandwidth and modulation mode. For more information, see [Capacity, transmit power and sensitivity](#) on page 4-58.

Available capacity upgrades are listed in [Table 1-3](#) and [Table 1-4](#). Select between a single-step and one or more step-by-step upgrades as required.

Table 1-3 Single-step capacity upgrades

Motorola part	Capacity
WB3538	20 Mbit/s
WB3539	30 Mbit/s
WB3540	40 Mbit/s
WB3541	50 Mbit/s
WB3542	100 Mbit/s
WB3543	150 Mbit/s
WB3544	200 Mbit/s
WB3545	300 Mbit/s
WB3546	Unlimited

Table 1-4 Step-by-step capacity upgrades

Motorola part	Capacity increase
WB3547	20 Mbit/s → 30 Mbit/s
WB3548	30 Mbit/s → 40 Mbit/s
WB3549	40 Mbit/s → 50 Mbit/s
WB3550	50 Mbit/s → 100 Mbit/s
WB3551	100 Mbit/s → 150 Mbit/s
WB3552	150 Mbit/s → 200 Mbit/s
WB3553	200 Mbit/s → 300 Mbit/s
WB3554	300 Mbit/s → Unlimited

This flexible approach allows users to match link capacity to their developing demand and revenue stream.

Capacity upgrades are supplied as an access key. The access key authorizes a specific capacity limit for one CMU. Two access keys are needed to operate a link at enhanced capacity. The upgrade is applied by entering an access key together with the MAC address of the target CMU into the PTP License Key Generator web page, which may be accessed from <http://www.motorola.com/ptp/support>.

This web page generates a new license key that must be installed on the CMU. Capacity upgrades become active as soon as the license key is validated.

There is no need to reboot the CMU, and the upgrade process does not involve a service interruption.

Once applied, the capacity upgrade is bound to a single CMU and is not transferrable.

For more information, see [Restoring the operational configuration](#) on page 7-57.

Upgrading to a protected link

A single CMU link may be upgraded to a protected link. The method for upgrading an existing CMU to one of a pair at a protected end and adding a second CMU is described in [Upgrading an unprotected link to protected](#) on page 5-4.

No special licenses are required for a protected link, but each of the CMUs providing the protected link must be individually licensed at the capacity of the link.

Chapter 2 Planning considerations

.....

This chapter provides information to help the user to plan a PTP 800 link.

The following topics are described in this chapter:

- [Link planning](#) on page 2-2
- [Grounding and lightning protection](#) on page 2-7
- [Data network planning](#) on page 2-17

Link planning

Process

The majority of the 6 to 38 GHz spectrum is licensed on a link by link basis. Licensing regimes vary from country to country, and the planning process must sometimes be adapted to local circumstances.

The link planning process typically consists of the following steps:

- Identify suitable sites at the ends of the link.
- Determine the data capacity and availability required for the link.
- Determine the protection requirements for the link:
 - Either: no protection required,
 - Or: CMU and ODU protection required;
 - Or: CMU, ODU and antenna protection required.
- Select an RF band, taking into account the range of link, the capacity required, the availability required, the licensing policy for bands in the region or country, and likely availability of individual licenses in that band.
- Use the PTP LINKPlanner to check that a satisfactory, unobstructed, line-of-sight path is possible between the ends.
- Use PTP LINKPlanner to investigate the performance increase provided by enabling ACM.
- Apply for an individual license.
- Use the PTP LINKPlanner with the license details to identify a Bill of Materials for the link.
- Order equipment from Motorola.

Motorola offers a license coordination service for links in the USA. The service includes link study, PCN, FCC application filling, Schedule-K completion and one year license protection warranty. The FCC Microwave license coordination service may be ordered as Motorola part number WB3659.

Site selection

The ODU and antenna should be mounted in elevated positions from the immediate surroundings and above obstructions to provide a clear line-of-sight path to the other end of the link. It is particularly important that no obstructions or reflecting surfaces are present within the near field zone in front and to the sides and rear of the antenna.

Maximum IF cable length

The maximum permitted IF cable length is 190 meters (620 ft) for CNT-400 cable. If the required IF cable length is between 190 and 300 meters (620 ft and 980 ft), contact Technical Support.

PTP LINKPlanner

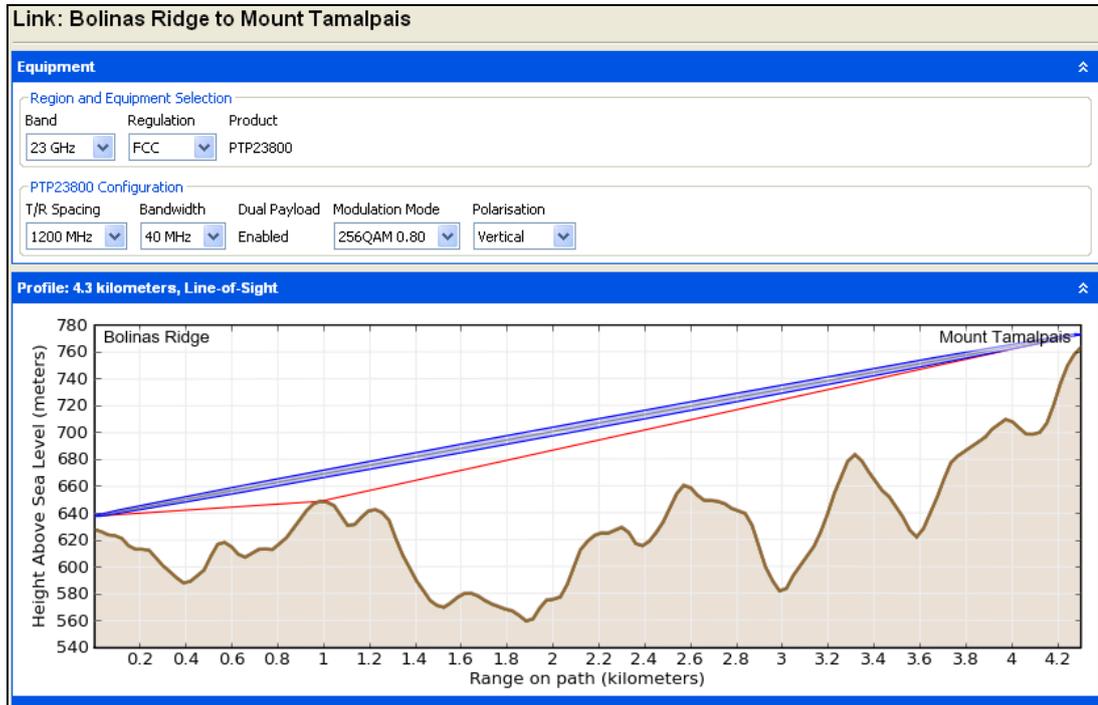
The Motorola PTP LINKPlanner is a link planning and optimization tool designed for use with all PTP products, including the PTP 800 licensed band products. PTP LINKPlanner is free and available from <http://www.motorola.com/ptp/software>.

The advantages of PTP LINKPlanner are as follows:

- It is supported on Windows and Macintosh Platforms.
- It is very easy to use without specialist radio planning knowledge.
- It is powerful, implementing the latest ITU recommendations for predicting the performance of a radio link.
- It expresses the performance in terms of data link capacity.
- It is integrated with Google Earth™ to facilitate site entry and path visualization.
- It provides bill of materials data for ease of purchasing.
- It can provide path data by an automated email service.
- It can model all Motorola PTP products.
- It can plan multiple links in the same session.
- It can generate an export file for Motorola's FCC Coordination service.

The PTP LINKPlanner provides path profile information for individual links as shown in [Figure 2-1](#).

Figure 2-1 LINKPlanner profile view



The PTP LINKPlanner also provides configuration and performance details as shown in Figure 2-2, and Bill of Materials data as shown in Figure 2-3.

This is necessarily a brief introduction to the PTP LINKPlanner. Please download and evaluate this free software in further detail.

Figure 2-2 LINKPlanner configuration and performance details

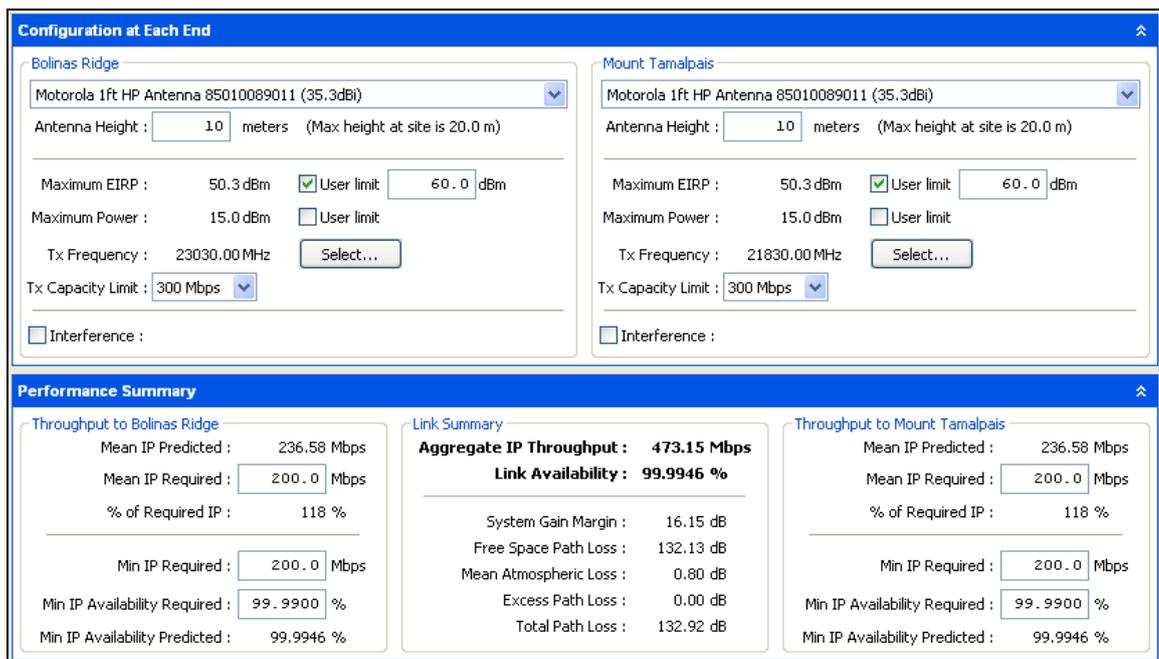


Figure 2-3 LINKPlanner Bill of Materials view

Bill of Materials for Marin		
P/N	Description	Qty
(no part number)	Unspecified 23 GHz ODU (invalid TX frequency selection)	2
01010210007	ODU-A 23GHz, TR1200, Lo, B6 (21600.0 - 22000.0 MHz), Rectangular WG, Neg Pol	1
01010210008	ODU-A 23GHz, TR1200, Hi, B6 (22800.0 - 23200.0 MHz), Rectangular WG, Neg Pol	1
30010194001	50 Ohm Braided Coaxial Cable - 75 meter	2
85010089011	1' HP Antenna, 21.20 ~ 23.60 GHz, Single Pol, Mot Interface	2
85010089013	2.5' HP Antenna, 21.20 ~ 23.60 GHz, Single Pol, Mot Interface	2
WB3480	PTP800 Modem 1000/100BaseT with Capacity CAP 10 Mbps	4
WB3545	PTP800 Modem Capacity CAP - 300 Mbps (per Unit)	2
WB3546	PTP800 Modem Capacity CAP - Full Capacity (per Unit)	2
WB3616	Coaxial Cable Installation Assembly Kit (w/o LPU Kit)	4
WB3657	Lightning Protection Kit (2xSPU+Mounting kit)	4

Planning link protection

Links can become unavailable because of failures of hardware or due to environmental factors affecting the radio propagation, such as rain fade.

A protected link uses redundant hardware that is able to replace the function of failed units with a minimum of interruption to the service provided by the link. It does not in general change the performance of the link due to environmental factors.

The two main advantages of a protected link are:

- Better hardware availability because in the unlikely event of hardware failure the link becomes operational again almost immediately rather than after a, possibly lengthy, wait for a maintainer to repair or replace a failed unit. This may be particularly important in remote locations or for safety critical applications.
- Maintenance operations can be carried out, such as installation of new software, with a minimum of interruption to the service provided by the link.

Three variants of link protection are supported (see [Protected link antenna interfaces](#) on page 1-28). These are:

- A single antenna and symmetric coupler.
- A single antenna and asymmetric coupler.
- Two antennas each connected to a separate ODU.

NOTE

When using LinkPlanner to plan a protected link, different values can be used for the required minimum availability for the primary to primary link and the primary to secondary link.

Designating primary and secondary units

Where an asymmetric coupler is used, or two antennas with different performance characteristics, the unit with the best predicted radio performance characteristics is designated the primary unit and must be configured as such (see [Configuring protected links](#) on page 6-43).

If the characteristics of both CMU/ODU/antenna paths are the same then either unit can be designated as the primary. The other unit is designated as the secondary unit.

Choosing asymmetric operation

An asymmetric coupler maximizes the performance of the radio link when the two primary units are operating the link (this is known as primary to primary operation). Before deciding to use an asymmetric coupler, consider the following questions:

- Can the link be operated satisfactorily by a primary unit at one end of the link and a secondary at the other? If not, symmetric operation could be used, or the link may need to be re-planned.
- Is there any requirement to operate secondary to secondary? This is normally unlikely because the likelihood of simultaneous equipment failures at both ends of the link is extremely small.
- Is any interruption caused by switching back to the primary unit going to cause a performance problem? When operating primary to secondary, a switch back to primary to primary operation (once the problem has been corrected) is recommended.
- Is primary to secondary operation likely to be for an extended period of time due to, for example, problems of accessibility of the equipment? If so, symmetric operation may be the preferred option.

Choosing antenna protection

If antenna protection is selected to provide protection from antenna faults or physical disturbance, the above questions apply when selecting the antennas to be used and the location of the antennas on the tower.

Reverting to the primary unit

The CMU has a configurable parameter which determines whether or not after a protection switchover to a secondary unit, after a period of fault free operation by the primary, the units should revert to using the primary unit. Where the performance of the primary unit is predicted to be better than that of the secondary unit (for example, when an asymmetric coupler is used) this timer should be set.

Grounding and lightning protection

Structures, equipment and people must be protected against power surges (typically caused by lightning) by conducting the surge current to ground via a separate preferential solid path.

The actual degree of protection required depends on local conditions and applicable local regulations.

Motorola recommends that PTP 800 installation is contracted to a professional installer.

Standards

Full details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the U.S. National Electric Code ANSI/NFPA No. 70-1984 or section 54 of the Canadian Electric Code.

CAUTION

EMD (Lightning) damage is not covered under standard warranty. The recommendations in this user manual, when implemented correctly, give the user the best protection from the harmful effects of EMD. However 100% protection is neither implied nor possible.

Lightning Protection Zones

The 'rolling sphere method' is used to determine where it is safe to mount equipment. An imaginary sphere, typically 50 meters in radius, is rolled over the structure. Where the sphere rests against the ground and a strike termination device (such as a finial or ground bar), all the space under the sphere is considered to be in the zone of protection (Zone B). Similarly, where the sphere rests on two finials, the space under the sphere is considered to be in the zone of protection.

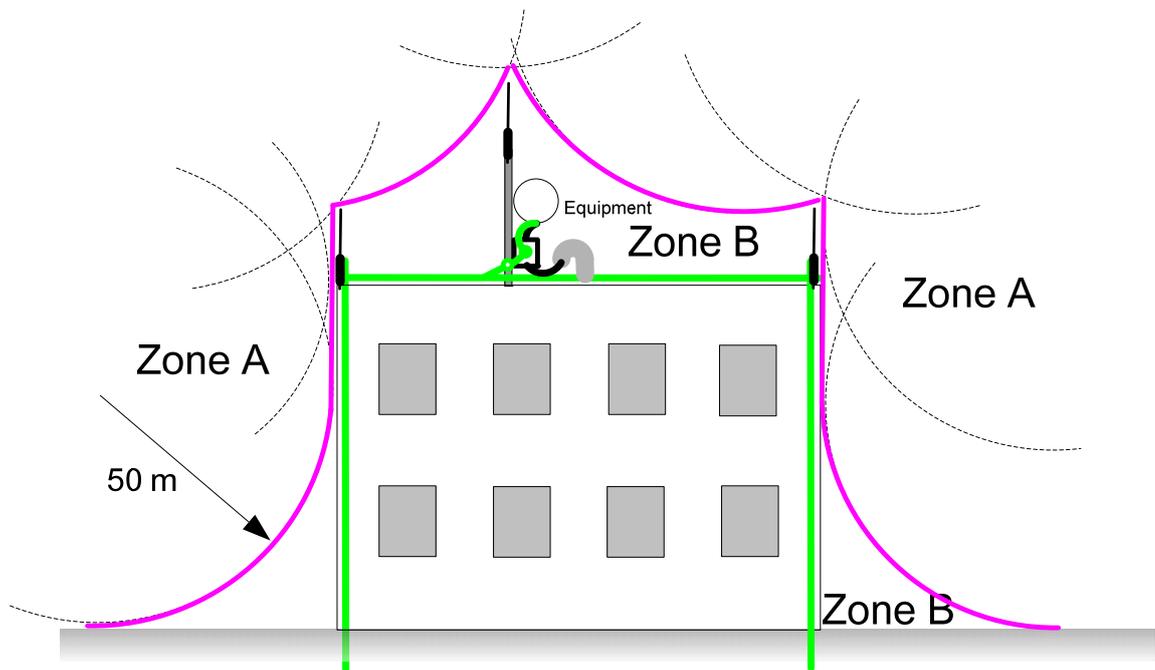
Assess locations on masts, towers and buildings to determine if the location is in Zone A or Zone B:

- Zone A: In this zone a direct lightning strike is possible. Do not mount equipment in this zone.
- Zone B: In this zone, direct EMD (lightning) effects are still possible, but mounting in this zone significantly reduces the possibility of a direct strike. Mount equipment in this zone.

⚠ WARNING

Never mount equipment in Zone A. Mounting in Zone A may put equipment, structures and life at risk.

Figure 2-4 Rolling sphere method to determine the lightning protection zones



General protection requirements

To adequately protect a PTP 800 installation, both ground bonding and transient voltage surge suppression are required.

NOTE

Where an installation already has, or requires the use of a Master Ground Bar then the requirements of Motorola specification *R56: Standards And Guidelines For Communication Sites (68P81089E50)* take precedence over those in this guide. This specification may be downloaded from <http://www.motorola.com/ptp/software>.

Basic requirements

The following basic protection requirements must be implemented;

- The equipment (ODU or antenna) must be in 'Zone B' (see [Lightning Protection Zones](#) on page 2-7).
- A lightning protection unit (LPU) must be installed within 600 mm (24 in) of the point at which the IF cable enters the building or equipment room. The use of the LPU provided in the lightning protection kit (WB3657) is strongly recommended.
- The IF cable must be bonded to the supporting structure in order to prevent lightning creating a potential between the structure and cable, which could cause arcing, resulting in damage to equipment.
- The IF cable must be grounded at the building entry point.
- The CMU chassis bonding point must be grounded.
- All grounding cables must be no less than 16mm² or #6AWG in size, solid or stranded, tinned and/or jacketed copper conductor.

Grounding cable requirements

When routing, fastening and connecting grounding cables, the following requirements must be observed:

- Grounding conductors must be run as short, straight, and smoothly as possible, with the fewest possible number of bends and curves.
- Grounding cables must not be installed with drip loops.
- All bends must have a minimum radius of 203 mm (8 in) and a minimum angle of 90°. A diagonal run is preferable to a bend, even though it does not follow the contour or run parallel to the supporting structure.
- All bends, curves and connections must be routed towards the grounding electrode system, ground rod, or ground bar.
- Grounding conductors must be securely fastened.
- Braided grounding conductors must not be used.
- Approved bonding techniques must be used for the connection of dissimilar metals.

Specific requirements for the ODU

The following ODU protection requirements must be implemented:

- The distance between the ODU and LPU should be kept to a minimum; it is recommended that the cable supplied in the accessory kit be used.
- The IF cable length between the ODU and LPU must be less than 800mm.
- The top LPU should be mounted lower than the ODU.
- The ODU and top LPU should be bonded together with the 800 mm long 16mm², #6AWG cable supplied in the accessory kit.
- The LPU should be bonded to the tower (or main grounding system) using the 600mm long 16mm², #6AWG cable supplied in the accessory kit.

Protection requirements for a mast or tower installation

If the equipment (ODU or antenna) is to be mounted on a metal tower or mast, then in addition to the general protection requirements (above), the following requirements must be observed:

- The equipment must be lower than the top of the tower or its lightning terminal and finial.
- The metal tower or mast must be correctly grounded.
- A grounding kit must be installed at the first point of contact between the drop cable and the tower, near the top.
- A grounding kit must be installed at the bottom of the tower, near the vertical to horizontal transition point. This grounding kit must be bonded to the tower or tower ground bus bar (TGB) if installed.
- If the tower is greater than 61 m (200 ft) in height, an additional grounding kit must be installed at the tower midpoint. Additional ground kits must be installed as necessary to reduce the distance between ground kits to 61 m (200 ft) or less.
- In high lightning prone geographical areas, additional ground kits should be installed at spacing between 15 to 22 m (50 to 75 ft). This is especially important on towers taller than 45 m (150 ft).

Mast or tower protection diagrams

Figure 2-5 shows the protection requirements for an ODU mounted on a metal tower or mast.

Figure 2-6 shows the protection requirements for a 1+1 Hot Standby protected end.

Figure 2-5 Grounding and lightning protection on mast or tower

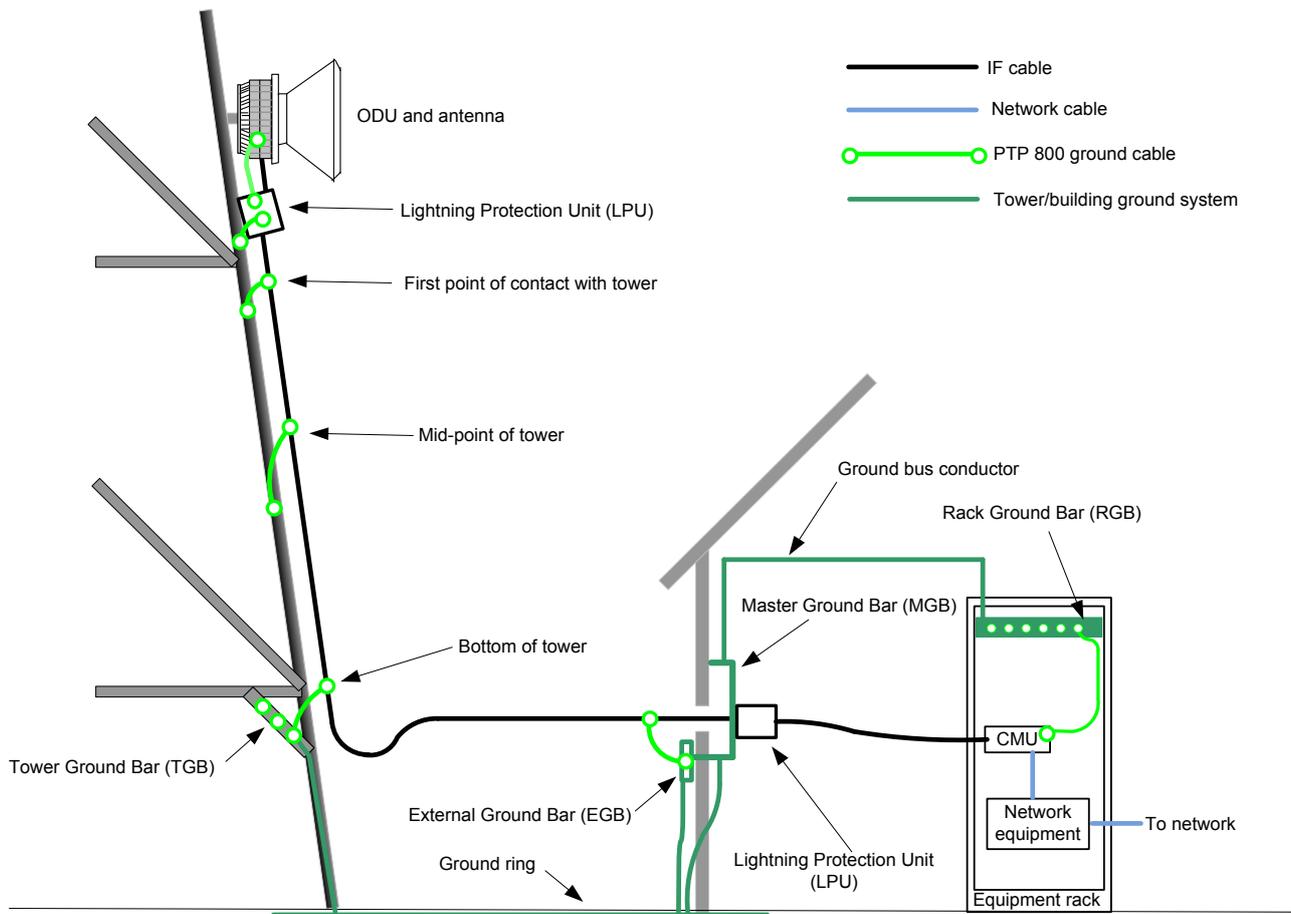
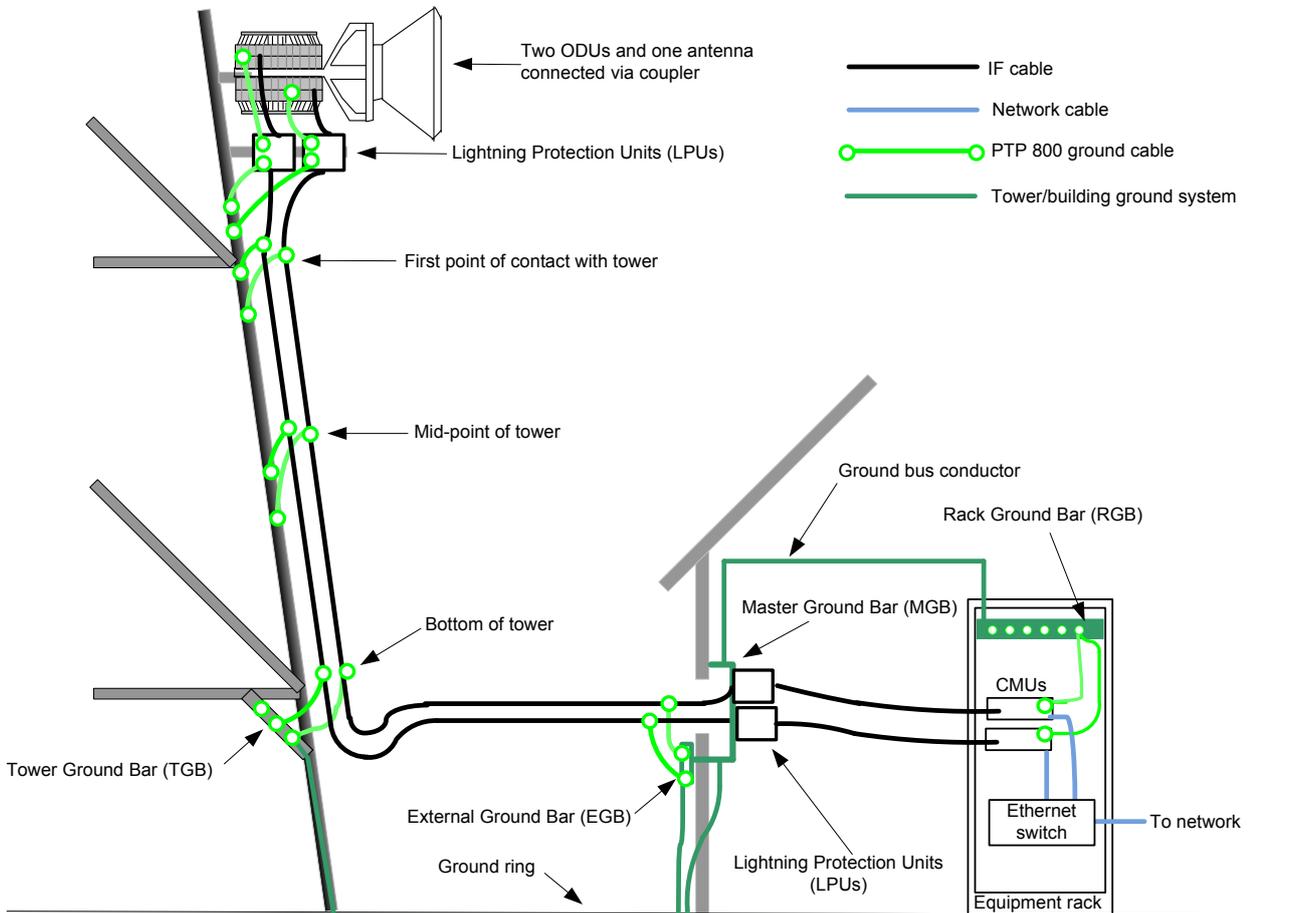


Figure 2-6 Grounding and lightning protection on mast or tower (protected end)

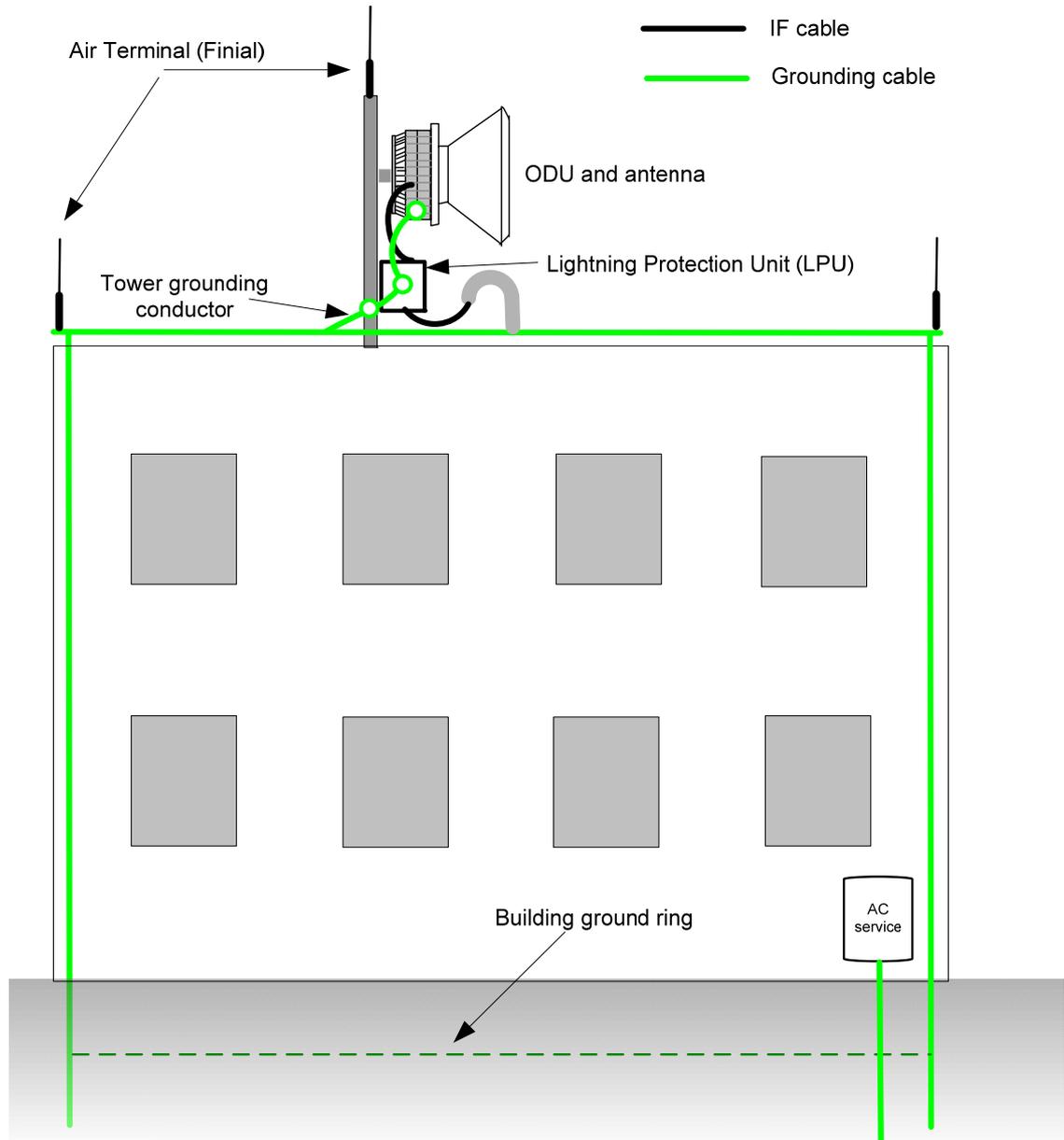


Protection requirements for the ODU on a high rise building

If the antenna or ODU is to be mounted on a high rise building, it is likely that cable entry is at roof level (Figure 2-7) and equipment room several floors below (Figure 2-8). In addition to the general protection requirements (above), the following requirements must be observed:

- The antenna and ODU must be below the lightning terminals and finials.
- A grounding conductor must be installed around the roof perimeter, to form the main roof perimeter lightning protection ring.
- Air terminals are typically installed along the length of the main roof perimeter lightning protection ring typically every 6.1m (20ft).
- The main roof perimeter lightning protection ring must contain at least two down conductors connected to the grounding electrode system. The down conductors should be physically separated from one another, as far as practical.

Figure 2-7 Grounding and lightning protection on building

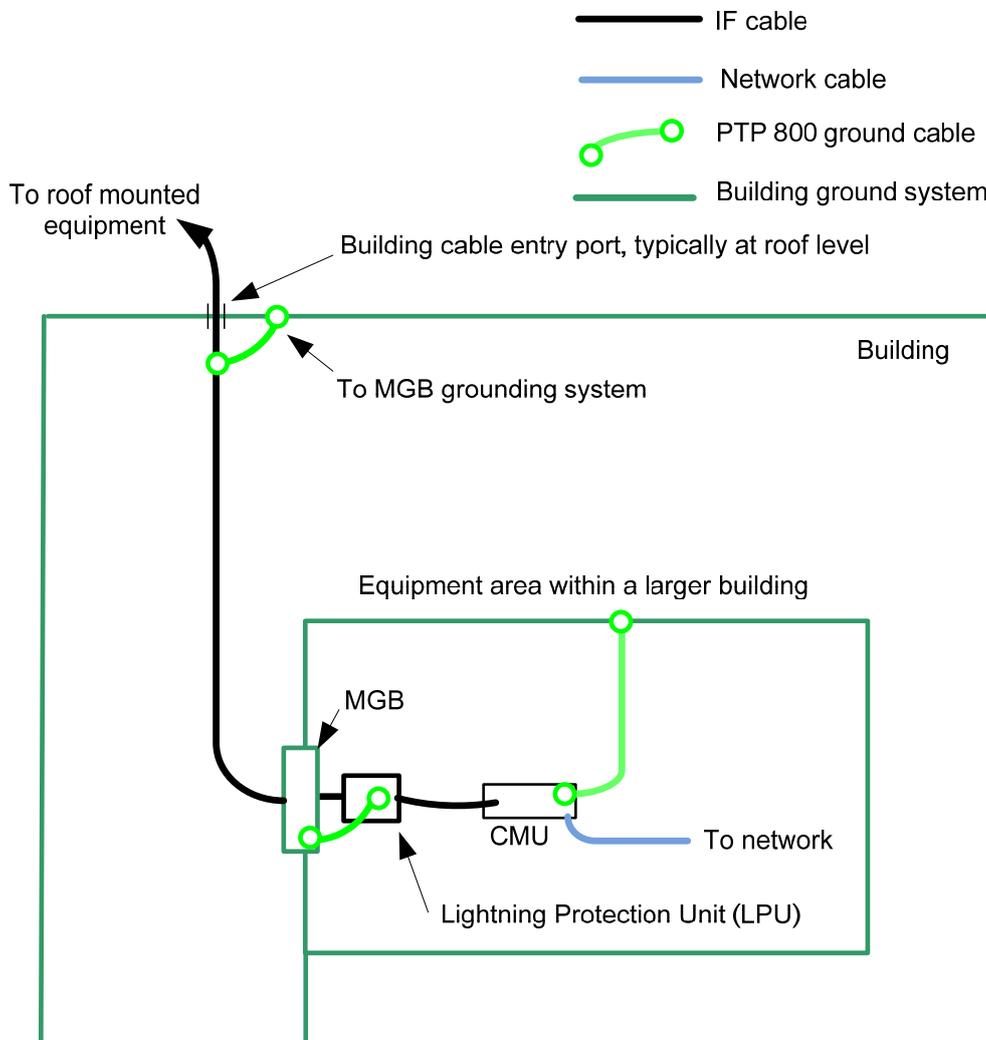


Protection inside the building

The following protection requirements must be observed inside multi-story or high rise buildings (Figure 2-8):

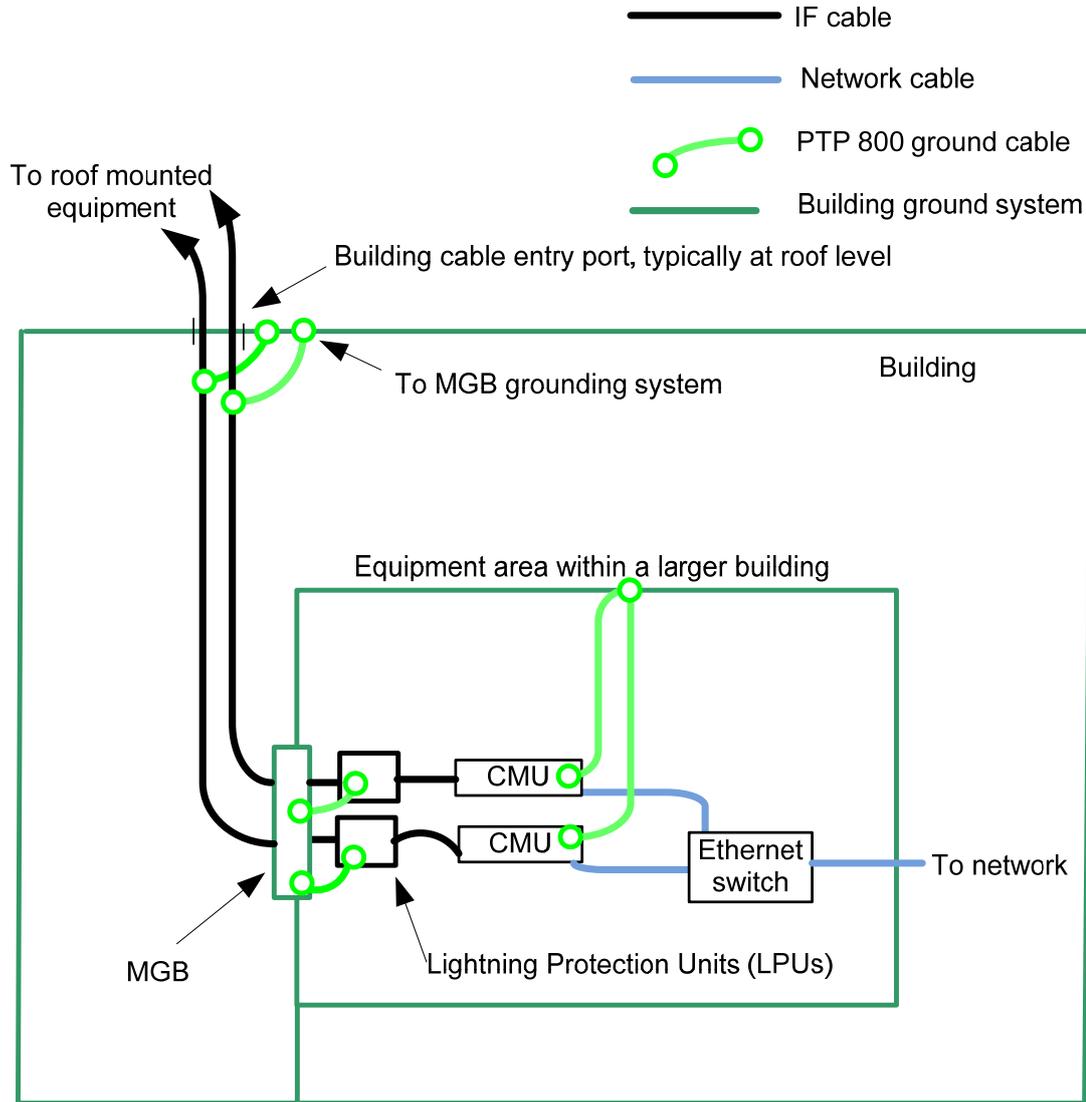
- The IF cable shield must be bonded to the building grounding system at the entry point to the building.
- The IF cable shield must be bonded to the building grounding system at the entry point to the equipment area.
- An LPU must be installed within 600 mm (24 in) of the entry point to the equipment area.

Figure 2-8 Grounding and lightning protection inside high building



In a 1+1 Hot Standby protected end, prior to connecting CMUs via the protection interface, the front panel ground stud of both CMUs must be connected to a common ground (Figure 2-9).

Figure 2-9 Grounding and lightning protection inside high building (protected end)



Power supply considerations

Consider the following when planning the power supply to the PTP 800.

- A means of removing power from the PTP 800 without disrupting other equipment, for example a circuit breaker.
- If the link is protected, a means of removing power from one PTP 800 without disrupting the other PTP 800.
- Any circuit breaker or switch should be labeled.
- Wiring from the power source to the PTP 800 should be sized accordingly.
- All supply wiring should be to national standards and best practice.
- A rack mounted power supply should be grounded in accordance with national standards and best practice.

For more information, refer to [AC to DC converter specifications](#) on page 4-15.

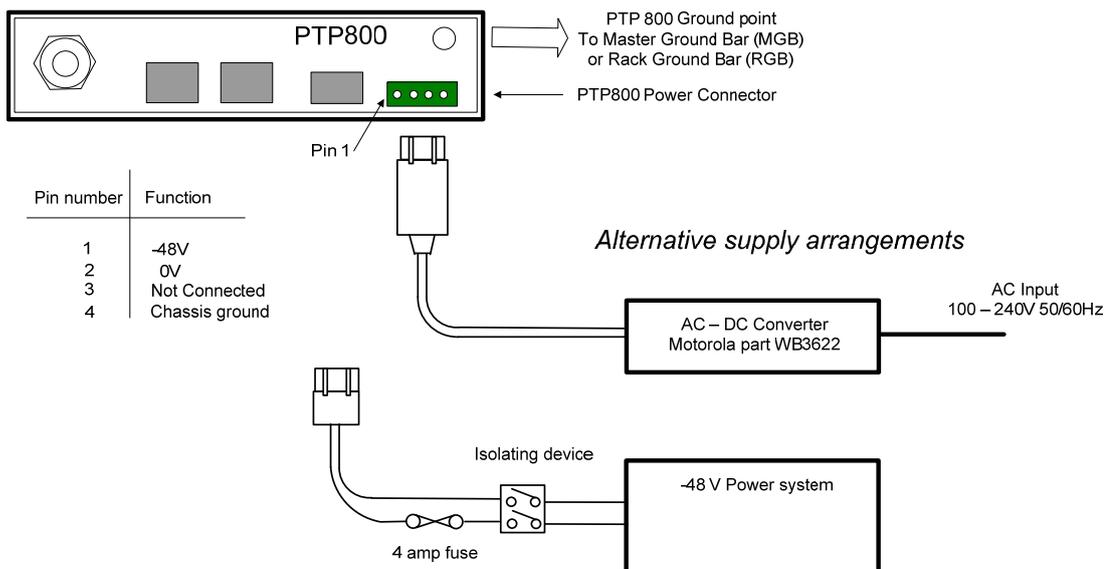
CAUTION

A 4 Amp fuse or similar protection device must be provided between the -48 volt supply source and the PTP 800 CMU

Always ensure that the -48V supply is turned off before attempting any service on the PTP 800.

The CMU/ODU is positive ground and the DC power supply or battery must also be positive ground or isolated.

Figure 2-10 Alternative supply arrangements



Data network planning

Management mode

Decide how the PTP 800 will be managed.

For a single PTP 800 the default mode is out-of-band local management mode; the management agent can be reached only from the Management port of the CMU.

In the default out-of-band local management mode, the management agent can be reached only from the Management port of the CMU. This mode is appropriate during configuration and installation when the equipment is managed using a locally connected PC at each end of the link. It may additionally be useful where network management communication is based on a completely independent data network (for example, one based on a 3G cellular wireless terminal at each site).

In many network applications the wireless link will provide the only communication path to a remote site. In such applications, CMUs and other network equipment at the remote site will be managed over the wireless link. For applications of this type, select either out-of-band or in-band management mode.

Use the out-of-band management mode where management traffic is segregated using a physically separate network interface at the CMU. Use the in-band management mode where management traffic is multiplexed with customer traffic at a single physical interface.

Make sure that the same management mode is selected for CMUs at both ends of a link. See [Management network](#) on page 1-37 for further explanation of management modes.

NOTE

When using out-of-band management mode, avoid connecting Management and Data ports in the same network. Loops in the network can be complicated to detect and correct.

Protected Link management

In a protected link configuration, each of the PTP 800s is managed as a separate piece of equipment. Thus although an inactive unit does not forward traffic, when remote management is enabled, it both receives and responds to management traffic.

For a protected link, in-band and out-of-band management is supported. Make sure that the same management mode is selected for both ends of a protected link. See [Management network](#) on page 1-37 for a further explanation of management modes

For remote management, both active and inactive PTP 800 units are manageable by the management system.

IP addresses

Each of the CMUs must be configured with a different IP address.

Ethernet switch requirements for a protected link

CAUTION

It is very important to select the Ethernet switch carefully for a protected link. It is unlikely that requirements will be satisfied by an inexpensive unmanaged switch.

When the active and inactive CMUs are both connected to the Ethernet switch, the switch is responsible for deciding which connection is operational and for routing traffic to it. In this configuration, if a protection switchover occurs, the PTP 800 drops the link for 0.5 to 1 second to indicate that the switch must flush its filter database and discover new routes. Therefore any Ethernet switch connected to the PTP 800 must fully support this feature.

If in-band management is used, the Ethernet switch at the remote end of a protection link must be able to route management traffic received from the active CMU to the inactive CMU using its data port, see [Figure 1-22](#).

Similarly if out-of-band management is used, if an Ethernet Switch is used it must route the management traffic received from the active CMU to the inactive CMU using its management port, see [Figure 1-24](#).

For maintenance the technician should be able to connect a PC to the Ethernet switch and access both the CMUs. If this is not possible then either the technician may have to connect directly to the data port or the management mode may have to be changed remotely and the technician given access via the local management port.

VLAN membership

Decide if the IP interface of the CMU management agent will be connected in a VLAN. If so, decide if this is a standard (IEEE 802.1Q) VLAN or provider bridged (IEEE 802.1ad) VLAN, and select the VLAN ID for this VLAN.

Use of a separate management VLAN is strongly recommended for applications based on the in-band management mode. Use of the management VLAN helps to ensure that the CMU management agent cannot be accessed by customers.

See [Management network](#) on page 1-37 for further explanation of VLAN membership.

Priority for management traffic

Choose the Ethernet priority for management traffic generated within the CMU management agent. The priority should be selected so as to be consistent with existing policy on priority of management traffic in the network. Use of a high priority is strongly recommended for applications based on the in-band management mode to ensure that management traffic is not discarded if the link is overloaded.

IP interface

Choose an IP address for the IP interface of the CMU management agent. The IP address must be unique and valid for the connected network segment and VLAN. Find out the correct subnet mask and gateway IP address for this network segment and VLAN.

Ensure that the design of the data network permits bi-direction routing of IP datagrams between network management systems and the CMUs. For example, ensure that the gateway IP address identifies a router or other gateway that provides access to the rest of the data network.

See [Management network](#) on page 1-37 for further explanation of configuration of the IP interface.

Quality of service for bridged Ethernet traffic

Decide on the classification of Ethernet Frames for Quality of Service (QoS). Refer to [Customer network](#) on page 1-35 for an explanation of Quality of Service. Maximum Capacity is achievable for Ethernet Frames which have the highest configured Quality of Service class. Maximum Capacity is 1.5 % lower for Ethernet Frames with a lower classification.

In a protected link, set the same QoS on primary and secondary units.

The user interface provides a convenient shortcut to select the assignment recommended in IEEE 802.1Q-2005.

NOTE

Ethernet priority information is coded in the Ethernet VLAN tag and differentiated quality of service is therefore not available in a network based on untagged Ethernet frames.

When the wireless link is configured for out-of-band management, select an appropriate setting for the Management CIR attribute. A high CIR will provide greater capacity for management traffic, at the cost of allowing bursty management traffic to have a greater impact on capacity remaining for customer traffic. A low CIR may result in extended response times for network management traffic.

Fast Ethernet port shutdown

If the PTP 800 link is part of a redundant network where STP or EAPS is used in external Ethernet bridges in order to resolve loops, enable the Data Port Wireless Down Alert and Management Data Port Wireless Down Alert to ensure that protection protocols are invoked promptly following loss of the wireless link.

Chapter 3 Legal information

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The following topics are described in this section:

- [Motorola Solutions, Inc. end user license agreement](#) on page 3-2
- [Hardware warranty](#) on page 3-13
- [Limit of liability](#) on page 3-14

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Chapter 4 Reference information

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This chapter describes the physical, environmental, safety, wireless and electromagnetic specifications for PTP 800.

The following topics are described in this chapter:

- [Installation inventories](#) on page 4-2
- [CMU specifications](#) on page 4-13
- [ODU specifications](#) on page 4-16
- [Antenna specifications](#) on page 4-31
- [Flexible waveguide specifications](#) on page 4-41
- [ODU coupler mounting specifications](#) on page 4-50
- [Protection interface specifications](#) on page 4-53
- [Wireless operation](#) on page 4-55
- [Data network](#) on page 4-90
- [Electromagnetic compliance](#) on page 4-92
- [Radiation hazard assessment](#) on page 4-96

Installation inventories

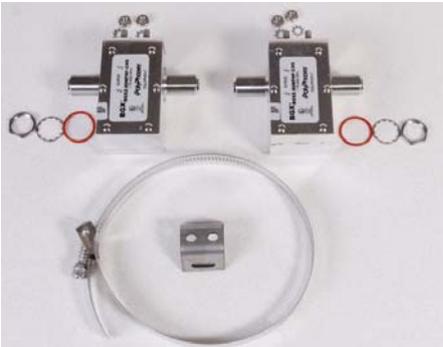
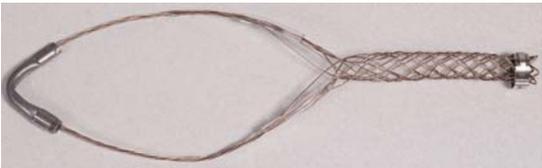
This section contains inventories of the components required, both for standard unprotected PTP 800 bridge installations and for the main installation options, such as protected links and remote mounted ODUs.

Standard link components

Standard links, that is links without 1+1 Hot Standby protection, remote-mounted ODUs or fiber interfaces, require the components listed in [Table 4-1](#).

Table 4-1 Inventory for standard unprotected links

Item	Motorola description, part number and notes
<p>Antenna (example with single ODU fitted)</p> 	<p>Two antennas are required per link. For part numbers, refer to Antenna specifications on page 4-31.</p>
<p>Outdoor unit (ODU)</p> 	<p>Two ODUs are required per link. For part numbers, refer to ODU specifications on page 4-16.</p>

Item	Motorola description, part number and notes
<p>Compact modem unit (CMU) kit</p> 	<p>Two CMUs are required per link.</p> <p>'PTP800 Modem 1000/100BaseT with Capacity CAP 10 Mbps'. Motorola part number WB3480.</p> <p>Kit contents: one CMU (Motorola model number WB3517), CMU bracket, power connector and ground lug.</p>
<p>Lightning protection unit (LPU) end kit</p> 	<p>Two kits are required per link (total four LPUs).</p> <p>'LPU END KIT PTP800'. Motorola part number WB3657.</p>
<p>CNT-400 coaxial cable, 50 Ohm (IF cable)</p> 	<p>CNT-400 cable is supplied by Motorola with the following lengths and part numbers.</p> <p>'50 Ohm Braided Coaxial Cable - 75 meter'. Motorola part number 30010194001.</p> <p>'50 Ohm Braided Coaxial Cable - 500 meter'. Motorola part number 30010195001.</p>
<p>Hoisting Grip for CNT-400 cable</p> 	<p>For hoisting the IF cable up to the ODU without damaging the connector.</p> <p>At least two grips are required per link.</p> <p>'Hoisting Grip for CNT-400 cable'. Motorola part number 07009304001.</p>

Item	Motorola description, part number and notes
<p>Coaxial cable installation assembly kit (for CNT-400 cable)</p> 	<p>Two kits are required per link.</p> <p>'Coaxial Cable Installation Assembly Kit'. Motorola part number WB3616.</p> <p>For kit contents, see Table 4-2.</p>
<p>Cable grounding kits for 1/4" and 3/8" cable</p> 	<p>The coaxial cable installation assembly kit includes two cable grounding kits, but additional grounding kits may be required to cover all IF cable grounding points.</p> <p>'Cable Grounding Kits For 1/4" And 3/8" Cable'. Motorola part number 01010419001.</p> <p>Kit contents: grounding cable, self-amalgamating tape, PVC tape, tie-wraps, bolts, washers and nuts.</p>
<p>Crimp tool for N-type connector</p> 	<p>Required for crimping N-type connectors to IF cables.</p> <p>'Crimp tool for N-type connector'. Motorola part number 66010063001.</p>
<p>Screened Cat5e cable</p>	<p>To minimise radiated emissions, use screened Cat5e cable for all copper connections from the CMU Ethernet ports (Data or Management) to any network switch.</p>

Table 4-2 Inventory of the coaxial cable installation assembly kit (WB3616)

Item	Notes
<p>Braided cable assembly</p> 	<p>Quantity per kit: 1.</p> <p>0.7meter long cable to go between the ODU and the LPU mounted close to the antenna.</p>
<p>Cable grounding kits for 1/4" and 3/8" cable</p> 	<p>Quantity per kit: 2.</p> <p>Each kit contains, earth wire, PVC tape, self amalgamating tape and fixings.</p>
<p>Ground lead</p> 	<p>Quantity per kit: 1</p> <p>Green, 0.8 meter long with M5 lugs fitted each end.</p>
<p>Ground lead</p> 	<p>Quantity per kit: 2.</p> <p>Green, 0.8 meter long with M5 lugs fitted one end and M10 the other.</p>

Item	Notes
<p>Weather proofing kit</p> 	<p>Quantity per kit: 1.</p> <p>Kit contains 6 reels of self amalgamating tape, 2 reels of 19mm wide PVC tape and 1 reel of 50mm wide PVC tape.</p>
<p>N type connector</p> 	<p>Quantity per kit: 4.</p> <p>To fit CNT-400 cable. Use crimp tool part number 66010063001.</p>
<p>Cable ties</p> 	<p>Quantity per kit: 50.</p>

Protected link components

Links with 1+1 Hot Standby protection require the components listed in [Table 4-3](#).

Table 4-3 Inventory for protected links

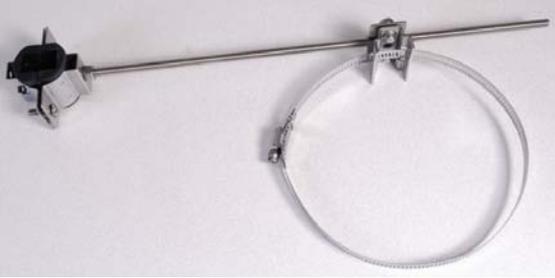
Item	Motorola description, part number and notes
Antenna (example with single ODU fitted)	If antenna protection is required, four antennas are required per protected link. For details, see Table 4-1 .
Outdoor unit (ODU)	Four ODUs are required per protected link. For details, see Table 4-1 .
Compact modem unit (CMU) kit	Four CMUs are required per protected link. For details, see Table 4-1 .
Lightning protection unit (LPU) end kit	Four kits are required per protected link (total eight LPUs). For details, see Table 4-1 .
CNT-400 coaxial cable, 50 Ohm (IF cable)	Protected links require twice the quantity of IF cable as unprotected links, as each ODU needs its own IF cable. For details, see Table 4-1 .
Hoisting Grip for CNT-400 cable	At least four grips are required per protected link. For details, see Table 4-1 .
Coaxial cable installation assembly kit (for CNT-400 cable)	Four kits are required per protected link. For details, see Table 4-1 .
Cable grounding kits for 1/4" and 3/8" cable	Additional grounding kits may be required to cover all IF cable grounding points. For details, see Table 4-1 .
Crimp tool for N-type connector	Required for crimping N-type connectors to IF cables. For details, see Table 4-1 .

Item	Motorola description, part number and notes
Screened Cat5e cable	For all copper connections from the CMU Ethernet ports (Data or Management) to any network switch.
<p>ODU coupler mounting kit</p> 	<p>Required for mounting one antenna with two ODUs. Two kits are required per protected link.</p> <p>Not required if antenna protection is implemented.</p> <p>For part numbers, refer to ODU coupler mounting specifications on page 4-50.</p>
<p>Out-of-band protection splitter</p> 	<p>Required for a protected link using out-of-band management. Two splitters are required per protected link.</p> <p>'1+1 Out-of-Band Splitter Kit'. Motorola part number WB3807.</p>
Protection cable	<p>Required for a protected link using data over redundant copper/fiber with in-band management. Purchase separately.</p> <p>For specification, see Protection cable on page 4-54.</p>

Remote-mounted ODU components

Remote mounted ODUs require the components listed in [Table 4-4](#).

Table 4-4 Inventory for remote-mounted ODUs

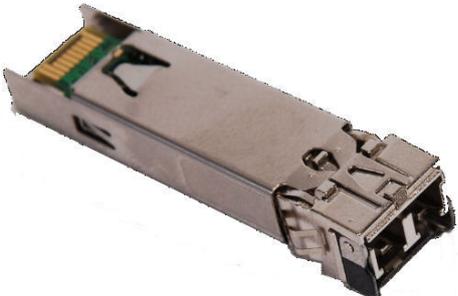
Item	Motorola description, part number and notes
<p>ODU remote mount kit</p> 	<p>One kit required per remote mounted ODU.</p> <p>For part numbers, refer to ODU remote mount kit specifications on page 4-30.</p>
<p>Flexible waveguide</p> 	<p>One waveguide required per remote mounted ODU.</p> <p>For part numbers, refer to Flexible waveguide specifications on page 4-41.</p>
<p>WR75 flex-twist hanger kit</p> 	<p>Required for remote mount installations. Two hangers are required for one 900mm flexible waveguide.</p> <p>For part numbers, refer to Flexible waveguide specifications on page 4-41.</p>

Item	Motorola description, part number and notes
<p>Tapered transition</p> 	<p>Required for mounting an 11 GHz antenna with taper transition and flexible waveguide.</p> <p>For part numbers, refer to Flexible waveguide specifications on page 4-41.</p>

Other components

Table 4-5 Inventory of other components

Item	Motorola description, part number and notes
<p>AC to DC power supply convertor</p> 	<p>Output voltage -48 VDC. No mains cable included.</p> <p>'AC-DC Power Supply Convertor'. Motorola part number WB3622.</p>
<p>DC connector</p>	<p>A DC connector is supplied in the CMU kit. Compatible DC connectors are also available from three manufacturers:</p> <p style="padding-left: 40px;">Molex: 395305004</p> <p style="padding-left: 40px;">Tyco: 4-796634-4</p> <p style="padding-left: 40px;">Phoenix Contact: 1757035</p>

Item	Motorola description, part number and notes
<p>Mains Lead (for AC to DC converter)</p> 	<p>'Mains Lead- US 3pin to C5 (PTP800 AC-DC PSU)'. Motorola part number WB3618.</p> <p>'Mains Lead- UK 3pin to C5 (PTP800 AC-DC PSU)'. Motorola part number WB3619.</p> <p>'Mains Lead- EU with dual earth to C5 (PTP800 AC-DC PSU)'. Motorola part number WB3620.</p> <p>'Mains Lead- AUS 3pin to C5 (PTP800 AC-DC PSU)'. Motorola part number WB3621.</p> <p>CAUTION</p> <p>Only appropriately rated and approved mains leads, in accordance with the regulations of the country of use, should be used with this equipment.</p>
<p>CMU rack mount kit</p> 	<p>Required for rack-mounted CMUs.</p> <p>'PTP800 CMU/PTP-SYNC 19inch Rack Mount Installation Kit'. Motorola part number WB3486.</p> <p>Kit contents: bracket, washers, screws, nuts, handles and rack mount blank plate.</p>
<p>Right angle IF cable connector</p>	<p>A right angle connector can make it easier to install the CMU in the rack.</p> <p>'RF CONNECTOR,N,MALE,RIGHT ANGLE FOR CNT-400 CABLE'. Motorola part number 01010589001.</p>
<p>SFP Gig-E fiber pluggable module</p> 	<p>If a fiber interface between the CMU and Ethernet switch is required, then two SFP modules are needed.</p> <p>Either: 'SFP SX Gig-E Optical Pluggable Module - 850 nm'. Motorola part number 01010430001.</p> <p>Or: 'SFP LX Gig-E Optical Pluggable Module - 1310 nm'. Motorola part number 01010431001.</p>
<p>Fiber cable and connectors</p>	<p>If a fiber interface between the CMU and Ethernet switch is required, then fiber cable and connectors are needed. Purchase separately.</p>

Item	Motorola description, part number and notes
ODU coupler mounting kit	A coupler may be required in unprotected links to support two parallel and simultaneously transmitting links, each operating on a different frequency pair. For part numbers, refer to ODU coupler mounting specifications on page 4-50.
Parabolic radome for antenna	'10 Foot Radome For Par10 Antenna'. Motorola part number 85009295001 '11 Foot Radome For Par12 Antenna'. Motorola part number 85009295002.

CMU specifications

This section contains specifications of the PTP 800 compact modem unit (CMU) and its power supply.

CMU dimensions and weight

The PTP 800 CMU conforms to the physical specifications listed in [Table 4-6](#).

Table 4-6 CMU physical specifications

Category	Specification
Dimensions	Width 18.0 cm (7.1 in), Height 3.5 cm (1.4 in), Depth 22.0 cm (8.7 in)
Weight	1.1 kg (2.4 lbs)

CMU environmental

The PTP 800 CMU conforms to the environmental specifications listed in [Table 4-7](#).

Table 4-7 CMU environmental specifications

Category	Specification
Temperature	-33°C (-27°F) to 55°C (131°F)
Humidity	95% non-condensing
Waterproof	IP20
UV Exposure	10 year operational life (UL746C test evidence)

CMU electrical

The PTP 800 CMU conforms to the electrical specifications listed in [Table 4-8](#).

Table 4-8 CMU electrical specifications

Category	Specification
Input voltage	-40.5 V to -60 V
Input voltage withstand	0 V to -72 V
CMU dissipation	21 W

Power consumption

The CMU and ODU power consumption figures are specified in [Table 4-9](#).

Table 4-9 ODU and CMU power consumption

Band (GHz)	ODU in Mute (W) (*1)	ODU in Transmit (W) (*2)	CMU (W)	1+0 Configuration (W)	1+1 Configuration (W)
6	29	46	20	66	115
7	29	46	20	66	115
8	29	46	20	66	115
11	23	46	20	66	109
13	10	35	20	55	85
15	10	35	20	55	85
18	7	35	20	55	82
23	14	35	20	55	89
26	14	35	20	55	89
28	13	35	20	55	88
32	19	35	20	55	94
38	21	35	20	55	96

(*1) Typical ODU DC power consumption in Mute condition (W)

(*2) Typical ODU DC power consumption in Transmit condition (W)

AC to DC converter specifications

This section describes the AC to DC converter that is available from Motorola. For details of alternative power supply arrangements, refer to [Power supply considerations](#) on page 2-16.

The PTP 800 AC to DC converter conforms to the specifications listed in [Table 4-10](#).

Table 4-10 AC to DC converter specifications

Category	Specification
Input range	90 to 264 V ac (wide range)
Output voltage	Single output 48 V dc nominal
Maximum output power	80 W
Line frequency	47 to 63 Hz
Inrush current	40 A maximum at 264 V ac, cold start 25 °C
Input current	1.8 A maximum
Power conversion efficiency	85% typical
Electromagnetic compatibility	FCC Part 15, Subpart B Class A EN55022 (CISPR 22) Class A
Safety ground leakage current	3.5 mA maximum at 60 Hz, 254 V ac input
Hold-up time	10 ms minimum at full load at 90/264 V ac
Overvoltage protection	53 - 60 V latching type, recycle ac to reset
Overcurrent protection	Output short-circuit protection automatic recovery
Thermal protection	Output will latch off
Waterproof	IP20
Temperature	-33°C (-27°F) to 55°C (131°F)

ODU specifications

This section contains specifications of the outdoor units (ODUs) that are available from Motorola for PTP 800 installations.

ODU dimensions and weight

The PTP 800 ODU conforms to the physical specifications listed in [Table 4-11](#).

Table 4-11 ODU physical specifications

Category	Specification
Dimensions	Diameter 26.7 cm (10.5 in), Depth 8.9 cm (3.5 in)
Weight	4.6 kg (10.1 lbs)

ODU environmental

The PTP 800 ODU conforms to the environmental specifications listed in [Table 4-12](#) and [Table 4-7](#).

Table 4-12 ODU environmental specifications

Category	Specification
Temperature	-33°C (-27°F) to 55°C (131°F)
Humidity	100% condensing
Waterproof	IP56
UV Exposure	10 year operational life (UL746C test evidence)

RSSI output

[Table 4-13](#) specifies the voltage measured at the RSSI connector of the ODU for each combination of received signal level (dBm) and channel separation or bandwidth (MHz).

Table 4-13 RSSI voltage, received signal level and bandwidth

RSL (dBm)	Channel separation 7, 13.75, 14, 27.5, 28, 29.65, 55 or 56 MHz	Bandwidth 10, 20 or 40 MHz	Bandwidth 30 MHz	Bandwidth 50 MHz
-20	4.54	4.63	4.71	4.57
-21	4.48	4.57	4.65	4.51
-22	4.41	4.50	4.58	4.44
-23	4.35	4.44	4.52	4.38
-24	4.29	4.38	4.46	4.32
-25	4.22	4.31	4.39	4.25
-26	4.16	4.25	4.33	4.19
-27	4.10	4.19	4.27	4.13
-28	4.03	4.12	4.20	4.06
-29	3.97	4.06	4.14	4.00
-30	3.90	4.00	4.08	3.94
-31	3.84	3.93	4.01	3.87
-32	3.78	3.87	3.95	3.81
-33	3.71	3.81	3.89	3.75
-34	3.65	3.74	3.82	3.68
-35	3.59	3.68	3.76	3.62
-36	3.52	3.62	3.70	3.56
-37	3.46	3.55	3.63	3.49
-38	3.40	3.49	3.57	3.43
-39	3.33	3.43	3.51	3.37
-40	3.27	3.36	3.44	3.30
-41	3.21	3.30	3.38	3.24
-42	3.14	3.24	3.32	3.18
-43	3.08	3.17	3.25	3.11

RSL (dBm)	Channel separation 7, 13.75, 14, 27.5, 28, 29.65, 55 or 56 MHz	Bandwidth 10, 20 or 40 MHz	Bandwidth 30 MHz	Bandwidth 50 MHz
-44	3.02	3.11	3.19	3.05
-45	2.95	3.05	3.13	2.98
-46	2.89	2.98	3.06	2.92
-47	2.83	2.92	3.00	2.86
-48	2.76	2.86	2.94	2.79
-49	2.70	2.79	2.87	2.73
-50	2.64	2.73	2.81	2.67
-51	2.57	2.67	2.75	2.60
-52	2.51	2.60	2.68	2.54
-53	2.45	2.54	2.62	2.48
-54	2.38	2.48	2.55	2.41
-55	2.32	2.41	2.49	2.35
-56	2.26	2.35	2.43	2.29
-57	2.19	2.29	2.36	2.22
-58	2.13	2.22	2.30	2.16
-59	2.07	2.16	2.24	2.10
-60	2.00	2.10	2.17	2.03
-61	1.94	2.03	2.11	1.97
-62	1.88	1.97	2.05	1.91
-63	1.81	1.90	1.98	1.84
-64	1.75	1.84	1.92	1.78
-65	1.69	1.78	1.86	1.72
-66	1.62	1.71	1.79	1.65
-67	1.56	1.65	1.73	1.59
-68	1.50	1.59	1.67	1.53
-69	1.43	1.52	1.60	1.46
-70	1.37	1.46	1.54	1.40
-71	1.31	1.40	1.48	1.34
-72	1.24	1.33	1.41	1.27
-73	1.18	1.27	1.35	1.21

RSL (dBm)	Channel separation 7, 13.75, 14, 27.5, 28, 29.65, 55 or 56 MHz	Bandwidth 10, 20 or 40 MHz	Bandwidth 30 MHz	Bandwidth 50 MHz
-74	1.11	1.21	1.29	1.15
-75	1.05	1.14	1.22	1.08
-76	0.99	1.08	1.16	1.02
-77	0.92	1.02	1.10	0.96
-78	0.86	0.95	1.03	0.89
-79	0.80	0.89	0.97	0.83
-80	0.73	0.83	0.91	0.77
-81	0.67	0.76	0.84	0.70
-82	0.61	0.70	0.78	0.64
-83	0.54	0.64	0.72	0.58
-84	0.48	0.57	0.65	0.51
-85	0.42	0.51	0.59	0.45
-86	0.35	0.45	0.53	0.39
-87	0.29	0.38	0.46	0.32
-88	0.23	0.32	0.40	0.26
-89	0.16	0.26	0.34	0.19
-90	0.10	0.19	0.27	0.13

ODU specifications (Lower 6 GHz)

Motorola can supply the ODUs listed in [Table 4-14](#) for PTP 800 links that will operate in the Lower 6 GHz band (frequency range 5.925 - 6.425 GHz).

Table 4-14 ODU specifications – main frequency Lower 6 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010411007	FCC, ETSI	B1-Lo	5925 – 6025 MHz	252 MHz
01010411008		B1-Hi	6175 – 6275 MHz	
01010411009		B2-Lo	6000 – 6100 MHz	
01010411010		B2-Hi	6250 – 6350 MHz	
01010411011		B3-Lo	6075 – 6175 MHz	
01010411012		B3-Hi	6325 – 6425 MHz	

ODU specifications (Upper 6 GHz)

Motorola can supply the ODUs listed in [Table 4-15](#) for PTP 800 links that will operate in the Upper 6 GHz band (frequency range 6.425 - 7.125 GHz).

Table 4-15 ODU specifications – main frequency Upper 6 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010411013	ETSI	B1-Lo	6430 – 6540 MHz	340 MHz
01010411014		B1-Hi	6770 – 6880 MHz	
01010411015		B2-Lo	6520 – 6630 MHz	
01010411016		B2-Hi	6860 – 6970 MHz	
01010411017		B3-Lo	6600 – 6710 MHz	
01010411018		B3-Hi	6940 – 7050 MHz	
01010411019		B4-Lo	6670 – 6780 MHz	
01010411020		B4-Hi	7010 – 7120 MHz	

ODU specifications (7 GHz)

Motorola can supply the ODUs listed in [Table 4-16](#) for PTP 800 links that will operate in the 7 GHz band (frequency range 7.125-7.900 GHz).

Table 4-16 ODU specifications – main frequency 7 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010610001	ETSI	B1-Lo	7428 – 7484 MHz	154 MHz
01010610002		B1-Hi	7582 – 7638 MHz	
01010610003		B2-Lo	7470 – 7526 MHz	
01010610004		B2-Hi	7624 – 7680 MHz	
01010610005		B3-Lo	7512 – 7568 MHz	
01010610006		B3-Hi	7666 – 7722 MHz	
01010610013	ETSI	B1-Lo	7114 – 7177 MHz	161 MHz
01010610014		B1-Hi	7275 – 7338 MHz	
01010610015		B2-Lo	7149 – 7212 MHz	
01010610016		B2-Hi	7310 – 7373 MHz	
01010610017		B3-Lo	7184 – 7247 MHz	
01010610018		B3-Hi	7345 – 7408 MHz	
01010610019		B4-Lo	7219 – 7282 MHz	
01010610020		B4-Hi	7380 – 7443 MHz	
01010610021		B5-Lo	7239 – 7302 MHz	
01010610022		B5-Hi	7400 – 7463 MHz	
01010610023		B6-Lo	7274 – 7337 MHz	
01010610024		B6-Hi	7435 – 7498 MHz	
01010610025		B7-Lo	7309 – 7372 MHz	
01010610026		B7-Hi	7470 – 7533 MHz	
01010610027		B8-Lo	7344 – 7407 MHz	
01010610028		B8-Hi	7505 – 7568 MHz	
01010610029		B9-Lo	7414 – 7477 MHz	
01010610030	B9-Hi	7575 – 7638 MHz		
01010610031	B10-Lo	7449 – 7512 MHz		

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010610032		B10-Hi	7610 – 7673 MHz	
01010610033		B21-Lo	7484 – 7547 MHz	
01010610034		B21-Hi	7645 – 7708 MHz	
01010610035		B22-Lo	7519 – 7582 MHz	
01010610036		B22-Hi	7680 – 7743 MHz	
01010610037		B23-Lo	7539 – 7602 MHz	
01010610038		B23-Hi	7700 – 7763 MHz	
01010610039		B24-Lo	7574 – 7637 MHz	
01010610040		B24-Hi	7735 – 7798 MHz	
01010610041		B25-Lo	7609 – 7672 MHz	
01010610042		B25-Hi	7770 – 7833 MHz	
01010610043		B26-Lo	7644 – 7707 MHz	
01010610044		B26-Hi	7805 – 7868 MHz	
01010610062	ETSI	B1-Lo	7443 – 7499 MHz	168 MHz
01010610063		B1-Hi	7611 – 7667 MHz	
01010610064		B2-Lo	7485 – 7541 MHz	
01010610065		B2-Hi	7653 – 7709 MHz	
01010610066		B3-Lo	7527 – 7583 MHz	
01010610067		B3-Hi	7695 – 7751 MHz	
01010610045	ETSI	B1-Lo	7093 – 7149 MHz	196 MHz
01010610046		B1-Hi	7289 – 7345 MHz	
01010610047		B2-Lo	7121 – 7177 MHz	
01010610048		B2-Hi	7317 – 7373 MHz	
01010610049		B3-Lo	7149 – 7205 MHz	
01010610050		B3-Hi	7345 – 7401 MHz	
01010610051		B4-Lo	7177 – 7233 MHz	
01010610052		B4-Hi	7373 – 7429 MHz	
01010610053		B5-Lo	7205 – 7261 MHz	
01010610054		B5-Hi	7401 – 7457 MHz	

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010610055	ETSI	B1-Lo	7400 – 7484 MHz	245 MHz
01010610056		B1-Hi	7645 – 7729 MHz	
01010610057		B2-Lo	7484 – 7568 MHz	
01010610058		B2-Hi	7729 – 7813 MHz	
01010610059		B3-Lo	7568 – 7652 MHz	
01010610060		B3-Hi	7813 – 7897 MHz	

ODU specifications (8 GHz)

Motorola can supply the ODUs listed in [Table 4-17](#) for PTP 800 links that will operate in the 8 GHz band (frequency range 7.725-8.500 GHz).

Table 4-17 ODU specifications – main frequency 8 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010611001	ETSI	B1-Lo	8279 – 8307 MHz	119 MHz and 126 MHz
01010611002		B1-Hi	8398 – 8426 MHz	
01010611003		B2-Lo	8293 – 8321 MHz	
01010611004		B2-Hi	8412 – 8440 MHz	
01010611005		B3-Lo	8307 – 8335 MHz	
01010611006		B3-Hi	8426 – 8454 MHz	
01010611007		B4-Lo	8321 – 8349 MHz	208 MHz
01010611008		B4-Hi	8440 – 8468 MHz	
01010611009		B5-Lo	8335 – 8363 MHz	
01010611010		B5-Hi	8454 – 8482 MHz	
01010611011		B6-Lo	8349 – 8377 MHz	
01010611012		B6-Hi	8468 – 8496 MHz	
01010611019	ETSI	B1-Lo	8043 – 8113 MHz	208 MHz
01010611020		B1-Hi	8251 – 8321 MHz	
01010611021		B2-Lo	8099 – 8169 MHz	

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010611022		B2-Hi	8307 – 8377 MHz	
01010611023		B3-Lo	8155 – 8225 MHz	
01010611024		B3-Hi	8363 – 8433 MHz	
01010611025		B4-Lo	8211 – 8281 MHz	
01010611026		B4-Hi	8419 – 8489 MHz	
01010611027	ETSI	B1-Lo	7905 – 8024 MHz	266 MHz
01010611028		B1-Hi	8171 – 8290 MHz	
01010611029		B2-Lo	8017 – 8136 MHz	
01010611030		B2-Hi	8283 – 8402 MHz	
01010611031	ETSI	B2-Lo	7835 – 7971 MHz	311 MHz
01010611032		B2-Hi	8146 – 8282 MHz	
01010611033		B3-Lo	7717 – 7867 MHz	
01010611034		B3-Hi	8028 – 8178 MHz	

ODU specifications (11 GHz)

Motorola can supply the ODUs listed in [Table 4-18](#) for PTP 800 links that will operate in the 11 GHz band (frequency range 10.70 - 11.70 GHz).

Table 4-18 ODU specifications – main frequency 11 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010208001	FCC, ETSI	B5-Lo	10700 – 10890 MHz	490 MHz and 500 MHz
01010208002		B5-Hi	11200 – 11390 MHz	
01010208003		B6-Lo	10855 – 11045 MHz	
01010208004		B6-Hi	11355 – 11545 MHz	
01010208005		B7-Lo	11010 – 11200 MHz	
01010208006		B7-Hi	11510 – 11700 MHz	
01010208007	ETSI	B1-Lo	10675 – 10855 MHz	530 MHz
01010208008		B1-Hi	11205 – 11385 MHz	

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010208009		B2-Lo	10795 – 10975 MHz	
01010208010		B2-Hi	11325 – 11505 MHz	
01010208011		B3-Lo	10915 – 11135 MHz	
01010208012		B3-Hi	11455 – 11665 MHz	
01010208013		B4-Lo	11035 – 11215 MHz	
01010208014		B4-Hi	11565 – 11745 MHz	

ODU specifications (13 GHz)

Motorola can supply the ODUs listed in [Table 4-19](#) for PTP 800 links that will operate in the 13 GHz band (frequency range 12.75 - 13.25 GHz).

Table 4-19 ODU specifications – main frequency 13 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010583001	ETSI	B1-Lo	12751 – 12814 MHz	266 MHz
01010583002		B1-Hi	13017 – 13080 MHz	
01010583003		B2-Lo	12807 – 12870 MHz	
01010583004		B2-Hi	13073 – 13136 MHz	
01010583005		B3-Lo	12863 – 12926 MHz	
01010583006		B3-Hi	13129 – 13192 MHz	
01010583007		B4-Lo	12919 – 12982 MHz	
01010583008		B4-Hi	13185 – 13248 MHz	

ODU specifications (15 GHz)

Motorola can supply the ODUs listed in [Table 4-20](#) for PTP 800 links that will operate in the 15 GHz band (frequency range 14.4 - 15.35 GHz).

Table 4-20 ODU specifications – main frequency 15 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010584001	ETSI	B4-Lo	14501 – 14613 MHz	420 MHz
01010584002		B4-Hi	14921 – 15033 MHz	
01010584003		B5-Lo	14606 – 14725 MHz	
01010584004		B5-Hi	15026 – 15145 MHz	
01010584005		B6-Lo	14718 – 14837 MHz	
01010584006		B6-Hi	15138 – 15257 MHz	
01010584007		B7-Lo	14816 – 14928 MHz	
01010584008		B7-Hi	15236 – 15348 MHz	
01010584009	ETSI	B4-Lo	14403 – 14522 MHz	490 MHz
01010584010		B4-Hi	14893 – 15012 MHz	
01010584011		B5-Lo	14515 – 14634 MHz	
01010584012		B5-Hi	15005 – 15124 MHz	
01010584013		B6-Lo	14627 – 14746 MHz	
01010584014		B6-Hi	15117 – 15236 MHz	
01010584015		B7-Lo	14739 – 14858 MHz	
01010584016		B7-Hi	15229 – 15384 MHz	
01010584020	ETSI	B2-Lo	14500 – 14625 MHz	728 MHz
01010584021		B2-Hi	15228 – 15353 MHz	
01010584022	Mexico	B1-Lo	14627 – 14746 MHz	315 MHz
01010584023		B1-Hi	14942 – 15061 MHz	
01010584024		B2-Lo	14725 – 14844 MHz	
01010584025		B2-Hi	15040 – 15159 MHz	
01010584026		B3-Lo	14823 – 14942 MHz	

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010584027		B3-Hi	15138 – 15257 MHz	
01010584028	ANZ	B1-Lo	14400 – 14512 MHz	644 MHz
01010584029		B1-Hi	15044 – 15156 MHz	
01010584030		B2-Lo	14498 – 14610 MHz	
01010584031		B2-Hi	15142 – 15254 MHz	
01010584032		B3-Lo	14596 – 14708 MHz	
01010584033		B3-Hi	15240 – 15352 MHz	

ODU specifications (18 GHz)

Motorola can supply the ODUs listed in [Table 4-21](#) for PTP 800 links that will operate in the 18 GHz band (frequency range 17.70 - 19.70 GHz).

Table 4-21 ODU specifications – main frequency 18 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010209001	ETSI	B1-Lo	17685 – 17985 MHz	1010 MHz and 1008 MHz
01010209002		B1-Hi	18695 – 18995 MHz	
01010209003		B2-Lo	17930 – 18230 MHz	
01010209004		B2-Hi	18940 – 19240 MHz	
01010209005		B3-Lo	18180 – 18480 MHz	
01010209006		B3-Hi	19190 – 19490 MHz	
01010209007		B4-Lo	18400 – 18700 MHz	
01010209008		B4-Hi	19410 – 19710 MHz	
01010209013	FCC, Brazil	B3-Lo	17700 – 18140 MHz	1560 MHz
01010209014		B3-Hi	19260 – 19700 MHz	

ODU specifications (23 GHz)

Motorola can supply the ODUs listed in [Table 4-22](#) for PTP 800 links that will operate in the 23 GHz band (frequency range 21.20 - 23.60 GHz).

Table 4-22 ODU specifications – main frequency 23 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010210001	ETSI	B1-Lo	21994 – 22330 MHz	1008 MHz
01010210002		B1-Hi	23002 – 23338 MHz	
01010210003		B2-Lo	22274 – 22610 MHz	
01010210004		B2-Hi	23282 – 23618 MHz	
01010210005	FCC	B5-Lo	21200 – 21600 MHz	1200 MHz
01010210006		B5-Hi	22400 – 22800 MHz	
01010210007		B6-Lo	21600 – 22000 MHz	
01010210008		B6-Hi	22800 – 23200 MHz	
01010210009		B7-Lo	22000 – 22400 MHz	
01010210010		B7-Hi	23200 – 23600 MHz	
01010210011	ETSI	B1-Lo	21200 – 21500 MHz	1232 MHz
01010210012		B1-Hi	22432 – 22732 MHz	
01010210013		B2-Lo	21472 – 21786 MHz	
01010210014		B2-Hi	22704 – 23018 MHz	
01010210015		B3-Lo	21779 – 22093 MHz	
01010210016		B3-Hi	23011 – 23325 MHz	
01010210017		B4-Lo	22086 – 22386 MHz	
01010210018		B4-Hi	23318 – 23618 MHz	

ODU specifications (26 GHz)

Motorola can supply the ODUs listed in [Table 4-23](#) for PTP 800 links that will operate in the 26 GHz band (frequency range 24.25 - 26.50 GHz).

Table 4-23 ODU specifications – main frequency 26 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010403003	ETSI	B1-Lo	24549 – 24885 MHz	1008 MHz
01010403004		B1-Hi	25557 – 25893 MHz	
01010403005		B2-Lo	24829 – 25165 MHz	
01010403006		B2-Hi	25837 – 26173 MHz	
01010403007		B3-Lo	25109 – 25445 MHz	
01010403008		B3-Hi	26117 – 26453 MHz	
01010403001	FCC	B1-Lo	24250 – 24450 MHz	800 MHz
01010403002		B1-Hi	25050 – 25250 MHz	

ODU specifications (38 GHz)

Motorola can supply the ODUs listed in [Table 4-24](#) for PTP 800 links that will operate in the 38 GHz band (frequency range 37 - 39.5 GHz).

Table 4-24 ODU specifications – main frequency 38 GHz

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010433002	FCC	B1-Lo	38595 – 38805 MHz	700 MHz
01010433003		B1-Hi	39295 – 39505 MHz	
01010433004		B2-Lo	38795 – 39005 MHz	
01010433005		B2-Hi	39495 – 39705 MHz	
01010433006		B3-Lo	38995 – 39205 MHz	
01010433007		B3-Hi	39695 – 39905 MHz	
01010433008		B4-Lo	39195 – 39405 MHz	

Motorola Part Number	Standard	Sub-band	Sub-band frequency	Transmit and receive spacing
01010433009		B4-Hi	39895 – 40105 MHz	
01010433010	ETSI	B1-Lo	37044 – 37632 MHz	1260 MHz
01010433011		B1-Hi	38304 – 38892 MHz	
01010433012		B2-Lo	37604 – 38192 MHz	
01010433001		B2-Hi	38864 – 39452 MHz	

ODU remote mount kit specifications

Table 4-25 contains specifications for optional ODU remote mount kits that can be ordered from Motorola.

Table 4-25 ODU remote mount kit specifications

Band	Output	Motorola part number
6 GHz	UDR70	07010109008
7 GHz	UBR84	07010109001
8 GHz	UBR84	07010109002
11 – 13 GHz	UBR120	07010109003
15 GHz	UBR140	07010109004
18 – 26 GHz	UBR220	07010109005
38 GHz	UBR320	07010109007

Antenna specifications

This section contains specifications of the antennas that are available from Motorola for PTP 800 installations.

Each available antenna is listed with the following parameters:

- Frequency
- Motorola number
- Diameter
- Polarization
- Interface
- Mid-band gain
- Vertical beamwidth
- Weight

Antenna wind velocity limits

For all the antennas listed in this section, the maximum permitted wind velocities are:

- Operational wind velocity: 113 km/h (70 mph)
- Peak survival wind velocity: 249 km/h (155 mph)

Antenna specifications (Lower 6 GHz and Upper 6 GHz)

Motorola can supply the antennas listed in [Table 4-26](#) and [Table 4-27](#) for PTP 800 links that will operate in the Lower 6 GHz band (frequency range 5.925-6.425 GHz) and the Upper 6 GHz band (frequency range 6.425-7.125 GHz).

Table 4-26 Antenna specifications for 6 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85009298001	1.0 m (3 ft)	MDM	33 dBi	3.3°	24 kg (53 lb)
85010089020	1.2 m (4 ft)	MDM	35 dBi	2.2°	55 kg (121 lb)
85010089021	1.8 m (6 ft)	MDM	39 dBi	1.8°	62 kg (137 lb)
85010091022	1.0 m (3 ft)	PDR70	33 dBi	3.3°	24 kg (53 lb)
85010091006	1.2 m (4 ft)	PDR70	35 dBi	2.2°	55 kg (121 lb)
85010091007	1.8 m (6 ft)	PDR70	39 dBi	1.8°	62 kg (137 lb)
85009294001	1.8 m (6 ft)	CPR137G	38.2 dBi	1.9°	78 kg (172 lb)
85009294002	2.4 m (8 ft)	CPR137G	40.8 dBi	1.4°	114 kg (251 lb)
85009294003	3 m (10 ft)	CPR137G	43.4 dBi	1.1°	144 kg (317 lb)
85009294004	3.7 m (12 ft)	CPR137G	44.9 dBi	0.9°	245 kg (540 lb)

MDM = Motorola direct mount

Table 4-27 Antenna specifications for 6 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010092048	1.0 m (3 ft)	PDR70	33 dBi	3.3°	24 kg (53 lb)
85010092020	1.2 m (4 ft)	PDR70	35 dBi	2.2°	55 kg (121 lb)
85010092021	1.8 m (6 ft)	PDR70	39 dBi	1.8°	62 kg (137 lb)

Antenna specifications (7 GHz and 8 GHz)

Motorola can supply the antennas listed in [Table 4-28](#) and [Table 4-29](#) for PTP 800 links that will operate in the 7 GHz band (frequency range 7.125-7.900 GHz) or the 8 GHz band (frequency range 7.725-8.5 GHz).

Table 4-28 Antenna specifications for 7 GHz and 8 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010089045	0.6 m (2 ft)	MDM	31.1 dBi	4.7°	11 kg (25 lb)
85009298002	1.0 m (3 ft)	MDM	35.5 dBi	2.6°	24 kg (53 lb)
85010089024	1.2 m (4 ft)	MDM	37.3 dBi	2.9°	55 kg (121 lb)
85010089025	1.8 m (6 ft)	MDM	40.8 dBi	1.5°	62 kg (137 lb)
85010091020	0.6 m (2 ft)	PDR84	31.1 dBi	4.7°	11 kg (25 lb)
85010091023	1.0 m (3 ft)	PDR84	35.5 dBi	2.6°	24 kg (53 lb)
85010091010	1.2 m (4 ft)	PDR84	37.3 dBi	2.9°	55 kg (121 lb)
85010091011	1.8 m (6 ft)	PDR84	40.8 dBi	1.5°	62 kg (137 lb)

MDM = Motorola direct mount

Table 4-29 Antenna specifications for 7 GHz and 8 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010092051	0.6 m (2 ft)	PDR84	31.1 dBi	4.7°	14 kg (31 lb)
85010092059	1.0 m (3 ft)	PDR84	35.5 dBi	2.6°	24 kg (53 lb)
85010092024	1.2 m (4 ft)	PDR84	37.3 dBi	2.2°	55 kg (121 lb)
85010092025	1.8 m (6 ft)	PDR84	40.6 dBi	1.5 °	62 kg (137 lb)

Antenna specifications (11 GHz)

Motorola can supply the antennas listed in [Table 4-30](#) and [Table 4-31](#) for PTP 800 links that will operate in the 11 GHz band (frequency range 10.70 - 11.70 GHz).

Table 4-30 Antenna specifications for 11 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010089049	0.6 m (2 ft)	MDM	34.5 dBi	3.3°	11 kg (25 lb)
85010089003	0.8 m (2.6 ft)	MDM	37.4 dBi	2.1°	30 kg (66 lb)
85009298003	1.0 m (3 ft)	MDM	38.4 dBi	2.0°	24 kg (53 lb)
85010089004	1.2 m (4 ft)	MDM	40.4 dBi	1.5°	46 kg (101 lb)
85010089005	1.8 m (6 ft)	MDM	43.8 dBi	1.1°	84 kg (185 lb)
85010091019	0.6 m (2 ft)	PDR100	34.5 dBi	3.3°	11 kg (25 lb)
85010091003	0.8 m (2.6 ft)	PDR100	37.4 dBi	2.1°	30 kg (66 lb)
85010091017	1.0 m (3 ft)	PDR100	38.4 dBi	2.0°	24 kg (53 lb)
85010091004	1.2 m (4 ft)	PDR100	40.4 dBi	1.5°	46 kg (101 lb)
85010091005	1.8 m (6 ft)	PDR100	43.8 dBi	1.1°	84 kg (185 lb)

MDM = Motorola direct mount

Table 4-31 Antenna specifications for 11 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010092052	0.6 m (2 ft)	PDR100	34.5 dBi	3.3°	11 kg (25 lb)
85010092003	0.8 m (2.6 ft)	PDR100	37.2 dBi	2.1°	30 kg (66 lb)
85010092042	1.0 m (3 ft)	PDR100	38.4 dBi	2.0°	24 kg (53 lb)
85010092004	1.2 m (4 ft)	PDR100	40.4 dBi	1.5°	46 kg (101 lb)
85010092005	1.8 m (6 ft)	PDR100	43.8 dBi	1.1°	84 kg (185 lb)

Antenna specifications (13 GHz)

Motorola can supply the antennas listed in [Table 4-32](#) and [Table 4-33](#) for PTP 800 links that will operate in the 13 GHz band (frequency range 12.75 - 13.25 GHz).

Table 4-32 Antenna specifications for 13 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010089026	0.3 m (1 ft)	MDM	30.9 dBi	4.7°	7 kg (15 lb)
85010089046	0.6 m (2 ft)	MDM	36.0 dBi	2.7°	11 kg (25 lb)
85009298004	1.0 m (3 ft)	MDM	40.0 dBi	1.6°	24 kg (53 lb)
85010089029	1.2 m (4 ft)	MDM	42.0 dBi	1.3°	55 kg (121 lb)
85010089030	1.8 m (6 ft)	MDM	45.2 dBi	0.9°	62 kg (137 lb)
85010091012	0.3 m (1 ft)	PBR120	30.9 dBi	4.7°	7 kg (15 lb)
85010091021	0.6 m (2 ft)	PBR120	36.0 dBi	2.7°	11 kg (25 lb)
85010091018	1.0 m (3 ft)	PBR120	40.0 dBi	1.6°	24 kg (53 lb)
85010091015	1.2 m (4 ft)	PBR120	42.0 dBi	1.3°	55 kg (121 lb)
85010091016	1.8 m (6 ft)	PBR120	45.2 dBi	0.9°	62 kg (137 lb)

MDM = Motorola direct mount

Table 4-33 Antenna specifications for 13 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010092026	0.3 m (1 ft)	PBR120	30.9 dBi	4.7°	7 kg (15 lb)
85010092056	0.6 m (2 ft)	PBR120	36.0 dBi	2.7°	11 kg (25 lb)
85010092043	1.0 m (3 ft)	PBR120	40.0 dBi	1.6°	24 kg (53 lb)
85010092029	1.2 m (4 ft)	PBR120	42.0 dBi	1.3°	55 kg (121 lb)
85010092030	1.8 m (6 ft)	PBR120	45.2 dBi	0.9°	62 kg (137 lb)

Antenna specifications (15 GHz)

Motorola can supply the antennas listed in [Table 4-34](#) and [Table 4-35](#) for PTP 800 links that will operate in the 15 GHz band (frequency range 14.25 - 15.35 GHz).

Table 4-34 Antenna specifications for 15 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010089031	0.3 m (1 ft)	MDM	32.1 dBi	4.3°	7 kg (15 lb)
85010089047	0.6 m (2 ft)	MDM	36.8 dBi	2.5 °	11 kg (25 lb)
85009298005	1.0 m (3 ft)	MDM	41.1 dBi	1.5°	24 kg (53 lb)
85010089034	1.2 m (4 ft)	MDM	42.9 dBi	1.2°	55 kg (121 lb)
85010089035	1.8 m (6 ft)	MDM	46.2 dBi	0.8°	62 kg (137 lb)

MDM = Motorola direct mount

Table 4-35 Antenna specifications for 15 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010092031	0.3 m (1 ft)	PBR140	32.0 dBi	4.3°	7 kg (15 lb)
85010092057	0.6 m (2 ft)	PBR140	36.8 dBi	2.5°	11 kg (25 lb)
85010092044	1.0 m (3 ft)	PBR140	41.1 dBi	1.5°	24 kg (53 lb)
85010092034	1.2 m (4 ft)	PBR140	42.9 dBi	1.2°	55 kg (121 lb)
85010092035	1.8 m (6 ft)	PBR140	46.2 dBi	0.8°	62 kg (137 lb)

Antenna specifications (18 GHz)

Motorola can supply the antennas listed in [Table 4-36](#) and [Table 4-37](#) for PTP 800 links that will operate in the 18 GHz band (frequency range 17.70 - 19.70 GHz).

Table 4-36 Antenna specifications for 18 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010089006	0.3 m (1 ft)	MDM	34.2 dBi	3.3°	6 kg (13 lb)
85010089042	0.6 m (2 ft)	MDM	38.9 dBi	2.1°	11 kg (25 lb)
85009298006	1.0 m (3 ft)	MDM	43.5 dBi	1.1°	24 kg (53 lb)
85010089009	1.2 m (4 ft)	MDM	44.7 dBi	0.9°	46 kg (101 lb)
85010089010	1.8 m (6 ft)	MDM	47.8 dBi	0.7°	84 kg (185 lb)

MDM = Motorola direct mount

Table 4-37 Antenna specifications for 18 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beamwidth	Weight
85010092006	0.3 m (1 ft)	PBR220	34.2 dBi	3.3°	6 kg (13 lb)
85010092053	0.6 m (2 ft)	PBR220	38.9 dBi	2.1°	11 kg (25 lb)
85010092045	1.0 m (3 ft)	PBR220	43.5 dBi	1.1°	24 kg (53 lb)
85010092009	1.2 m (4 ft)	PBR220	44.7 dBi	0.9°	46 kg (101 lb)
85010092010	1.8 m (6 ft)	PBR220	47.6 dBi	0.7°	84 kg (185 lb)

Antenna specifications (23 GHz)

Motorola can supply the antennas listed in [Table 4-38](#) and [Table 4-39](#) for PTP 800 links that will operate in the 23 GHz band (frequency range 21.20 - 23.60 GHz).

Table 4-38 Antenna specifications for 23 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beam -width	Weight
85010089011	0.3 m (1 ft)	MDM	35.3 dBi	3.0°	6 kg (13 lb)
85010089043	0.6 m (2 ft)	MDM	40.5 dBi	1.7°	11 kg (25 lb)
85009298007	1.0 m (3 ft)	MDM	44.8 dBi	1.0°	24 kg (53 lb)
85010089014	1.2 m (4 ft)	MDM	46.7 dBi	0.8°	46 kg (101 lb)
85010089015	1.8 m (6 ft)	MDM	49.7 dBi	0.5°	84 kg (185 lb)

MDM = Motorola direct mount

Table 4-39 Antenna specifications for 23 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beam -width	Weight
85010092011	0.3 m (1 ft)	PBR220	35.3 dBi	3.0°	6 kg (13 lb)
85010092054	0.6 m (2 ft)	PBR220	40.5 dBi	1.7°	11 kg (25 lb)
85010092046	1.0 m (3 ft)	PBR220	44.8 dBi	1.0°	24 kg (53 lb)
85010092014	1.2 m (4 ft)	PBR220	46.7 dBi	0.8°	46 kg (101 lb)
85010092015	1.8 m (6 ft)	PBR220	49.4 dBi	0.5°	84 kg (185 lb)

Antenna specifications (26 GHz)

Motorola can supply the antennas listed in [Table 4-40](#) and [Table 4-41](#) for PTP 800 links that will operate in the 26 GHz band (frequency range 24.25 - 26.50 GHz).

Table 4-40 Antenna specifications for 26 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beam-width	Weight
85010089016	0.3 m (1 ft)	MDM	36.6 dBi	2.5°	6 kg (13 lb)
85010089044	0.6 m (2 ft)	MDM	41.6 dBi	1.5°	11 kg (25 lb)
85009298008	1.0 m (3 ft)	MDM	45.8 dBi	0.8°	24 kg (53 lb)
85010089019	1.2 m (4 ft)	MDM	47.4 dBi	0.6°	46 kg (101 lb)

MDM = Motorola direct mount

Table 4-41 Antenna specifications for 26 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beam-width	Weight
85010092016	0.3 m (1 ft)	PBR220	36.6 dBi	2.5°	6 kg (13 lb)
85010092055	0.6 m (2 ft)	PBR220	41.6 dBi	1.5°	11 kg (25 lb)
85010092047	1.0 m (3 ft)	PBR220	45.8 dBi	0.8°	24 kg (53 lb)
85010092019	1.2 m (4 ft)	PBR220	47.4 dBi	0.6°	46 kg (101 lb)

Antenna specifications (38 GHz)

Motorola can supply the antennas listed in [Table 4-42](#) and [Table 4-43](#) for PTP 800 links that will operate in the 38 GHz band (frequency range 37 - 39.5 GHz).

Table 4-42 Antenna specifications for 38 GHz – single polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beam-width	Weight
85010089038	0.3 m (1 ft)	MDM	40.1 dBi	1.6°	6 kg (13 lb)
85010089048	0.6 m (2 ft)	MDM	45.2 dBi	0.9°	11 kg (25 lb)

MDM = Motorola direct mount

Table 4-43 Antenna specifications for 38 GHz – dual polarization

Motorola number	Diameter	Interface	Mid-band gain	Vertical beam-width	Weight
85010092038	0.3 m (1 ft)	PBR320	40.1 dBi	1.6°	7 kg (15 lb)
85010092058	0.6 m (2 ft)	PBR320	45.2 dBi	0.9°	11 kg (25 lb)

Flexible waveguide specifications

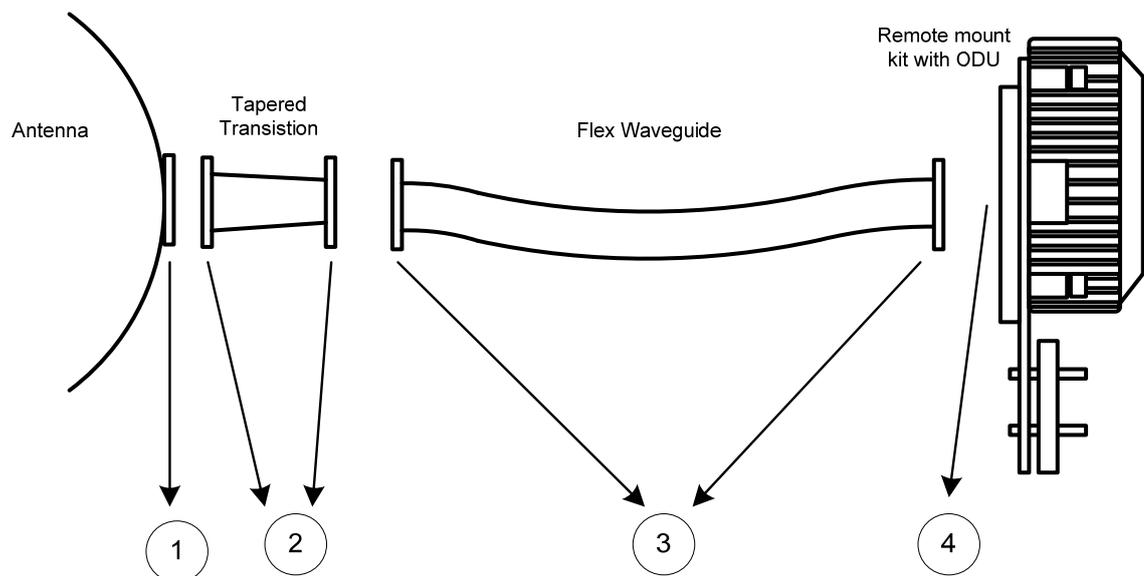
This section contains specifications of the flexible waveguides and flexible waveguide accessories that are available from Motorola for PTP 800 remote mount installations.

Waveguide flanges

Locating the flanges

Figure 4-1 shows the locations of the flanges on the antenna, transition, waveguide and remote mount kit (RMK). The numbers (1 to 4) refer to Table 4-44.

Figure 4-1 Locations of waveguide flanges



The numbered call-outs in Figure 4-1 are:

1. Antenna flange
2. Tapered transition flanges
3. Flexible waveguide flanges
4. RMK flange

Flanges for each frequency variant

Table 4-44 specifies the antenna, transition, waveguide and RMK flanges for each frequency variant.

Table 4-44 Antenna, transition, waveguide and RMK flanges

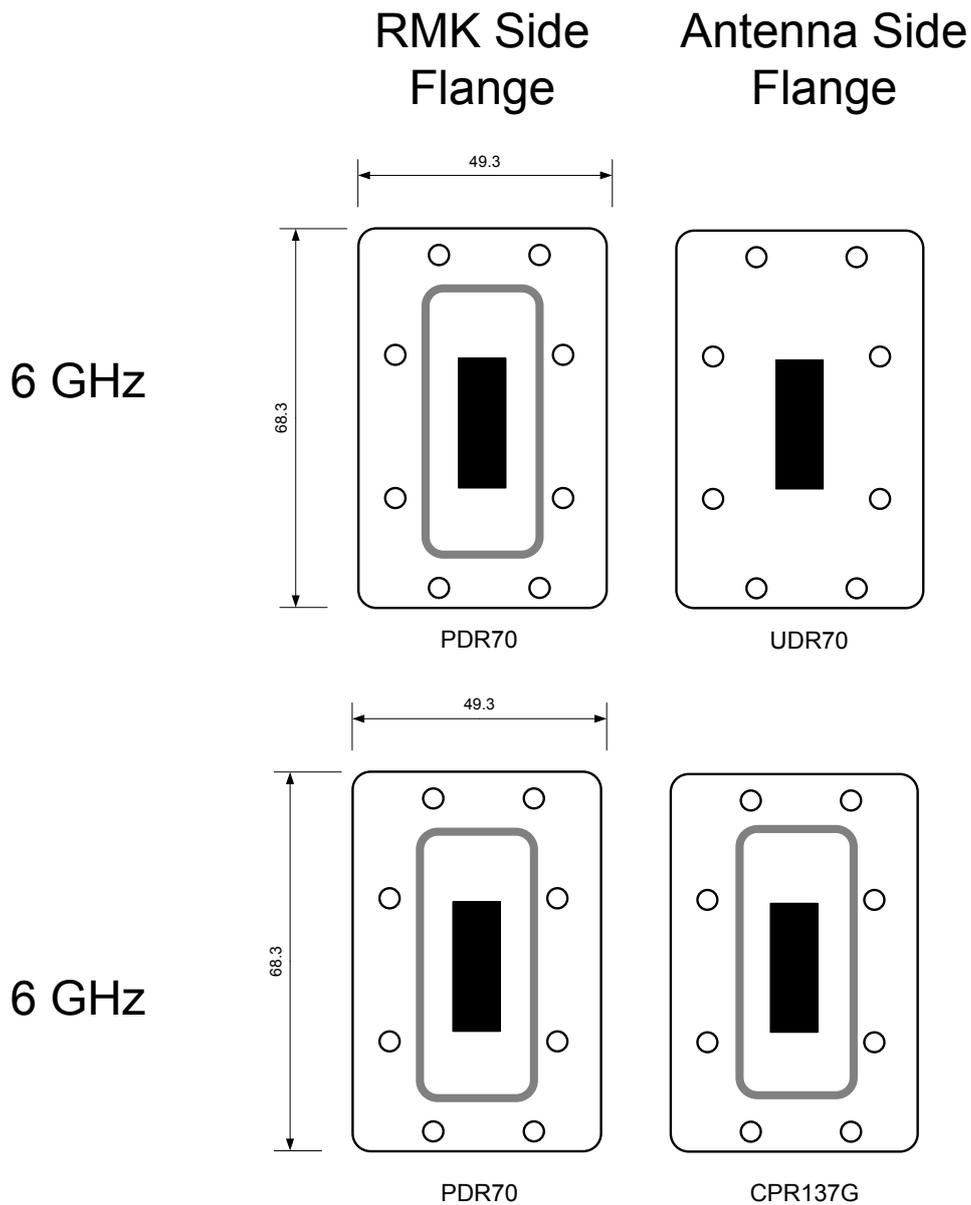
Frequency	1 Antenna flange	2 Tapered transition flanges	3 Waveguide flange (antenna)	3 Waveguide flange (ODU)	4 RMK flange	Wave guide size
6 GHz (*)	PDR70	n/a	UDR70	PDR70	UDR70	WR137
6 GHz (*)	CPR137G	n/a	CPR137G	PDR70	UDR70	WR137
7 GHz	PDR84	n/a	UDR84	PBR84	UBR84	WR112
8 GHz	PDR84	n/a	UDR84	PBR84	UBR84	WR112
11 GHz	PDR100	UDR100/ PBR120	UBR120	PBR120	UBR120	WR75
13 GHz	PBR120	n/a	UBR120	PBR120	UBR120	WR75
15 GHz	PBR140	n/a	UBR140	PBR140	UBR140	WR62
18 GHz	PBR220	n/a	UBR220	PBR220	UBR220	WR42
23 GHz	PBR220	n/a	UBR220	PBR220	UBR220	WR42
26 GHz	PBR220	n/a	UBR220	PBR220	UBR220	WR42
38 GHz	PBR320	n/a	UBR320	PBR320	UBR320	WR28

(*) These flanges are used for both Lower 6 GHz and Upper 6 GHz).

Waveguide flange diagrams

Waveguide flanges are illustrated in [Figure 4-2](#) (Lower and Upper 6 GHz), [Figure 4-3](#) (7 to 15 GHz), [Figure 4-4](#) (18 to 38 GHz) and [Figure 4-5](#) (11 GHz tapered transition).

Figure 4-2 Waveguide flanges – 6 GHz



Note that the CPR137G has the same overall dimensions as the PDR70 but with a shallower groove depth.

Figure 4-3 Waveguide flanges – 7 to 15 GHz

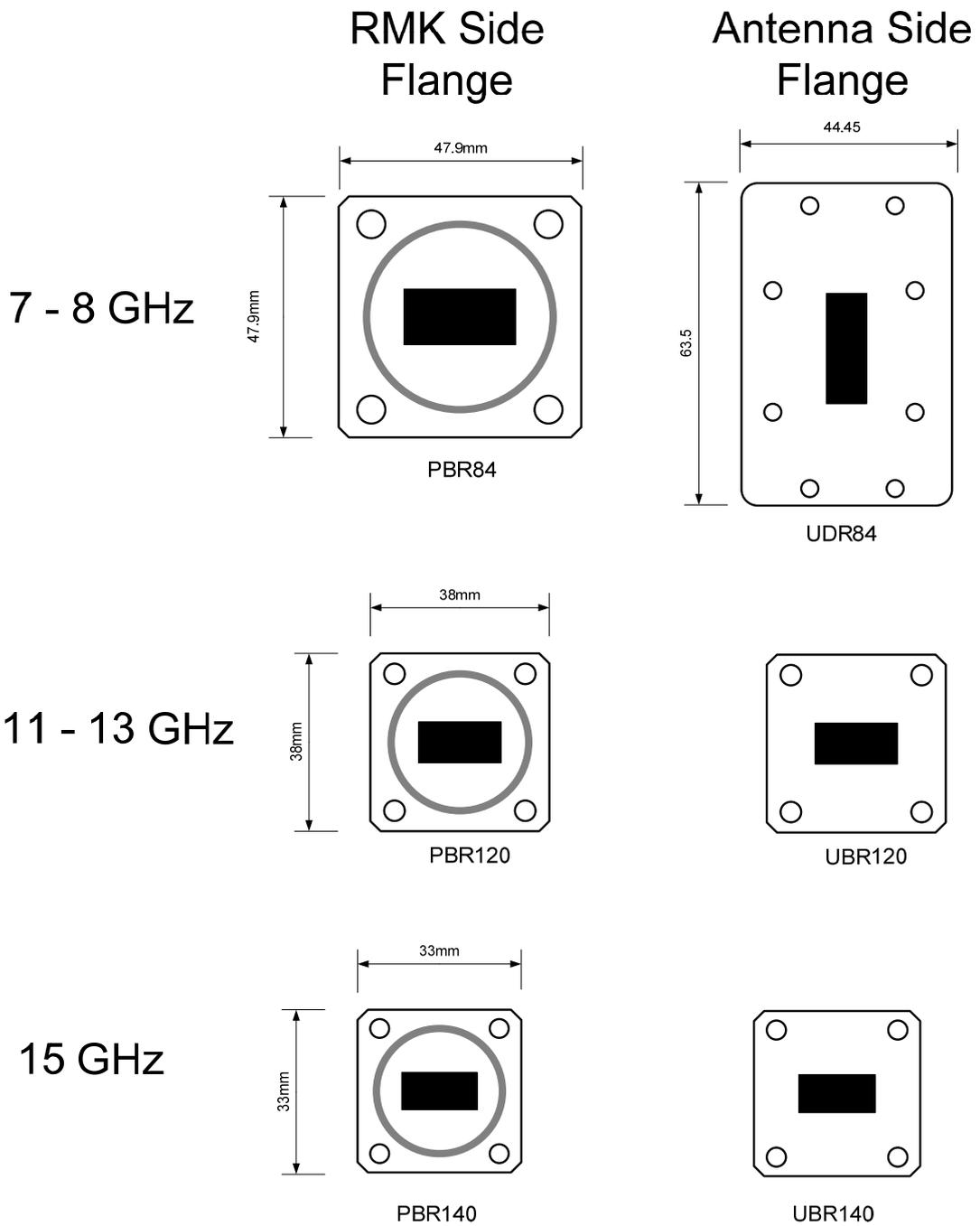


Figure 4-4 Waveguide flanges – 18 to 38 GHz

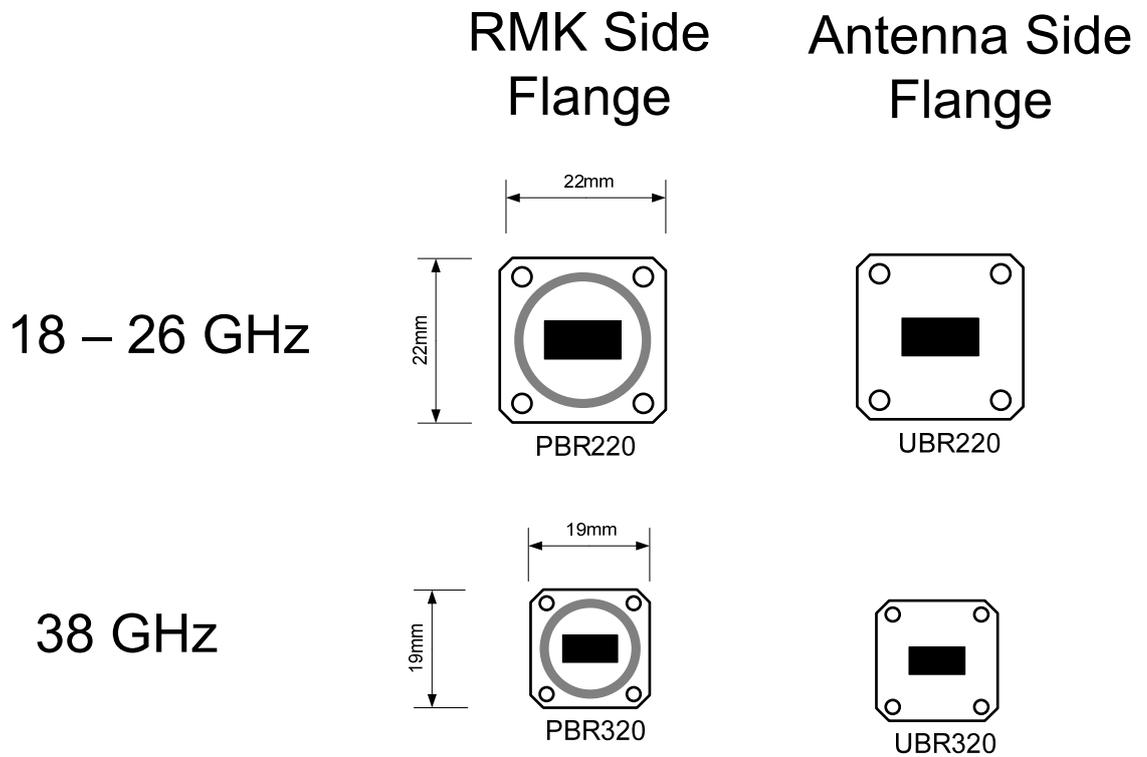
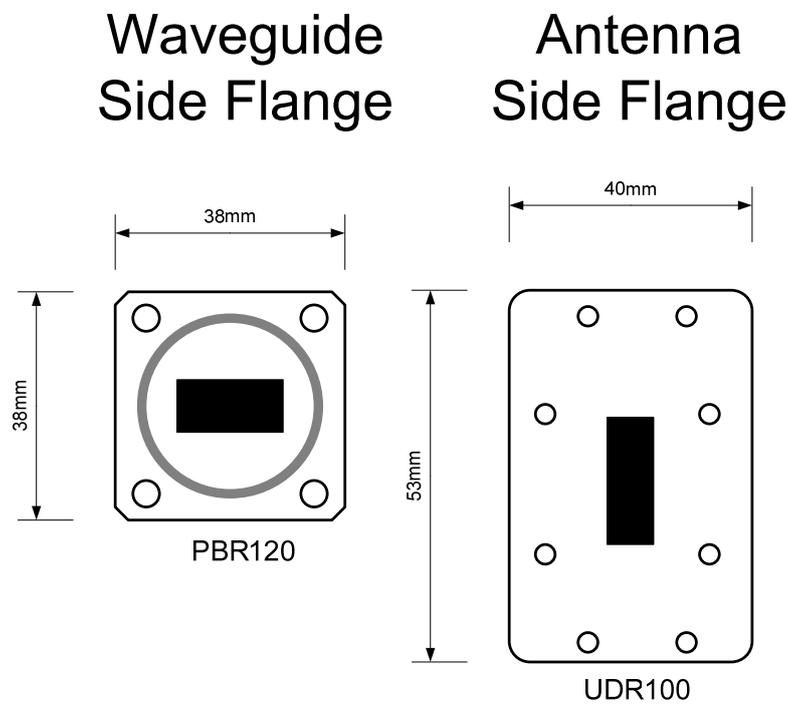


Figure 4-5 Waveguide flanges – 11 GHz tapered transition



Torque values for waveguide flanges

To obtain the correct torque values for fastening waveguides, refer to [Table 4-45](#).

Table 4-45 Torque value in Nm (lb ft) for each fastener size

Material	M3	M4	M5	M6	M8
Stainless steel	0.9 (0.6)	2.2 (1.6)	4.5 (3.3)	7.7 (5.7)	18.7 (13.8)

Flexible waveguide specifications (6 GHz)

Motorola can supply the flexible waveguides listed in [Table 4-46](#) for 6 GHz links (Lower and Upper).

Table 4-46 Flexible waveguide specifications – 6 GHz

Motorola part number	58010076016	58010076017
Operating frequency range	5.9 GHz to 8.2 GHz	5.9 GHz to 8.2 GHz
Length	900 mm (35 in)	900 mm (35 in)
Attenuation	0.3 dB/m	0.3 dB/m
VSWR	1.10	1.10
Waveguide size	WR137, WG14, R70	WR137, WG14, R70
RMK flange	PDR70	PDR70
Antenna flange	CPR137G	UDR70
Maximum twist	214°/m	214°/m
Minimum bend radius (E plane)	102 mm (4.0 in)	102 mm (4.0 in)
Minimum bend radius (H plane)	204 mm (8.0 in)	204 mm (8.0 in)

Flexible waveguide specifications (7 GHz and 8 GHz)

Motorola can supply the flexible waveguide listed in [Table 4-47](#) for 7 GHz links.

Table 4-47 Flexible waveguide specifications – 7 GHz

Motorola part number	58010076019
Operating frequency range	7.1 GHz to 10.0 GHz
Length	900 mm (35 in)
Attenuation	0.4 dB/m
VSWR	1.10
Waveguide size	WR112, WG15, R84
RMK flange	PBR84
Antenna flange	UDR84
Maximum twist	264°/m
Minimum bend radius (E plane)	76 mm (3.0 in)
Minimum bend radius (H plane)	152 mm (6.0 in)

Flexible waveguide specifications (11 and 13 GHz)

Motorola can supply the flexible waveguide listed in [Table 4-48](#) for 11 GHz and 13 GHz links.

Table 4-48 Flexible waveguide specifications – 11 GHz

Motorola part number	58010076005
Operating frequency range	10.0 GHz to 15.0 GHz
Length	900 mm (35 in)
Attenuation	0.6 dB/m
VSWR	1.10
Waveguide size	WR75, WG17, R120
RMK flange	PBR120
Antenna flange	UBR120
Maximum twist	360°/m
Minimum bend radius (E plane)	64 mm (2.5 in)
Minimum bend radius (H plane)	115 mm (4.5 in)

Flexible waveguide specifications (15 GHz)

Motorola can supply the flexible waveguide listed in [Table 4-49](#) for 15 GHz links.

Table 4-49 Flexible waveguide specifications – 15 GHz

Motorola part number	58010076008
Operating frequency range	12.4 GHz to 18.0 GHz
Length	900 mm (35 in)
Attenuation	0.99 dB/m
VSWR	1.10
Waveguide size	WR62, WG18, R140
RMK flange	PBR140
Antenna flange	UBR140
Maximum twist	445°/m
Minimum bend radius (E plane)	52 mm (2 in)
Minimum bend radius (H plane)	102 mm (4 in)

Flexible waveguide specifications (18, 23 and 26 GHz)

Motorola can supply the flexible waveguide listed in [Table 4-50](#) for 18, 23 and 26 GHz links.

Table 4-50 Flexible waveguide specifications – 18, 23 and 26 GHz

Motorola part number	58010076011
Operating frequency range	17.7 GHz to 26.5 GHz
Length	900 mm (35 in)
Attenuation	2.6 dB/m
VSWR	1.25
Waveguide size	WR42, WG20, R220
RMK flange	PBR220
Antenna flange	UBR220
Maximum twist	510°/m
Minimum bend radius (E plane)	38 mm (1.5 in)
Minimum bend radius (H plane)	76 mm (3.0 in)

Flexible waveguide specifications (38 GHz)

Motorola can supply the flexible waveguide listed in [Table 4-51](#) for 38 GHz links.

Table 4-51 Flexible waveguide specifications – 38 GHz

Motorola part number	58010076014
Operating frequency range	26.5 GHz to 40.1 GHz
Length	900 mm (35 in)
Attenuation	3.3 dB/m
VSWR	1.30
Waveguide size	WR28, WG22, R320
RMK flange	PBR320
Antenna flange	UBR320
Maximum twist	510°/m
Minimum bend radius (E plane)	38 mm (1.5 in)
Minimum bend radius (H plane)	76 mm (3.0 in)

Flexible waveguide accessory specifications

Motorola can supply the flexible waveguide accessories listed in [Table 4-52](#). To provide adequate support for a 900mm flexible waveguide, two hangers are required. The 11 GHz remote mount antenna requires the use of the tapered transition fitted between the antenna and the flexible waveguide.

Table 4-52 Flexible waveguide accessory specifications

Accessory	Frequency variant	Motorola part number
WR137 flex-twist hanger kit	6 GHz	07010118001
WR112 flex-twist hanger kit	7 – 8 GHz	07010118002
WR75 flex-twist hanger kit	11 – 13 GHz	07010118003
WR62 flex-twist hanger kit	15 GHz	07010118004
WR42 flex-twist hanger kit	18 – 26 GHz	07010118005
WR28 flex-twist hanger kit	38 GHz	07010118006
Tapered transition	11 GHz	58010077001

ODU coupler mounting specifications

This section contains specifications of the ODU coupler mounting kits that are available from Motorola for PTP 800 installations.

Coupler dimensions and weight

The PTP 800 ODU coupler mounting kit conforms to the physical specifications listed in [Table 4-11](#).

Table 4-53 ODU coupler physical specifications

Category	Specification
Packed dimensions	250 x 280 x 390 (W x L x H) mm
	10 x 11 x 15.5 (W x L x H) ins
Weight	6 GHz band:
	7 GHz to 11 GHz bands: 4.6 kg (10.1 lbs)
	13 GHz to 38 GHz bands: 4.2 kg (9.3 lbs)

Coupler environmental

The PTP 800 ODU coupler mounting kit conforms to the environmental specifications listed in [Table 4-12](#) and [Table 4-7](#).

Table 4-54 ODU coupler environmental specifications

Category	Specification
Temperature	-40°C (-40°F) to 50°C (122°F)
Relative humidity	0% to 100%
Weatherproofing	IP67
Exposure	Salt mist, industrial atmospheres and UV radiation
Shock and Vibration	ETSI EN 300 019-2-4 (class 4.1E) IEC class 4M5

Coupler losses and isolation

Table 4-55 contains ODU port return losses and isolation figures for Motorola-supplied ODU couplers. These figures apply to both symmetric and asymmetric couplers.

Table 4-55 ODU coupler return losses and isolation

Bands	ODU port return loss	Isolation between ODU ports
6 GHz	18 dB minimum	20 dB minimum
7 GHz to 38 GHz	20 dB maximum	20 dB minimum

Table 4-56 contains ODU port insertion losses for Motorola-supplied ODU couplers.

Table 4-56 ODU coupler insertion losses

Bands	Coupler type	ODU port maximum insertion losses
6 GHz	3 dB symmetric	
	6 dB asymmetric	Main 1.9 dB, Standby 7.5 dB
7 GHz to 26 GHz	3 dB symmetric	3.8 dB
	6 dB asymmetric	Main 1.8 dB, Standby 7.2 dB
32 GHz to 38 GHz	3 dB symmetric	4.0 dB
	6 dB asymmetric	Main 2.0 dB, Standby 7.4 dB

Coupler part numbers

Table 4-57 contains part numbers for Motorola-supplied ODU coupler mounting kits.

Table 4-57 ODU coupler mounting kit part numbers

Band	Coupler type	Motorola part number
6 GHz	3 dB symmetric	07010110021
6 GHz	6 dB asymmetric	07010110022
7 GHz	3 dB symmetric	07010110001
7 GHz	6 dB asymmetric	07010110002
8 GHz	3 dB symmetric	07010110003
8 GHz	6 dB asymmetric	07010110004
11 GHz	3 dB symmetric	07010110005
11 GHz	6 dB asymmetric	07010110006
13 GHz	3 dB symmetric	07010110007
13 GHz	6 dB asymmetric	07010110008
15 GHz	3 dB symmetric	07010110009
15 GHz	6 dB asymmetric	07010110010
18 GHz	3 dB symmetric	07010110011
18 GHz	6 dB asymmetric	07010110012
23 GHz	3 dB symmetric	07010110013
23 GHz	6 dB asymmetric	07010110014
26 GHz	3 dB symmetric	07010110015
26 GHz	6 dB asymmetric	07010110016
38 GHz	3 dB symmetric	07010110019
38 GHz	6 dB asymmetric	07010110020

Protection interface specifications

This section contains specifications of components used in 1+1 protection interfaces.

Out-of-band protection splitter specifications

The out-of-band protection splitter conforms to the specifications listed in [Table 4-58](#).

Table 4-58 Out-of-band protection splitter specifications

Category	Specification
Motorola part number	WB3807
Operating mode	1000-BASE-SX operating in Multi-Mode with a wavelength of 850 nm
Operating temperature range	-33°C (-27°F) to 55°C (131°F)
Storage temperature range	-40°C (-40°F) to 60°C (140°F)
Humidity	90% non-condensing
Compliance	IEC 721, RoHS, WEEE, CMM
Restrictions	For indoor operation only

Protection cable

The maximum length of the protection cable is 2 meters. The wiring must comply with one of the following options given in [Table 4-59](#):

Table 4-59 Out-of-band protection cable pin outs

Option 1 – cable pin out	Option 2 – cable pin out (standard Gigabit cross over cable)
1 – 1	1 – 3
2 – 2	2 – 6
3 – 3	3 – 1
4 – 7	4 – 7
5 – 8	5 – 8
6 – 6	6 – 2
7 – 4	7 – 4
8 – 5	8 – 5

Wireless operation

General wireless specifications

The PTP 800 conforms to the general wireless specifications listed in [Table 4-60](#).

Table 4-60 General wireless specifications

Feature	Specification
Licensed bands	Lower 6 GHz (FCC/IC/ETSI) Upper 6 GHz (ETSI) 7 GHz (ETSI) 8 GHz (ETSI) 11 GHz (FCC/IC/ETSI) 13 GHz (ETSI) 15 GHz (ETSI/Mexico/ANZ) 18 GHz (FCC/IC/ETSI/Brazil) 23 GHz (FCC/IC/ETSI) 26 GHz (FCC/ETSI) 38 GHz (FCC/IC/ETSI)
Channel separation (ETSI)	7, 13.75, 14, 27.5, 28, 30, 40, 55, 56 or 60 MHz.
Channel bandwidth (FCC/IC)	10, 20, 30, 40 or 50 MHz.
Modulation	QPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM and 256QAM. Fixed or adaptive modulation.
Duplex scheme	Frequency division duplex.
Capacity options	Basic capacity is 10 Mbit/s in each link direction. May be upgraded via software license key to one of the following capacity levels: 20, 30, 40, 50, 100, 150, 200, 300 Mbit/s, Unlimited.
Latency	Ultra-low latency, <115 us @ 368 Mbit/s with 64 bytes frame.
Encryption	FIPS-197 128/256 bit AES encryption.
ATPC	Supported in all configurations.

Frequency bands and channel separation

EN 302 217 refers to the relevant ITU-R and CEPT recommendations which are appropriate for operation in ETSI regions. This is summarized in [Table 4-61](#).

Table 4-61 ETSI band plan

Frequency (GHz)	ERC (CEPT)	ITU-R	T/R (MHz)	Channel separation (MHz)
5.9-6.4	14-01 Annex 1	F.383-8	252.04	29.65
6.4-7.1	14-02E	F.384-10	340	30, 40, 60
			340	7, 14
7.1-7.9	02-06 Annex 1 and 3	F.385-9	154, 161, 168, 196, 254	7, 14, 28
7.7 – 8.5		F.386-8	119, 126, 208, 266	7, 14, 28
			311.32	29.65
10.7-11.7	Rec12.06E	F.387-10	490, 530	40
12.75-13.25	12-02E	F.497-7	266	7, 14, 28
14.4-15.35	T/R 12-07	F.636-3	420, 490, 728	7, 14, 28, 56
17.7-19.7	Rec12.03E	F.595-9	1010	7, 13.75, 27.5, 55
	-	F.595-9 An 3	1008	7
21.2-23.6	T/R 13.02E An A	F.637-3 An 3/5	1008	7, 14, 28, 56
	-	F.637-3 An 1	1232	7, 14, 28
24.5-26.5	13.02 An B	F.748-4 An 1	1008	7, 14, 28, 56
37-39.5	T/R 12-01	F.749-2 An 1	1260	7, 14, 28, 56

FCC 101.147 defines the frequency plans for FCC. The relevant sections of FCC 101.147 are summarized in [Table 4-62](#).

Table 4-62 FCC band plan

Frequency (GHz)	FCC	T/R (MHz)	Bandwidth (MHz)
5.9-6.4		252.04	10, 30
10.7-11.7	Part 101-147 (o) 10-1-08 Edition	490	40, 30, 10
17.7-19.7	Part 101-147 (r) 10-1-08 Edition	1560	50, 40, 30, 20, 10
21.2-23.6	Part 101-147 (s) 10-1-08 Edition	1200	50, 40, 30, 20, 10
24.5-26.5	Part 101-147 (s) 10-1-08 Edition	800	40, 20, 10
37-39.5		700	50, 10

The frequency plan for Brazil is summarized in [Table 4-63](#).

Table 4-63 Brazil band plan

Frequency (GHz)	ERC (CEPT)	ITU-R	T/R (MHz)	Channel separation (MHz)
17.7-19.7		F.595-9 An 7	1560	55, 27.5, 13.75

Capacity, transmit power and sensitivity

This section contains tables that specify, for each frequency band, region (FCC and ETSI), bandwidth and modulation mode, the following data:

- 'Capacity' refers to the maximum sustained aggregate load (Mbit/s) applied to the data and management Ethernet ports that can be delivered to the remote Ethernet ports without packet discard. This capacity is achievable for Ethernet Frames which have the highest configured Quality of Service class. Capacity is approximately 1.5% lower for Ethernet Frames with a lower classification. Please refer to [Customer network](#) on page 1-35 for an explanation of Ethernet Frame classification.
- 'Fixed/ref' refers to the availability of the modulation mode as a fixed or reference mode.
- 'Sensitivity' refers to the typical receive signal level which produces a Frame Error Rate of 5×10^{-4} using 64 octet frames. This is equivalent to a Bit Error Rate of 1×10^{-6} as defined in EN 302 217 Annex F.
- 'ACM Threshold In' refers to the typical signal level required for a given modulation to be automatically selected when adaptive modulation is enabled.
- 'ACM Threshold Out' refers to the typical signal level at which a given modulation can no longer be supported. When adaptive modulation is enabled and the signal level falls below this level, the modulation with the next lower capacity is automatically selected.
- 'Max tx Power' refers to the maximum value to which the Maximum Transmit Power parameter may be configured. The PTP 800 will not transmit at a level greater than the configured value of Maximum Transmit Power. However if ATPC is enabled, the PTP 800 may transmit at a lower power than the configured value for Maximum Transmit Power.
- 'Min tx Power' refers to the minimum value to which the Maximum Transmit Power parameter may be configured. If ATPC is enabled, the PTP 800 may transmit at a lower power than the configured value for Minimum Transmit Power.

The tables are ordered by frequency band as follows:

- [Capacity, transmit power and sensitivity – Lower 6 GHz on page 4-59](#)
- [Capacity, transmit power and sensitivity – Upper 6 GHz on page 4-60](#)
- [Capacity, transmit power and sensitivity – 7 GHz on page 4-63](#)
- [Capacity, transmit power and sensitivity – 8 GHz on page 4-64](#)
- [Capacity, transmit power and sensitivity – 11 GHz on page 4-66](#)
- [Capacity, transmit power and sensitivity – 13 GHz on page 4-69](#)
- [Capacity, transmit power and sensitivity – 15 GHz on page 4-70](#)
- [Capacity, transmit power and sensitivity – 18 GHz on page 4-73](#)
- [Capacity, transmit power and sensitivity – 23 GHz on page 4-79](#)
- [Capacity, transmit power and sensitivity – 26 GHz on page 4-83](#)
- [Capacity, transmit power and sensitivity – 38 GHz on page 4-87](#)

Capacity, transmit power and sensitivity – Lower 6 GHz

Table 4-64 Lower 6 GHz FCC and Canada with 10 MHz bandwidth

Modulation	128QAM 0.83
Fixed/ref	Yes
Capacity (Mbit/s)	50.7
Sensitivity (dBm)	-74.1
Max tx power (dBm)	22
Min tx power (dBm)	9

Table 4-65 Lower 6 GHz FCC and Canada with 30 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.87
Fixed/ref	Yes	Yes	Yes
Capacity (Mbit/s)	177.4	155.1	135.4
Sensitivity (dBm)	-67.8	-70.6	-73
ACM threshold out (dBm)	-60.1	-67.3	-69.6
ACM threshold in (dBm)	-57.5	-66.1	-68.3
Max tx power (dBm)	22	22	22
Min tx power (dBm)	9	9	9

Table 4-66 Lower 6 GHz ETSI with 29.65 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.1	-70.9	-73.9	-76.4	-80.3	-	-86.1
ACM thresh out (dBm)	-61.2	-67.5	-70.4	-73.2	-77.3	-79	-
ACM thresh in (dBm)	-59.2	-66.3	-69.2	-71.9	-76.1	-77.8	-
Max tx power (dBm)	22	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14	14

Capacity, transmit power and sensitivity – Upper 6 GHz

Table 4-67 Upper 6 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.4	-78.8	-80.8	-83.7	-	-90.4
ACM thresh out (dBm)	-71.7	-74.2	-76.4	-79.6	-81.4	-
ACM thresh in (dBm)	-70.3	-72.9	-75.2	-78.3	-80.1	-
Max tx power (dBm)	24	24	26	28	28	30
Min tx power (dBm)	14	14	14	14	14	14

Table 4-68 Upper 6 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-73.4	-75.7	-77.7	-80.6	-	-87.3
ACM thresh out (dBm)	-68.6	-71.1	-73.4	-76.5	-78.3	-
ACM thresh in (dBm)	-67.2	-69.8	-72.1	-75.3	-77	-
Max tx power (dBm)	24	24	26	28	28	30
Min tx power (dBm)	14	14	14	14	14	14

Table 4-69 Upper 6 GHz ETSI with 30 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.1	-70.9	-73.9	-76.4	-80.3	-	-86.1
ACM thresh out (dBm)	-61.2	-67.5	-70.4	-73.2	-77.3	-79	-
ACM thresh in (dBm)	-59.2	-66.3	-69.2	-71.9	-76.1	-77.8	-
Max tx power (dBm)	22	24	24	26	28	28	30
Min tx power (dBm)	14	14	14	14	14	14	14

Table 4-70 Upper 6 GHz ETSI with 40 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.88	32QAM 0.92	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	No	Yes	Yes	No	No	No	No
Capacity (Mbit/s)	236.6	206.8	181.9	150.7	103.8	78.9	52.5
Sensitivity (dBm)	-	-69.4	-71.8	-	-	-	-
ACM thresh out (dBm)	-59.8	-66.1	-68.4	-70.7	-75.9	-77.6	-
ACM thresh in (dBm)	-57.8	-64.9	-67.1	-69.5	-74.7	-76.3	-
Max tx power (dBm)	22	24	24	26	28	28	30
Min tx power (dBm)	14	14	14	14	14	14	14

Table 4-71 Upper 6 GHz ETSI with 60 MHz channel separation

Modulation	256QAM 0.91	256QAM 0.80	128QAM 0.82	64QAM 0.82	32QAM 0.84	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	No	No	No	No
Capacity (Mbit/s)	368.6	347.1	303.5	255.2	202.7	152.4	115.8	77.1
Sensitivity (dBm)	-63.2	-65.1	-67.8	-70.8	-	-	-	-
ACM thresh out (dBm)	-58.1	-58.1	-64.5	-67.3	-70.2	-74.2	-75.9	-
ACM thresh in (dBm)	-56.1	-56.1	-63.2	-66.1	-68.9	-73	-74.7	-
Max tx power (dBm)	22	22	24	24	26	28	28	30
Min tx power (dBm)	14	14	14	14	14	14	14	14

Capacity, transmit power and sensitivity – 7 GHz

Table 4-72 7 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.4	-78.8	-	-83.7	-	-90.4
ACM thresh out (dBm)	-71.7	-74.2	-76.4	-79.6	-81.4	-
ACM thresh in (dBm)	-70.3	-72.9	-75.2	-78.3	-80.1	-
Max tx power (dBm)	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14

Table 4-73 7 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-73.4	-75.7	-77.7	-80.6	-	-87.3
ACM thresh out (dBm)	-68.6	-71.1	-73.4	-76.5	-78.3	-
ACM thresh in (dBm)	-67.2	-69.8	-72.1	-75.3	-77	-
Max tx power (dBm)	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14

Table 4-74 7 GHz ETSI with 28 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.1	-70.9	-73.9	-76.4	-80.3	-	-86.1
ACM thresh out (dBm)	-61.2	-67.5	-70.4	-73.2	-77.3	-79	-
ACM thresh in (dBm)	-59.2	-66.3	-69.2	-71.9	-76.1	-77.8	-
Max tx power (dBm)	22	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14	14

Capacity, transmit power and sensitivity – 8 GHz

Table 4-75 8 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.4	-78.8	-	-83.7	-	-90.4
ACM thresh out (dBm)	-71.7	-74.2	-76.4	-79.6	-81.4	-
ACM thresh in (dBm)	-70.3	-72.9	-75.2	-78.3	-80.1	-
Max tx power (dBm)	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14

Table 4-76 8 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-73.4	-75.7	-77.7	-80.6	-	-87.3
ACM thresh out (dBm)	-68.6	-71.1	-73.4	-76.5	-78.3	-
ACM thresh in (dBm)	-67.2	-69.8	-72.1	-75.3	-77	-
Max tx power (dBm)	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14

Table 4-77 8 GHz ETSI with 28 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.1	-70.9	-73.9	-76.4	-80.3	-	-86.1
ACM thresh out (dBm)	-61.2	-67.5	-70.4	-73.2	-77.3	-79	-
ACM thresh in (dBm)	-59.2	-66.3	-69.2	-71.9	-76.1	-77.8	-
Max tx power (dBm)	22	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14	14

Table 4-78 8 GHz ETSI with 29.65 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.1	-70.9	-73.9	-76.4	-80.3	-	-86.1
ACM thresh out (dBm)	-61.2	-67.5	-70.4	-73.2	-77.3	-79	-
ACM thresh in (dBm)	-59.2	-66.3	-69.2	-71.9	-76.1	-77.8	-
Max tx power (dBm)	22	24	24	28	28	28	30
Min tx power (dBm)	14	14	14	14	14	14	14

Capacity, transmit power and sensitivity – 11 GHz

Table 4-79 11 GHz FCC and Canada with 10 MHz bandwidth

Modulation	128QAM 0.83
Fixed/ref	Yes
Capacity (Mbit/s)	50.7
Sensitivity (dBm)	-74.6
Max tx power (dBm)	19
Min tx power (dBm)	6

Table 4-80 11 GHz FCC and Canada with 30 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.82	32QAM 0.84
Fixed/ref	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	177.4	155.1	130.4	103.6
Sensitivity (dBm)	-68.5	-71.2	-74.2	-76.8
ACM threshold out (dBm)	-61.5	-67.9	-70.8	-73.6
ACM threshold in (dBm)	-59.6	-66.6	-69.5	-72.4
Max tx power (dBm)	19	19	19	19
Min tx power (dBm)	6	6	6	6

Table 4-81 11 GHz FCC and Canada with 40 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.88	32QAM 0.92
Fixed/ref	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	236.6	206.8	181.9	150.7
Sensitivity (dBm)	-67.2	-69.9	-72.3	-74.4
ACM threshold out (dBm)	-60.3	-66.6	-68.9	-71.2
ACM threshold in (dBm)	-58.3	-65.4	-67.6	-70
Max tx power (dBm)	19	19	19	19
Min tx power (dBm)	6	6	6	6

Table 4-82 11 GHz ETSI with 40 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.88	32QAM 0.92	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	No	Yes	Yes	No	No	No	No
Capacity (Mbit/s)	236.6	206.8	181.9	150.7	103.8	78.9	52.5
Sensitivity (dBm)	-	-69.9	-72.3	-	-	-	-
ACM thresh out (dBm)	-60.3	-66.6	-68.9	-71.2	-76.4	-78.1	-
ACM thresh in (dBm)	-58.3	-65.4	-67.6	-70	-75.2	-76.8	-
Max tx power (dBm)	19	21	21	26	26	26	28
Min tx power (dBm)	11	11	11	11	11	11	11

Capacity, transmit power and sensitivity – 13 GHz

Table 4-83 13 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.9	-79.3	-	-84.2	-	-90.9
ACM thresh out (dBm)	-72.2	-74.7	-76.9	-80.1	-81.9	-
ACM thresh in (dBm)	-70.8	-73.4	-75.7	-78.8	-80.6	-
Max tx power (dBm)	18	18	23	23	23	26
Min tx power (dBm)	8	8	8	8	8	8

Table 4-84 13 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-73.9	-76.2	-78.2	-81.1	-	-87.8
ACM thresh out (dBm)	-69.1	-71.6	-73.9	-77	-78.8	-
ACM thresh in (dBm)	-67.7	-70.3	-72.6	-75.8	-77.5	-
Max tx power (dBm)	18	18	23	23	23	26
Min tx power (dBm)	8	8	8	8	8	8

Table 4-85 13 GHz ETSI with 28 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.6	-71.4	-74.4	-76.9	-80.8	-	-86.6
ACM thresh out (dBm)	-61.7	-68	-70.9	-73.7	-77.8	-79.5	-
ACM thresh in (dBm)	-59.7	-66.8	-69.7	-72.4	-76.6	-78.3	-
Max tx power (dBm)	16	18	18	23	23	23	26
Min tx power (dBm)	8	8	8	8	8	8	8

Capacity, transmit power and sensitivity – 15 GHz

Table 4-86 15 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.9	-79.3	-	-84.2	-	-90.9
ACM thresh out (dBm)	-72.2	-74.7	-76.9	-80.1	-81.9	-
ACM thresh in (dBm)	-70.8	-73.4	-75.7	-78.8	-80.6	-
Max tx power (dBm)	18	18	23	23	23	26
Min tx power (dBm)	8	8	8	8	8	8

Table 4-87 15 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-73.9	-76.2	-78.2	-81.1	-	-87.8
ACM thresh out (dBm)	-69.1	-71.6	-73.9	-77	-78.8	-
ACM thresh in (dBm)	-67.7	-70.3	-72.6	-75.8	-77.5	-
Max tx power (dBm)	18	18	23	23	23	26
Min tx power (dBm)	8	8	8	8	8	8

Table 4-88 15 GHz ETSI with 28 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.6	-71.4	-74.4	-76.9	-80.8	-	-86.6
ACM thresh out (dBm)	-61.7	-68	-70.9	-73.7	-77.8	-79.5	-
ACM thresh in (dBm)	-59.7	-66.8	-69.7	-72.4	-76.6	-78.3	-
Max tx power (dBm)	16	18	18	23	23	23	26
Min tx power (dBm)	8	8	8	8	8	8	8

Table 4-89 15 GHz ETSI with 56 MHz channel separation

Modulation	256 QAM 0.91	256 QAM 0.80	128 QAM 0.82	64 QAM 0.82	32 QAM 0.84	16 QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	368.6	347.1	303.5	255.2	202.7	152.4	115.8	77.1
Sensitivity (dBm)	-63.7	-65.6	-68.3	-71.3	-	-77.7	-	-83.5
ACM thresh out (dBm)	-58.6	-58.6	-65	-67.8	-70.7	-74.7	-76.4	-
ACM thresh in (dBm)	-56.6	-56.6	-63.7	-66.6	-69.4	-73.5	-75.2	-
Max tx power (dBm)	16	16	18	18	23	23	23	26
Min tx power (dBm)	8	8	8	8	8	8	8	8

Capacity, transmit power and sensitivity – 18 GHz

Table 4-90 18 GHz FCC and Canada with 10 MHz bandwidth

Modulation	128QAM 0.83	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	50.7	42.2	34.7	28.2	20.8	13.8
Sensitivity (dBm)	-74.6	-77.8	-79.8	-82.7	-85	-89.4
ACM thresh out (dBm)	-69.5	-73.2	-75.4	-78.6	-80.4	-
ACM thresh in (dBm)	-68	-71.9	-74.1	-77.3	-79.1	-
Max tx power (dBm)	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2

Table 4-91 18 GHz FCC and Canada with 20 MHz bandwidth

Modulation	256QAM 0.76	128QAM 0.83	64QAM 0.81	32QAM 0.84	16QAM 0.91	8PSK 0.83	QPSK 0.88
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	113.7	102.2	84.9	67.8	58.5	40.3	28.5
Sensitivity (dBm)	-70.4	-72.5	-75.9	-78.3	-80.6	-83.6	-87.6
ACM thresh out (dBm)	-61.8	-68.7	-72.1	-74.8	-77.3	-79.8	-
ACM thresh in (dBm)	-58.9	-67.4	-70.9	-73.5	-76.1	-78.6	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-92 18 GHz FCC and Canada with 30 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.82	32QAM 0.84	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	177.4	155.1	130.4	103.6	77.9	59.1	39.4
Sensitivity (dBm)	-68.5	-71.2	-74.2	-76.8	-80.6	-82.8	-86.4
ACM thresh out (dBm)	-61.5	-67.9	-70.8	-73.6	-77.6	-79.4	-
ACM thresh in (dBm)	-59.6	-66.6	-69.5	-72.4	-76.4	-78.1	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-93 18 GHz FCC and Canada with 40 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.88	32QAM 0.92	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	236.6	206.8	181.9	150.7	103.8	78.9	52.5
Sensitivity (dBm)	-67.2	-69.9	-72.3	-74.4	-79.3	-81.5	-85.1
ACM thresh out (dBm)	-60.3	-66.6	-68.9	-71.2	-76.4	-78.1	-
ACM thresh in (dBm)	-58.3	-65.4	-67.6	-70	-75.2	-76.8	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-94 18 GHz FCC and Canada with 50 MHz bandwidth

Modulation	256QAM 0.83	128QAM 0.82	64QAM 0.82	32QAM 0.87	16QAM 0.91	8PSK 0.84	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	301.7	258.6	217.4	178.6	150.5	103.7	65.7
Sensitivity (dBm)	-65.8	-69	-72	-74.3	-76.3	-79.6	-84.2
ACM thresh out (dBm)	-58.5	-65.6	-68.5	-71	-73.3	-76.1	-
ACM thresh in (dBm)	-56.3	-64.3	-67.2	-69.8	-72	-74.8	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-95 18 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.9	-79.3	-	-84.2	-	-90.9
ACM thresh out (dBm)	-72.2	-74.7	-76.9	-80.1	-81.9	-
ACM thresh in (dBm)	-70.8	-73.4	-75.7	-78.8	-80.6	-
Max tx power (dBm)	17	17	22	22	22	25.5
Min tx power (dBm)	7	7	7	7	7	7

Table 4-96 18 GHz ETSI with 13.75 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	69.8	60.7	49.9	40.6	29.9	19.9
Sensitivity (dBm)	-74	-76.3	-78.3	-81.2	-	-87.9
ACM thresh out (dBm)	-69.2	-71.7	-73.9	-77.1	-78.9	-
ACM thresh in (dBm)	-67.8	-70.4	-72.7	-75.8	-77.6	-
Max tx power (dBm)	17	17	22	22	22	25.5
Min tx power (dBm)	7	7	7	7	7	7

Table 4-97 18 GHz ETSI with 27.5 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	167	148	122.7	99.1	73.3	55.7	37
Sensitivity (dBm)	-68.7	-71.4	-74.4	-76.9	-80.8	-	-86.6
ACM thresh out (dBm)	-61.8	-68.1	-71	-73.8	-77.9	-79.6	-
ACM thresh in (dBm)	-59.8	-66.9	-69.8	-72.5	-76.7	-78.4	-
Max tx power (dBm)	15	17	17	22	22	22	25.5
Min tx power (dBm)	7	7	7	7	7	7	7

Table 4-98 18 GHz ETSI with 55 MHz channel separation

Modulation	256 QAM 0.91	256 QAM 0.80	128 QAM 0.82	64 QAM 0.82	32 QAM 0.84	16 QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	364.9	343.6	300.4	252.6	200.7	150.9	114.6	76.3
Sensitivity (dBm)	-63.7	-65.6	-68.3	-71.3	-	-77.7	-	-83.5
ACM thresh out (dBm)	-58.6	-58.6	-65	-67.9	-70.7	-74.8	-76.5	-
ACM thresh in (dBm)	-56.7	-56.7	-63.8	-66.6	-69.5	-73.5	-75.2	-
Max tx power (dBm)	15	15	17	17	22	22	22	25.5
Min tx power (dBm)	7	7	7	7	7	7	7	7

Table 4-99 18 GHz Brazil with 13.75 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	No	No	Yes	Yes	No	Yes
Capacity (Mbit/s)	69.8	60.7	49.9	40.6	29.9	19.9
Sensitivity (dBm)	-	-	-78.3	-81.2	-	-87.9
ACM thresh out (dBm)	-69.2	-71.7	-73.9	-77.1	-78.9	-
ACM thresh in (dBm)	-67.8	-70.4	-72.7	-75.8	-77.6	-
Max tx power (dBm)	17	17	22	22	22	25.5
Min tx power (dBm)	7	7	7	7	7	7

Table 4-100 18 GHz Brazil with 27.5 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	No	Yes	No	No	Yes	No	Yes
Capacity (Mbit/s)	167	148	122.7	99.1	73.3	55.7	37
Sensitivity (dBm)	-	-71.4	-	-	-80.8	-	-86.6
ACM thresh out (dBm)	-61.8	-68.1	-71	-73.8	-77.9	-79.6	-
ACM thresh in (dBm)	-59.8	-66.9	-69.8	-72.5	-76.7	-78.4	-
Max tx power (dBm)	15	17	17	22	22	22	25.5
Min tx power (dBm)	7	7	7	7	7	7	7

Table 4-101 18 GHz Brazil with 55 MHz channel separation

Modulation	256 QAM 0.91	256 QAM 0.80	128 QAM 0.82	64 QAM 0.82	32 QAM 0.84	16 QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	No	No	No	No	No	Yes	No	No
Capacity (Mbit/s)	364.9	343.6	300.4	252.6	200.7	150.9	114.6	76.3
Sensitivity (dBm)	-	-	-	-	-	-77.7	-	-
ACM thresh out (dBm)	-58.6	-58.6	-65	-67.9	-70.7	-74.8	-76.5	-
ACM thresh in (dBm)	-56.7	-56.7	-63.8	-66.6	-69.5	-73.5	-75.2	-
Max tx power (dBm)	15	15	17	17	22	22	22	25.5
Min tx power (dBm)	7	7	7	7	7	7	7	7

Capacity, transmit power and sensitivity – 23 GHz

Table 4-102 23 GHz FCC and Canada with 10 MHz bandwidth

Modulation	128QAM 0.83	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	50.7	42.2	34.7	28.2	20.8	13.8
Sensitivity (dBm)	-74.1	-77.3	-79.3	-82.2	-84.5	-88.9
ACM thresh out (dBm)	-69	-72.7	-74.9	-78.1	-79.9	-
ACM thresh in (dBm)	-67.5	-71.4	-73.6	-76.8	-78.6	-
Max tx power (dBm)	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2

Table 4-103 23 GHz FCC and Canada with 20 MHz bandwidth

Modulation	256QAM 0.76	128QAM 0.83	64QAM 0.81	32QAM 0.84	16QAM 0.91	8PSK 0.83	QPSK 0.88
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	113.7	102.2	84.9	67.8	58.5	40.3	28.5
Sensitivity (dBm)	-69.9	-72	-75.4	-77.8	-80.1	-83.1	-87.1
ACM thresh out (dBm)	-61.3	-68.2	-71.6	-74.3	-76.8	-79.3	-
ACM thresh in (dBm)	-58.4	-66.9	-70.4	-73	-75.6	-78.1	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-104 23 GHz FCC and Canada with 30 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.82	32QAM 0.84	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	177.4	155.1	130.4	103.6	77.9	59.1	39.4
Sensitivity (dBm)	-68	-70.7	-73.7	-76.3	-80.1	-82.3	-85.9
ACM thresh out (dBm)	-61	-67.4	-70.3	-73.1	-77.1	-78.9	-
ACM thresh in (dBm)	-59.1	-66.1	-69	-71.9	-75.9	-77.6	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-105 23 GHz FCC and Canada with 40 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.88	32QAM 0.92	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	236.6	206.8	181.9	150.7	103.8	78.9	52.5
Sensitivity (dBm)	-66.7	-69.4	-71.8	-73.9	-78.8	-81	-84.6
ACM thresh out (dBm)	-59.8	-66.1	-68.4	-70.7	-75.9	-77.6	-
ACM thresh in (dBm)	-57.8	-64.9	-67.1	-69.5	-74.7	-76.3	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-106 23 GHz FCC and Canada with 50 MHz bandwidth

Modulation	256QAM 0.83	128QAM 0.82	64QAM 0.82	32QAM 0.87	16QAM 0.91	8PSK 0.84	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	301.7	258.6	217.4	178.6	150.5	103.7	65.7
Sensitivity (dBm)	-65.3	-68.5	-71.5	-73.8	-75.8	-79.1	-83.7
ACM thresh out (dBm)	-58	-65.1	-68	-70.5	-72.8	-75.6	-
ACM thresh in (dBm)	-55.8	-63.8	-66.7	-69.3	-71.5	-74.3	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-107 23 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.4	-78.8	-	-83.7	-	-90.4
ACM thresh out (dBm)	-71.7	-74.2	-76.4	-79.6	-81.4	-
ACM thresh in (dBm)	-70.3	-72.9	-75.2	-78.3	-80.1	-
Max tx power (dBm)	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7

Table 4-108 23 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-73.4	-75.7	-	-80.6	-	-87.3
ACM thresh out (dBm)	-68.6	-71.1	-73.4	-76.5	-78.3	-
ACM thresh in (dBm)	-67.2	-69.8	-72.1	-75.3	-77	-
Max tx power (dBm)	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7

Table 4-109 23 GHz ETSI with 28 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.1	-70.9	-73.9	-76.4	-80.3	-	-86.1
ACM thresh out (dBm)	-61.2	-67.5	-70.4	-73.2	-77.3	-79	-
ACM thresh in (dBm)	-59.2	-66.3	-69.2	-71.9	-76.1	-77.8	-
Max tx power (dBm)	15	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7	7

Table 4-110 23 GHz ETSI with 56 MHz channel separation

Modulation	256 QAM 0.91	256 QAM 0.80	128 QAM 0.82	64 QAM 0.82	32 QAM 0.84	16 QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	368.6	347.1	303.5	255.2	202.7	152.4	115.8	77.1
Sensitivity (dBm)	-63.2	-65.1	-67.8	-70.8	-	-77.2	-	-83
ACM thresh out (dBm)	-58.1	-58.1	-64.5	-67.3	-70.2	-74.2	-75.9	-
ACM thresh in (dBm)	-56.1	-56.1	-63.2	-66.1	-68.9	-73	-74.7	-
Max tx power (dBm)	15	15	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7	7	7

Capacity, transmit power and sensitivity – 26 GHz

Table 4-111 26 GHz FCC with 10 MHz bandwidth

Modulation	128QAM 0.83	64QAM 0.83	32QAM 0.84	16QAM 0.91	8PSK 0.85	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	50.8	42.8	33.6	29.1	20.4	13.8
Sensitivity (dBm)	-74.8	-77.8	-80.4	-82.9	-85.5	-90.4
ACM thresh out (dBm)	-70.3	-73.5	-76.4	-79.1	-81.2	-
ACM thresh in (dBm)	-68.9	-72.3	-75.1	-77.9	-80	-
Max tx power (dBm)	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2

Table 4-112 26 GHz FCC with 20 MHz bandwidth

Modulation	256QAM 0.76	128QAM 0.83	64QAM 0.81	32QAM 0.84	16QAM 0.91	8PSK 0.83	QPSK 0.88
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	113.7	102.2	84.9	67.8	58.5	40.3	28.5
Sensitivity (dBm)	-69.9	-72	-75.4	-77.8	-80.1	-83.1	-87.1
ACM thresh out (dBm)	-61.3	-68.2	-71.6	-74.3	-76.8	-79.3	-
ACM thresh in (dBm)	-58.4	-66.9	-70.4	-73	-75.6	-78.1	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-113 26 GHz FCC with 40 MHz bandwidth

Modulation	256QAM 0.80	128QAM 0.82	64QAM 0.88	32QAM 0.92	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	236.6	206.8	181.9	150.7	103.8	78.9	52.5
Sensitivity (dBm)	-66.7	-69.4	-71.8	-73.9	-78.8	-81	-84.6
ACM thresh out (dBm)	-59.8	-66.1	-68.4	-70.7	-75.9	-77.6	-
ACM thresh in (dBm)	-57.8	-64.9	-67.1	-69.5	-74.7	-76.3	-
Max tx power (dBm)	15	17	17	22	22	22	23
Min tx power (dBm)	2	2	2	2	2	2	2

Table 4-114 26 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-76.4	-78.8	-	-83.7	-	-90.4
ACM thresh out (dBm)	-71.7	-74.2	-76.4	-79.6	-81.4	-
ACM thresh in (dBm)	-70.3	-72.9	-75.2	-78.3	-80.1	-
Max tx power (dBm)	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7

Table 4-115 26 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-73.4	-75.7	-	-80.6	-	-87.3
ACM thresh out (dBm)	-68.6	-71.1	-73.4	-76.5	-78.3	-
ACM thresh in (dBm)	-67.2	-69.8	-72.1	-75.3	-77	-
Max tx power (dBm)	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7

Table 4-116 26 GHz ETSI with 28 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-68.1	-70.9	-73.9	-76.4	-80.3	-	-86.1
ACM thresh out (dBm)	-61.2	-67.5	-70.4	-73.2	-77.3	-79	-
ACM thresh in (dBm)	-59.2	-66.3	-69.2	-71.9	-76.1	-77.8	-
Max tx power (dBm)	15	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7	7

Table 4-117 26 GHz ETSI with 56 MHz channel separation

Modulation	256 QAM 0.91	256 QAM 0.80	128 QAM 0.82	64 QAM 0.82	32 QAM 0.84	16 QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	368.6	347.1	303.5	255.2	202.7	152.4	115.8	77.1
Sensitivity (dBm)	-63.2	-65.1	-67.8	-70.8	-	-77.2	-	-83
ACM thresh out (dBm)	-58.1	-58.1	-64.5	-67.3	-70.2	-74.2	-75.9	-
ACM thresh in (dBm)	-56.1	-56.1	-63.2	-66.1	-68.9	-73	-74.7	-
Max tx power (dBm)	15	15	17	17	22	22	22	25
Min tx power (dBm)	7	7	7	7	7	7	7	7

Capacity, transmit power and sensitivity – 38 GHz

Table 4-118 38 GHz FCC and Canada with 10 MHz bandwidth

Modulation	128QAM 0.83	64QAM 0.83	32QAM 0.84	16QAM 0.91	8PSK 0.85	QPSK 0.86
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	50.8	42.8	33.6	29.1	20.4	13.8
Sensitivity (dBm)	-71.8	-74.8	-77.4	-79.9	-82.5	-87.4
ACM thresh out (dBm)	-67.3	-70.5	-73.4	-76.1	-78.2	-
ACM thresh in (dBm)	-65.9	-69.3	-72.1	-74.9	-77	-
Max tx power (dBm)	16	16	20	20	20	21
Min tx power (dBm)	1	1	1	1	1	1

Table 4-119 38 GHz FCC and Canada with 50 MHz bandwidth

Modulation	256QAM 0.83	128QAM 0.82	64QAM 0.82	32QAM 0.87	16QAM 0.91	8PSK 0.84	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Capacity (Mbit/s)	301.7	258.6	217.4	178.6	150.5	103.7	65.7
Sensitivity (dBm)	-62.3	-65.5	-68.5	-70.8	-72.8	-76.1	-80.7
ACM thresh out (dBm)	-55	-62.1	-65	-67.5	-69.8	-72.6	-
ACM thresh in (dBm)	-52.8	-60.8	-63.7	-66.3	-68.5	-71.3	-
Max tx power (dBm)	14	16	16	20	20	20	21
Min tx power (dBm)	1	1	1	1	1	1	1

Table 4-120 38 GHz ETSI with 7 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.88
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	34.4	30	24.6	20	14.7	10
Sensitivity (dBm)	-74.4	-76.8	-	-81.7	-	-88.4
ACM thresh out (dBm)	-69.7	-72.2	-74.4	-77.6	-79.4	-
ACM thresh in (dBm)	-68.3	-70.9	-73.2	-76.3	-78.1	-
Max tx power (dBm)	16	16	20	20	20	23
Min tx power (dBm)	6	6	6	6	6	6

Table 4-121 38 GHz ETSI with 14 MHz channel separation

Modulation	128QAM 0.76	64QAM 0.82	32QAM 0.87	16QAM 0.88	8PSK 0.86	QPSK 0.86
Fixed/ref	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	71	61.8	50.7	41.3	30.4	20.3
Sensitivity (dBm)	-71.4	-73.7	-	-78.6	-	-85.3
ACM thresh out (dBm)	-66.6	-69.1	-71.4	-74.5	-76.3	-
ACM thresh in (dBm)	-65.2	-67.8	-70.1	-73.3	-75	-
Max tx power (dBm)	16	16	20	20	20	23
Min tx power (dBm)	6	6	6	6	6	6

Table 4-122 38 GHz ETSI with 28 MHz channel separation

Modulation	256QAM 0.80	128QAM 0.84	64QAM 0.82	32QAM 0.85	16QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	Yes	No	Yes
Capacity (Mbit/s)	170.5	151.1	125.3	101.2	74.8	56.8	37.8
Sensitivity (dBm)	-66.1	-68.9	-71.9	-74.4	-78.3	-	-84.1
ACM thresh out (dBm)	-59.2	-65.5	-68.4	-71.2	-75.3	-77	-
ACM thresh in (dBm)	-57.2	-64.3	-67.2	-69.9	-74.1	-75.8	-
Max tx power (dBm)	14	16	16	20	20	20	23
Min tx power (dBm)	6	6	6	6	6	6	6

Table 4-123 38 GHz ETSI with 56 MHz channel separation

Modulation	256 QAM 0.91	256 QAM 0.80	128 QAM 0.82	64 QAM 0.82	32 QAM 0.84	16 QAM 0.79	8PSK 0.80	QPSK 0.80
Fixed/ref	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Capacity (Mbit/s)	368.6	347.1	303.5	255.2	202.7	152.4	115.8	77.1
Sensitivity (dBm)	-61.2	-63.1	-65.8	-68.8	-	-75.2	-	-81
ACM thresh out (dBm)	-56.1	-56.1	-62.5	-65.3	-68.2	-72.2	-73.9	-
ACM thresh in (dBm)	-54.1	-54.1	-61.2	-64.1	-66.9	-71	-72.7	-
Max tx power (dBm)	14	14	16	16	20	20	20	23
Min tx power (dBm)	6	6	6	6	6	6	6	6

Data network

Ethernet interfaces

The PTP 800 Ethernet ports conform to the specifications listed in [Table 4-124](#), [Table 4-125](#), and [Table 4-126](#).

Table 4-124 Copper data port specifications

Feature	Specification
Ethernet Speed	1000 Base-T
Auto-negotiation advertisement options	1000 Mbit/s Full Duplex 100 Mbit/s Full Duplex
Forced configuration options	100 Mbit/s Full Duplex
Auto MDI / MDIX	Enabled when auto-negotiation enabled
Maximum frame size (bytes)	9600

Table 4-125 Fiber data port specifications

Feature	Specification
Ethernet Speed	1000 Base-SX 1000 Base-LX Requires upgrade kit
Auto-negotiation advertisement options	1000 Mbit/s Full Duplex
Forced configuration options	None
Auto MDI / MDIX	Not applicable
Maximum frame size (bytes)	9600

Table 4-126 Management port specifications

Feature	Specification
Ethernet Speed	100 Base-T
Auto-negotiation advertisement options	100 Mbit/s Full Duplex 10 Mbit/s Full Duplex
Forced configuration options	100 Mbit/s Full Duplex 10 Mbit/s Full Duplex
Auto MDI / MDIX	Enabled when auto-negotiation enabled
Maximum frame size (bytes)	2000

Ethernet bridging

The PTP 800 conforms to the Ethernet bridging specifications listed in [Table 4-127](#).

Table 4-127 Ethernet bridging specifications

Feature	Specification
Frame types	Ethernet, IEEE 802.3-2008 C-VLAN, IEEE 802.1Q-2005 S-VLAN, IEEE 802.1ad-2005
Service type	Transparent Ethernet bridging equivalent to Ethernet private line (EPL).
Service classes for bridged traffic	8 classes (Out-of-band management mode) 7 classes (In-band management mode)
QoS Classification	Layer 2, based on the priority code point (PCP) in the outermost VLAN tag
Scheduling	Strict priority

Electromagnetic compliance

Electrical safety compliance

The PTP 800 hardware has been tested for compliance to the electrical safety specifications listed in [Table 4-128](#).

Table 4-128 Electrical safety specifications

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No.60950
International	CB certified & certificate to IEC 60950

EMC immunity compliance

The PTP 800 has been tested for compliance to the EMC immunity specifications listed in [Table 4-129](#).

The top level Specification is ETSI 301-489.

Table 4-129 EMC immunity compliance specifications

Specification	Comment
EN 55082-1 Generic EMC and EMI requirements for Europe	
EN 61000-4-2: 2001 Electro Static Discharge (ESD), Class 2, 8 kV air, 4 kV contact discharge	The levels used for testing were increased to ensure immunity to 15kV air and 8kV contact discharges.
EN 61000-4-3 (2006) Radiated Immunity 3 V/m	
EN 61000-4-4: 2004 (Bursts/Fast Transients), Class 4, 4 kV level (power lines AC & DC)	Equipment was tested with level increased for dc input and signal lines @ 0.5 kV open circuit voltage.
EN 61000-4-5 (2006) Surge Immunity	
EN 61000-4-6: 1996 (Injected RF), power line, Class 3 @ 10 V/m	Signal lines, Class 3 @ 3 V RMS unmodulated.

Compliance testing

Changes or modifications not expressly approved by Motorola could void the user's authority to operate the system.

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply.

Safety testing

The PTP 800 system has been tested for compliance with IEC 60950-1:2005 Edition 2.0 and IEC 60950-1:2001 Edition 1.0, with deviations applicable for Australia and New Zealand.

ETSI compliance testing

The PTP 800 system has been tested for compliance to harmonized European standard *EN 302 217.2.2 Digital systems operating in frequency bands where frequency coordination is applied*. This covers the essential requirements of Article 3.2 of the R&TTE directive.

It has also been tested for compliance to the electro-magnetic compatibility standards *EN 301 489-1 V1.8.1* and *EN 301 489-4 V1.4.1*. The limits for radiated and conducted radiations of Class A have been applied.

Compliance to the requirements of the R&TTE directive has been confirmed by a Notified Body.

Canada compliance

The PTP 800 system has been tested for compliance to RSS-GEN and the band specific Technical Requirements documents in the SRSP series. The test results have been scrutinized by a TCB who have issued a Certificate of Conformity.

Notifications

General notification

Where necessary, the end user is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

In order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the Effective Isotropic Radiated Power (EIRP) is not more than that permitted for successful communication.

United States and Canada notification

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules and with RSS-GEN of Industry Canada. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE

A Class A Digital Device is a device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

European Union notification

This product complies with the Class A limits for Radiated and Conducted Emissions. It may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

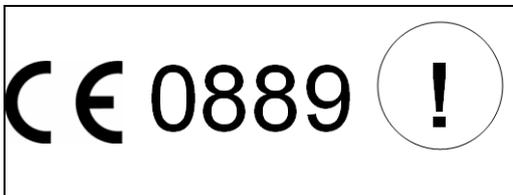
The PTP 800 is a Class 2 device as it operates on frequencies that are not harmonized across the EU. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country. See <http://www.ero.dk> for further information.

Hereby, Motorola Solutions, Inc. declares that the PTP 800 product complies with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at:

<http://www.motorola.com/ptp/support>.

This equipment is marked to show compliance with the European R&TTE directive 1999/5/EC.

Figure 4-6 European Union compliance label



This equipment may be used in the following EU states: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

This equipment may also be used in the following non-EU states that belong to CEPT: Belarus, Iceland, Norway, Switzerland and Turkey.

Radiation hazard assessment

ETSI method

This section evaluates the radiation levels produced by the PTP 800 products against the following standards:

- *1999/519/EC* of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz).
- *EN 50385:2002* Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz to 40 GHz) — general public.
- *EN 50383:2002* Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz to 40 GHz).

Exposure categories

EN 50385:2002 Clause 3.1 defines the restrictions on exposure to time-varying electric, magnetic, and electromagnetic fields that are based directly on established health effects. Between 10 GHz and 40 GHz, the physical quantity is the power density.

1999/519/EC defines the exposure limit ('Basic Restriction') to be considered for the general public. Annex II and Table 1 define this to be 10 W/m².

Antenna directivity

The Motorola recommended antennas have Hi-Performance polar patterns in accordance with ETSI EN302 217-4-1 classes 2 and 3. They have gains in excess of 30 dB and beamwidths of less than 5 degrees. Thus, they provide high attenuation of radiated energy at the sides and rear of the antenna.

Calculation

Calculation is used to identify the Compliance Boundary; outside this boundary the radiation levels meet the Basic Restriction, which is defined in *1999/519/EC* as 10 W/m².

The distance from the antenna at which the Power Flux Density limit is equal to some specified value is calculated using the Cylindrical Wave model as follows:

$$S = \frac{P.180}{\pi Dd\delta}$$

Where S = Power density (W/m²), P = Maximum average transmit power capability of the radio (Watts), D = Antenna diameter (meters), d = Distance from point source (meters), δ = 3 dB antenna beamwidth (degrees).

Rearranging terms to solve for distance yields:

$$d = \frac{P.180}{S\pi D\delta}$$

Distances from antenna

[Table 4-130](#) specifies calculated minimum separation distances for a range of frequency bands and antenna sizes at the peak of the antenna beam. At these and greater distances, the power density from the RF field is not considered to be hazardous.

Table 4-130 PTP 800 minimum separation distances, ETSI method

Band	Antenna diameter				
	0.3 m (1 ft)	0.6 m (2 ft)	0.8 m (2.5 ft)	1.2 m (4 ft)	1.8 m (6 ft)
6 GHz	N/A	N/A	N/A	1.7 m	1.8 m
7 and 8 GHz	N/A	2.0 m	2.2 m	2.2 m	2.1 m
11 GHz	N/A	1.8 m	2.2 m	2.0 m	1.8 m
13 GHz	1.6 m	1.4 m	1.4 m	1.5 m	1.4 m
15 GHz	1.8 m	1.5 m	1.6 m	1.6 m	1.6 m
18 GHz	2.1 m	1.6 m	1.7 m	1.9 m	1.6 m
23 GHz	2.0 m	1.8 m	2.0 m	2.0 m	2.0 m
26 GHz	2.4 m	2.0 m	2.3 m	2.5 m	N/A
38 GHz	2.4 m	2.1 m	N/A	N/A	N/A

These separation distances are significantly lower than those calculated by the method specified by the FCC. The ETSI method recognises that radiation is distributed across the antenna aperture and is not in reality a point source.

FCC method

Relevant standards (North America and EC) applicable when working with RF equipment are:

- *ANSI IEEE C95.1-1991, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.*
- US FCC limits for the general population. See the FCC web site at <http://www.fcc.gov>, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limités_e.html and Safety Code 6.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at <http://www.icnirp.de/> and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

Calculation

FCC OET Bulletin 65 specifies the far-field method to calculate power density:

$$S = \frac{PG}{4\pi R^2}$$

Where S = Power density (W/m²), P = Maximum average transmit power capability of the radio (Watts), G = Antenna gain, R = Distance from point source (meters).

FCC Title 47 Part 1.1310 defines the exposure limit for the general population to be 10 W/m² (1 mW/cm²) in the frequency range 1500 to 100,000 MHz. This defines an exposure time of 30 minutes. Higher levels are permitted for shorter periods of exposure.

Rearranging terms to solve for distance yields:

$$R = \sqrt{\frac{4\pi S}{PG}}$$

Distances from antenna

[Table 4-131](#) specifies calculated minimum separation distances for a range of frequency bands and antenna sizes at the peak of the antenna beam. At these and greater distances, the power density from the RF field is not considered to be hazardous.

Table 4-131 PTP 800 minimum separation distances, FCC method

Band	Antenna diameter				
	0.3 m (1 ft)	0.6 m (2 ft)	0.8 m (2.5 ft)	1.2 m (4 ft)	1.8 m (6 ft)
6 GHz	N/A	N/A	N/A	2.7 m (8.8 ft)	4.2 m (13.6 ft)
11 GHz	N/A	1.7 m (5.6 ft)	2.4 m (7.9 ft)	3.3 m (10.8 ft)	5.0 m (16.3 ft)
18 GHz	2.6 m (8.6 ft)	4.3 m (14.2 ft)	5.6 m (18.4 ft)	8.6 m (28.3 ft)	12.5 m (41.1 ft)
23 GHz	3.0 m (9.9 ft)	5.4 m (17.8 ft)	7.1 m (23.3 ft)	10.7 m (35.2 ft)	14.9 m (48.9 ft)
26 GHz	3.4 m (11.2 ft)	5.9 m (19.4 ft)	8.0 m (26.3 ft)	11.7 m (38.4 ft)	N/A
38 GHz	3.6 m (11.9 ft)	6.6 m (21.7 ft)	N/A	N/A	N/A

Chapter 5 Installation

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This chapter describes how to install and test the hardware for a PTP 800 link. This chapter is arranged as follows:

- [Installation process summary](#) on page 5-2: This section summarizes the installation processes for unprotected and protected links.
- [Preparing for installation](#) on page 5-6: This section describes the checks to be performed before proceeding with the installation.
- [Installing antenna with a single ODU](#) on page 5-9: This section describes how to connect one antenna to one ODU, either in a direct mount or remote mount configuration.
- [Installing antenna with two ODUs and a coupler](#) on page 5-24: This section describes how to connect one antenna to two ODUs via a coupler, either in a direct mount or remote mount configuration.
- [Installing the IF and ground cables](#) on page 5-37: This section describes how to install the IF cables and how to install grounding and lightning protection.
- [Testing the installation](#) on page 5-63: This section describes how to perform pre-power tests on the ODU, LPUs and the IF cable.
- [Installing the CMU](#) on page 5-73: This section describes how to install and connect the CMU.
- [Preparing the network connections \(unprotected\)](#) on page 5-80: This section describes how to connect the CMUs to the network equipment for unprotected links.
- [Preparing the network connections \(protected\)](#) on page 5-84: This section describes how to connect the CMUs to the network equipment for 1+1 protected links.

Installation process summary

This section summarizes the installation process for unprotected and protected links. It also summarizes the process for upgrading an unprotected link to protected.

Installation process for unprotected links

To install a link without link protection, follow this process:

1	<p>It is common practice to pre-configure the CMUs during staging before site installation. Perform the following tasks from Chapter 6 Configuration and alignment for each CMU:</p> <p style="padding-left: 40px;">from Task 1: Connecting to the unit on page 6-2, to Task 10: Configuring wireless interface on page 6-47.</p> <p>These tasks may be performed after installation, if preferred.</p> <p>When performing Task 9: Configuring protection interface on page 6-42, select the option to configure an unprotected link.</p>
2	<p>Check that it is safe to proceed and that all equipment and tools are ready. Perform Preparing for installation on page 5-6.</p>
3	<p>Install the ODUs and antennas by performing one or other of the following tasks:</p> <p style="padding-left: 40px;">Either: Installing antenna with a single ODU on page 5-9 for each antenna and ODU pair.</p> <p style="padding-left: 40px;">Or: Installing antenna with two ODUs and a coupler on page 5-24.</p>
4	<p>Perform Installing the IF and ground cables on page 5-37 for each ODU.</p>
5	<p>Test the installation. Perform Testing the installation on page 5-63.</p>
6	<p>Install and ground the CMUs. Perform Installing the CMU on page 5-73.</p>
7	<p>Prepare the cables to connect the CMU to the Ethernet switch by performing Preparing the network connections (unprotected) on page 5-80. Do not complete these connections until antenna alignment is complete.</p>
8	<p>Align the antennas and complete the configuration by performing the following tasks from Chapter 6 Configuration and alignment,</p> <p style="padding-left: 40px;">from Task 11: Aligning antennas on page 6-59, to Task 13: Connecting link to the network on page 6-70.</p>
9	<p>Check that there are no alarms on any unit, as described in Managing alarms on page 7-13.</p>

Installation process for protected links

To install a link with the 1+1 Hot Standby link protection feature, follow this process:

1	<p>It is common practice to pre-configure the CMUs during staging before site installation. Perform the following tasks from Chapter 6 Configuration and alignment for each CMU:</p> <p style="padding-left: 40px;">from Task 1: Connecting to the unit on page 6-2, to Task 10: Configuring wireless interface on page 6-47.</p> <p>These tasks may be performed after installation, if preferred.</p> <p>When performing Task 9: Configuring protection interface on page 6-42, select the option to configure a protected link.</p>
2	<p>Check that it is safe to proceed and that all equipment and tools are ready by performing Preparing for installation on page 5-6.</p>
3	<p>Install the ODUs and antennas by performing one or other of the following tasks:</p> <p style="padding-left: 40px;">If antenna redundancy is required, perform Installing antenna with a single ODU on page 5-9 for each antenna and ODU pair.</p> <p style="padding-left: 40px;">If antenna redundancy is not required, perform Installing antenna with two ODUs and a coupler on page 5-24.</p>
4	<p>Perform Installing the IF and ground cables on page 5-37 for each ODU. Each ODU requires its own IF cable, ground cables and LPUs.</p>
5	<p>Test the installation by performing Testing the installation on page 5-63. At each link end, test both ODU and CMU pairs.</p>
6	<p>Install and ground the CMUs by performing Installing the CMU on page 5-73 for each CMU.</p>
7	<p>Prepare the cables to connect the CMUs to the Ethernet switch by performing Preparing the network connections (protected) on page 5-84. Do not complete these connections until antenna alignment is complete.</p>
8	<p>Align the antennas and complete the configuration by performing the following tasks from Chapter 6 Configuration and alignment:</p> <p style="padding-left: 40px;">from Task 11: Aligning antennas on page 6-59, to Task 13: Connecting link to the network on page 6-70.</p>
9	<p>Re-enable Fault Protection Switching, as described in Configuring protected links on page 6-43.</p>
10	<p>Check that there are no alarms on any unit, as described in Managing alarms on page 7-13.</p>

Upgrading an unprotected link to protected

This section describes how to upgrade an existing unprotected link to use the 1+1 Hot Standby link protection feature.

CAUTION

Although the disruption to an existing link can be minimized, this process cannot be carried out without interrupting the operation of the link.

The following actions will interrupt link operation:

- Upgrading the software. This can be carried out in advance of hardware installation. Alternatively during the installation after the inactive units have been installed and when the inactive units are providing an operational link, the existing units may be upgraded and configured.
- Installing a second ODU on the coupler if a single antenna is used at each end.
- Aligning antennas when antenna protection is implemented. As the new antennas operate on the same frequencies as the existing ones, alignment cannot be performed while the existing antennas run an operational link.
- Other operations if working close to an antenna.
- Testing that the protection is working correctly by forcing protection switchovers.

NOTE

If configuration is carried out on site, then before the new units are taken to site, radio transmission should be inhibited as described in [Disabling wireless transmission](#) on page 7-25. This prevents possible interference with the existing operational unit.

To implement protection on an unprotected link, follow this process:

1	<p>It is common practice to pre-configure the two new CMUs during staging before site installation. Perform the following tasks from Chapter 6 Configuration and alignment for each CМУ:</p> <p style="padding-left: 40px;">from Task 1: Connecting to the unit on page 6-2, to Task 10: Configuring wireless interface on page 6-47.</p> <p>These tasks may be performed after installation, if preferred.</p> <p>When performing Task 9: Configuring protection interface on page 6-42, select the option to configure a protected link.</p>
2	<p>Check that it is safe to proceed and that all equipment and tools are ready. Perform Preparing for installation on page 5-6.</p>
3	<p>In the field, upgrade the operational CMUs to the latest software version by performing Task 5: Upgrading software version on page 6-24.</p>

4	<p>In the field, configure the operational CMUs for protected operation by performing Task 9: Configuring protection interface on page 6-42.</p> <p>NOTE</p> <p>If this is done in advance of installation of the new CMUs, the PTP 800 will still be operational and the wireless link can operate with single units, but alarms will be issued due to the absence of protecting units.</p> <p>The Protected link page is now available with local and remote ends shown as unprotected, see Viewing the status of a protected link on page 7-28.</p>
5	<p>Install the new ODUs and antennas by performing one or other of the following tasks:</p> <p>If antenna redundancy is required, perform Installing antenna with a single ODU on page 5-9 for each antenna and ODU pair.</p> <p>If antenna redundancy is not required, perform Installing antenna with two ODUs and a coupler on page 5-24.</p>
6	<p>Perform Installing the IF and ground cables on page 5-37 for each ODU. Each ODU requires its own IF cable, ground cables and LPUs.</p>
7	<p>Test the installation. Perform Testing the installation on page 5-63.</p> <p>NOTE</p> <p>At each link end, test both ODU and CMU pairs.</p>
8	<p>Install and ground the CMUs by performing Installing the CMU on page 5-73 for each CMU.</p>
9	<p>Prepare the cables to connect the CMUs to the Ethernet switch by performing Preparing the network connections (protected) on page 5-84. Do not complete these connections until antenna alignment is complete.</p>
10	<p>Align the antennas and complete the configuration. Perform the following tasks from Chapter 6 Configuration and alignment:</p> <p>from Task 11: Aligning antennas on page 6-59, to Task 13: Connecting link to the network on page 6-70.</p>
11	<p>Enable Fault Protection Switching, as described in Configuring protected links on page 6-43.</p>
12	<p>See that the wireless interface is enabled for all units, as described in Enabling wireless transmission on page 7-27.</p>
13	<p>Check that there are no alarms on any unit, as described in Managing alarms on page 7-13.</p>
14	<p>Initiate a protection switch so that the link is running active to active. If primary recovery is set, the units will switch automatically after the timer has expired.</p>

Preparing for installation

This section describes the checks to be performed before proceeding with the installation.

Precautions before installation

All national and local safety standards **must** be followed while developing a site, installing equipment, or performing maintenance.

WARNING

In planning, installing, or modifying any antenna tower or other antenna site, the need to comply with regulations and standards concerning human exposure to RF energy must be considered.

The following guidelines should be followed

- Always power down the ODU before exposing the antenna port.
- Never work in front of the antenna when the ODU is powered.
- Always power down the CMU when connecting and disconnecting the IF cable from either the CMU or ODU.

CAUTION

The installation must meet the requirements defined in [Grounding and lightning protection](#) on page 2-7.

CAUTION

Apply the practices and procedures detailed in manual *R56 STANDARDS AND GUIDELINES FOR COMMUNICATION SITES (68P81089E50)* to all new site build activities.

Preparing personnel

IN NO EVENT SHALL MOTOROLA SOLUTIONS, INC. BE LIABLE FOR ANY INJURY TO ANY PERSONS OR ANY DAMAGE CAUSED DURING THE INSTALLATION OF THE MOTOROLA PTP 800 PRODUCT.

Ensure that only qualified personnel undertake the installation of a PTP 800 link.

Ensure that all safety precautions can be observed.

Preparing inventory

Perform the following inventory checks:

- Check that an installation report is available and that it is based on the principles described in [Chapter 2 Planning considerations](#).
- Check that the correct components are available, as described [Installation inventories](#) on page 4-2.
- Check the contents of all packages against their packing lists.

Preparing tools

Check that the tools listed in [Table 5-1](#) are available.

Table 5-1 Tools required for PTP 800 installation

Equipment to be Installed	Tools Required
CMU	Pozi screw driver (PZ1) Ground lug crimp tool (diameter 5mm) 8mm spanner
Direct Mount ODU	Lubricant (supplied)
Remote Mount	17mm spanner Lubricant (supplied)
Flexible Wave Guide	Allen key (supplied in the kit)
Flexible Wave Guide hanger	13mm spanner 5mm Allen key Flat bladed screw driver (6mm) or Pozi screw driver (PZ2)
Coupler	6mm Allen key 2.5mm and 3mm Allen keys (supplied) Lubricant (supplied)
Antenna	17mm spanner 7 mm spanner (for tapered transition) Voltmeter and BNC lead Compass and GPS meter

Equipment to be Installed	Tools Required
Cable	Cable cutters Cable hoist Flat file to dress the cable inner core Wire brush to comb the braid Crimp tool Motorola part 66010063001 Torque wrench

Installing antenna with a single ODU

Perform this task when one antenna is to be connected to one ODU, either in a direct mount or remote mount configuration:

- If a direct mount configuration is required, perform [Direct mounting of antenna with a single ODU](#) on page 5-10.
- If a remote mount configuration is required, perform [Remote mounting of antenna with a single ODU](#) on page 5-12.

WARNING

Follow applicable health and safety rules for use of silicone grease. If necessary use the latex gloves supplied with the products.

Protected link considerations

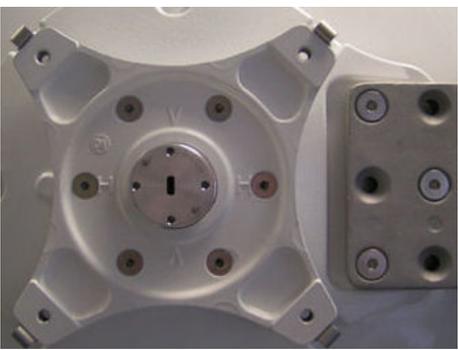
Perform this task when a protected link requires ODU and antenna redundancy. At each end, connect each of the two antennas to a separate ODU, either in a direct mount or remote mount configuration.

The ODUs are labeled 'Hi' or 'Lo' depending on the frequency sub-band. When installing a protected link, ensure that the two 'Hi' ODUs are installed at one end of the link and the two 'Lo' ODUs are installed at the other end.

Direct mounting of antenna with a single ODU

In the direct mount configuration, the ODU is attached directly to the antenna (with Motorola ODU interface) via four latches.

To install a direct mount antenna with a single ODU, proceed as follows:

- | | |
|----------|--|
| 1 | Follow the antenna manufacturer’s instructions to attach the antenna to its bracket. |
| 2 | <p>Polarization depends upon the antenna waveguide interface position. To change polarization, rotate the antenna transition, following the antenna manufacturer’s instructions.</p> <p>Vertical polarization: Horizontal polarization:</p> <div>A close-up photograph of the antenna transition. The central waveguide is oriented vertically, with a horizontal slot. The surrounding structure is white plastic with several mounting holes and latches.</div> <div>A close-up photograph of the antenna transition. The central waveguide is oriented horizontally, with a vertical slot. The surrounding structure is white plastic with several mounting holes and latches.</div> |
| 3 | <p>Apply silicone grease to the ‘O’ Ring of the antenna transition.</p> <div>A close-up photograph showing a hand using a small applicator to apply a yellowish substance (silicone grease) to the O-ring of the antenna transition. The transition is white plastic with a central metal waveguide.</div> |

- 4** Remove the ODU waveguide interface dust cover.



- 5** Fit the ODU to the antenna transition, ensuring that the antenna and ODU waveguide interfaces align correctly. Observe the polarization of the antenna waveguide interface.

Vertical polarization:



Horizontal polarization:



- 6** Secure the ODU to the antenna with the four latches, taking care to ensure they are correctly engaged.



- 7 Check that the antenna, mounting bracket and ODU are assembled.



- 8 Follow the manufacturer's instructions to attach the assembly to the mast or pole.



Remote mounting of antenna with a single ODU

In the remote mount configuration, the antenna and ODU are attached to the mast separately, connected to each other via a flexible waveguide. The flexible waveguide is designed to isolate vibration and eliminate difficulties caused by misalignment.

CAUTION

The flexible waveguide must be protected from damage that may be caused by contamination, vibration or bending.

When installing a flexible waveguide, observe the following precautions:

- **Unpacking:** To avoid damage to the waveguide, do not unpack it until required. When unpacked, protect the waveguide from dirt, dust or ingress of foreign objects.
- **Vibration:** Flexible waveguides may be damaged if subjected to excessive vibration or excessive bending. If a flexible waveguide is installed in a stressed (tensile) condition, vibration should be kept to a minimum, as the waveguide rubber jacket may become more susceptible to ozone and general environmental attack. Always use the waveguide hangers; two hangers should be used for the 900mm (3ft) flexible waveguide.
- **Bend radius:** Conform to the bend radii, maximum twist and torque settings specified in [Flexible waveguide specifications](#) on page 4-41.
- **Static bend radius:** When installing a flexible waveguide, pay attention to the static bend radius (quoted in the waveguide manufacturer's data sheet). Static bend radius is the minimum bend that an assembly may be subject to without repeat movement (except as a consequence of small vibrations or axial expansions).

 **NOTE**

Before installation, check that the ODU, remote mount kit, waveguide and antenna have compatible interfaces.

Mounting ODU on pole using remote mount kit (RMK)

To mount the ODU on the pole using a remote mount kit (RMK), proceed as follows:

1 Follow the manufacturer’s instructions to attach the RMK to the mast or pole.

A photograph showing a silver metal remote mount kit (RMK) attached to a dark metal pole. The RMK has a central circular waveguide interface, several mounting holes with screws, and a yellow label with the text 'RMK1B-2010R'. A green circular logo is also visible on the metal surface.

2 Apply silicone grease to the ‘O’ ring of the RMK transition.

A close-up photograph of a hand applying a clear, viscous substance (silicone grease) from a small tube onto the circular waveguide interface of the RMK. The RMK is mounted on a pole, and the yellow label and green logo are visible in the background.

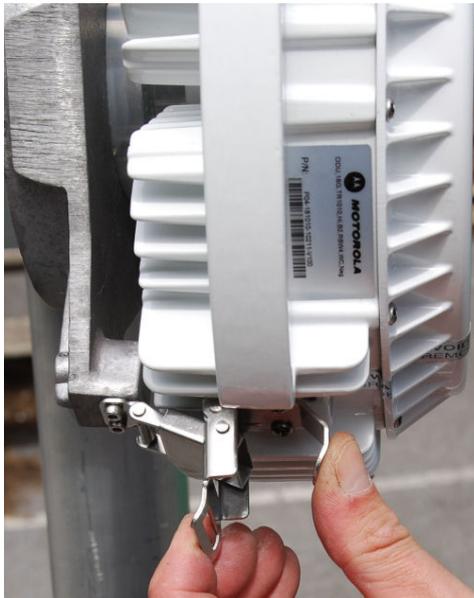
3 Remove the ODU waveguide interface dust cover.

A photograph showing a hand holding a yellow plastic dust cover and pulling it away from the waveguide interface of a white, finned ODU. The interface shows a metal contact point.

- 4 Fit the ODU to the RMK transition, ensuring that the locating pegs on the RMK transition fit into the peg holes in the ODU waveguide interface.



- 5 Secure the ODU to the RMK with the four latches, taking care to ensure they are correctly engaged.



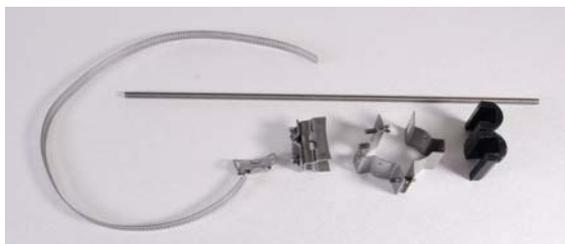
- 6 Check that the RMK and ODU are correctly mounted on the mast or pole.



Assembling the flexible waveguide hangers

To provide adequate support for a 900mm flexible waveguide, two hangers are required. To assemble the flexible waveguide hangers, proceed as follows:

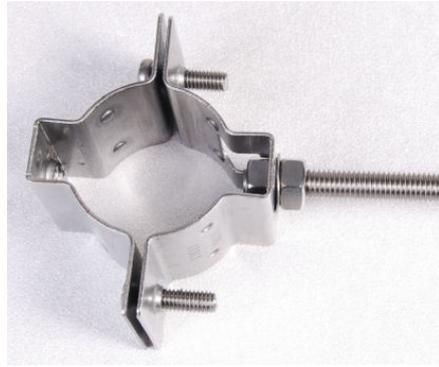
- 1 Check the flexible waveguide hanger kit contents.



- 2 Assemble the pole clip, making note of the angle of the slots in the metal strip.



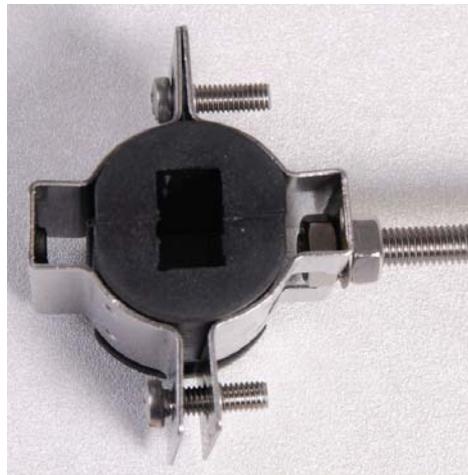
- 3** Fit the rubber moulding clamp to the studding.



- 4** Use the 5mm Allen key to fit the pole clip to the studding.



- 5** Temporarily fit the rubber mouldings.



- 6** Check the finished assembly.



Attaching antenna and waveguide to pole

NOTE

If the antenna is 11 GHz, a tapered transition must be fitted between the antenna and waveguide as described in [Mounting an 11 GHz antenna with tapered transition and waveguide](#) on page 5-22.

To mount the antenna on the pole and attach it to the ODU via the flexible waveguide, proceed as follows:

- 1 Follow the antenna manufacturer's instructions to attach the antenna to its bracket and to the mast or pole.
- 2 Check that the waveguide, antenna and remote mount kit have compatible interfaces. Check that the mating surfaces are clean and free from damage.



- 3 Fit one of the 'O' ring seals supplied with the waveguide kit to the flexible waveguide flange that has the O ring groove.

- 4 Using the waveguide flange fitted with the 'O' ring, fit the flexible waveguide to the remote mount. Ensure that the waveguide cavity orientation matches the opening in the remote mount kit. Fit four shorter screws, using a spring washer and a plain washer on each screw. It is sometimes more convenient to complete this operation before the assembly is fitted to the mast, connecting the flexible waveguide to the antenna when fitting the remote mount to the mast.



- 5 Fit the remote mount to the tower. Fit an 'O' ring seal to the antenna interface and secure the plain flange of flexible waveguide to the antenna. Ensure that the waveguide cavity orientation matches the opening in the antenna. Secure the flexible waveguide using four of the shorter screws to the antenna. Fit each screw with a spring washer and a plain washer.



- 6** Fit the rubber inserts from the hanger kit to the flex waveguide.



- 7** Insert the rubber insert and flex waveguide into the hanger.



- 8** Fit the hanger cover and tighten.



- 9** When routing the flex waveguide ensure that the minimum bend radius is not exceeded.



- 10** Check the complete assembly.



Mounting an 11 GHz antenna with tapered transition and waveguide

The 11GHz remote mount antenna requires the use of the tapered transition fitted between the antenna and the flexible waveguide.

The tapered transition converts from the PDR100 waveguide flange on the antenna to the UBR120 flange on the flexible waveguide.

To mount an 11 GHz antenna with taper transition and flexible waveguide, proceed as follows:

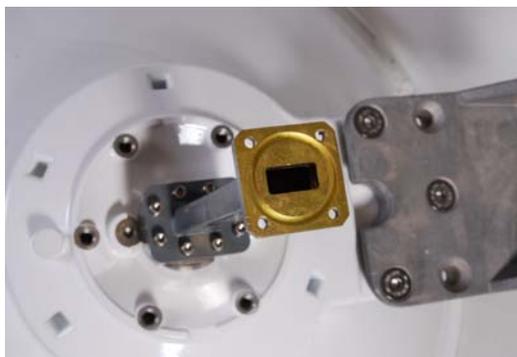
- 1 Mount the bracket on the antenna.



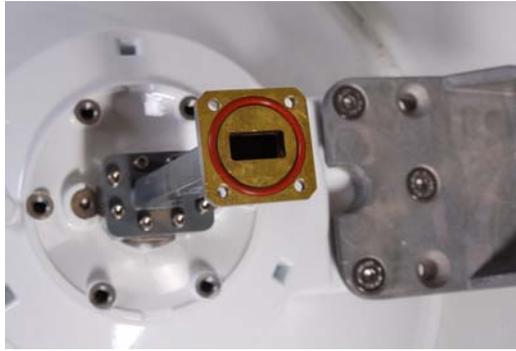
- 2 Remove the protective film from the antenna waveguide and fit the gasket, (supplied in the kit).



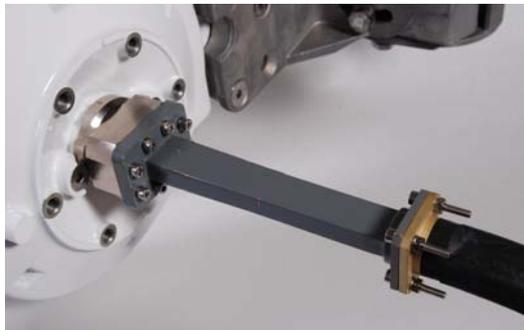
- 3 Use the 8 screws to fit the tapered transition to the antenna.



- 4** Fit the seal to the tapered transition, (supplied in the kit).



- 5** Use the four screws supplied in the kit to fit the flexible waveguide to the tapered transition. It makes taping the joint easier if the four screws are inserted in the direction shown.



- 6** Use FT-TB fusion tape (Andrews part FT-TB) to water proof the junctions as shown.



Installing antenna with two ODUs and a coupler

Perform this task when one antenna is to be connected to two ODUs via a coupler, either in a direct mount or remote mount configuration:

- If a direct mount configuration is required, perform [Direct mounting of antenna with two ODUs and coupler](#) on page 5-25.
- If a remote mount configuration is required, perform [Remote mounting of antenna with two ODUs and coupler](#) on page 5-30.

WARNING

Follow applicable health and safety rules for use of silicone grease. If necessary use the latex gloves supplied with the products.

Protected link considerations

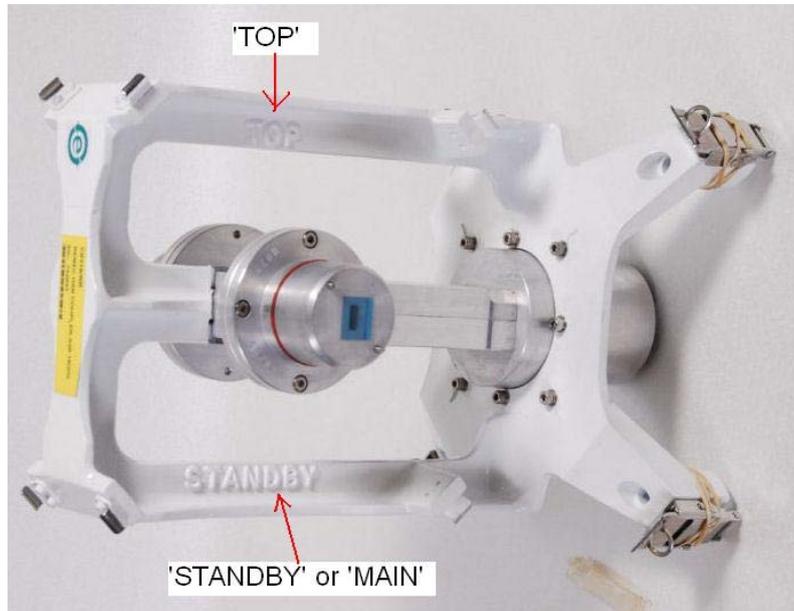
Perform this task when a protected link requires ODU redundancy but not antenna redundancy. At each end, connect one antenna to two ODUs via a coupler, either in a direct mount or remote mount configuration.

WARNING

If upgrading an unprotected link to protected, mute the active unit before installing the coupler. For safety reasons this is required when working with the ODUs or when working close to the antenna. See [Disabling and enabling the wireless interface](#) on page 7-25.

The ODUs are labeled 'Hi' or 'Lo' depending on the frequency sub-band. When installing a protected link, ensure that the two 'Hi' ODUs are installed at one end of the link and the two 'Lo' ODUs are installed at the other end.

If the coupler is asymmetric, one side is embossed with the word 'MAIN' and the other side with 'STANDBY' ([Figure 5-1](#)). The 'MAIN' side has lower loss. For a protected link, ensure that the 'MAIN' and 'STANDBY' sides can still be identified after the ODUs are fitted, as the 'MAIN' side ODU must be connected to the 'Primary' CMU and the 'STANDBY' side ODU must be connected to the 'Secondary' CMU.

Figure 5-1 Words embossed on coupler (asymmetric shown)

Direct mounting of antenna with two ODUs and coupler

In the direct mount configuration, the coupler (with ODUs) is attached directly to the antenna (with Motorola ODU interface) via four latches.

Attaching coupler to antenna

To attach the coupler to the antenna, proceed as follows:

- 1 Follow the antenna manufacturer's instructions to attach the antenna to its bracket.
- 2 Check that the supplied coupler is the correct type for this installation. Check the contents of the coupler mounting kit.



- 3** Ensure the correct spacers are fitted to each of the four legs:
11GHz - spacer length 27mm
18 GHz, 23 GHz, and 26 GHz - spacer length 7.75mm.



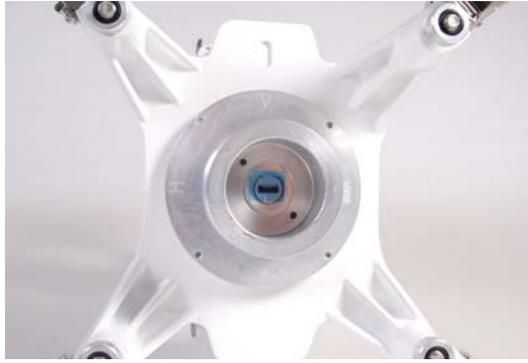
- 4** For a protected link, check that the circular transitions on the coupler have the same alignment (vertical or horizontal depending on the antenna polarity).
If necessary, rotate the circular transitions according to the manufacturer's instructions.



- 5** Take note of the word 'TOP' embossed in the casting; ensure this edge is upper most when attached to the antenna.



- 6** Remove protective film from coupler antenna port.



- 7** Apply silicone grease to the 'O' Ring of the antenna transition.



- 8** Fit the coupler to the antenna by following this sequence:
- Initially, hand-tighten two of the diagonally opposed M8 bolts with the Allen key supplied in the kit.
 - Using the latch clamp, clip the same two corners.
 - Repeat the above on the remaining two diagonally opposed bolts and clips.
 - Torque down all four M8 bolts to 18 Nm.



Attaching ODUs to coupler

To attach the ODUs to the coupler and mount the assembly on the pole, proceed as follows:

- 1 Remove protective film from the coupler ports.



- 2 Apply silicone grease to the 'O' rings of the coupler transitions.

- 3 Fit the ODUs to the coupler transitions, ensuring that the waveguide interfaces align correctly for vertical or horizontal polarization. Both ODUs must be fitted with handles at the top and connectors at the bottom. For asymmetric couplers, check that the 'MAIN' and 'STANDBY' sides of the coupler can still be identified.



- 4 Follow the manufacturer's instructions to attach the assembly to the mast or pole.



- 5 Check the finished installation.



Remote mounting of antenna with two ODUs and coupler

In the remote mount configuration, the antenna and coupler (with two ODUs) are attached to the mast separately, connected to each other via a flexible waveguide. The flexible waveguide is designed to isolate vibration and eliminate difficulties caused by misalignment.

CAUTION

The flexible waveguide must be protected from damage that may be caused by contamination, vibration or bending. Observe the precautions in [Remote mounting of antenna with a single ODU](#) on page 5-12.

NOTE

Before installation, check that the ODUs, coupler, remote mount kit, waveguide and antenna have compatible interfaces.

Attaching coupler to remote mount kit

To attach the coupler to the remote mount bracket, proceed as follows:

- 1 Ensure the correct remote mount kit, coupler and flexible wave guide are present for the frequency band.



- 2** Check that the supplied coupler is the correct type for this installation. Check the contents of the coupler mounting kit.



- 3** Ensure the correct spacers are fitted to each of the four legs:
11GHz - spacer length 27mm
18 GHz, 23 GHz and 26 GHz - spacer length 7.75mm



- 4 Check that the circular transition on the coupler is correctly aligned for remote mount bracket polarity (vertical or horizontal). If necessary, rotate the circular transition according to the manufacturer’s instructions.



- 5 Take note of the polarization marks on the remote mount bracket.



- 6 Take note of the word 'TOP' embossed in the casting; ensure this edge is upper most when attached to the antenna.



- 7** Remove the protective film from the coupler remote mount port.



- 8** Apply silicone grease to the 'O' ring of the remote mount transition.



- 9** Fit the coupler to the remote mount bracket by following this sequence:
- Initially, hand tighten two of the diagonally opposed M8 bolts with the Allen Key supplied in the kit.
 - Using the latch clamp, clip the same two corners.
 - Repeat the above on the remaining two diagonally opposed bolts and clips.
 - Torque down all four M8 bolts to 18Nm.



Assembling the flexible waveguide hangers

Assemble the hangers as described in [Assembling the flexible waveguide hangers](#) on page 5-16.

Attaching antenna to pole

Follow the antenna manufacturer's instructions to attach the antenna to its bracket and to the mast or pole.

Attaching ODUs to coupler

To attach the ODUs to the coupler and mount the assembly on the pole, proceed as follows:

- 1 Fit the flex waveguide to the remote mount bracket.



- 2 Fit assembly to pole.



- 3** Connect the flexible waveguide to the antenna.



- 4** Remove protective film from coupler ports.

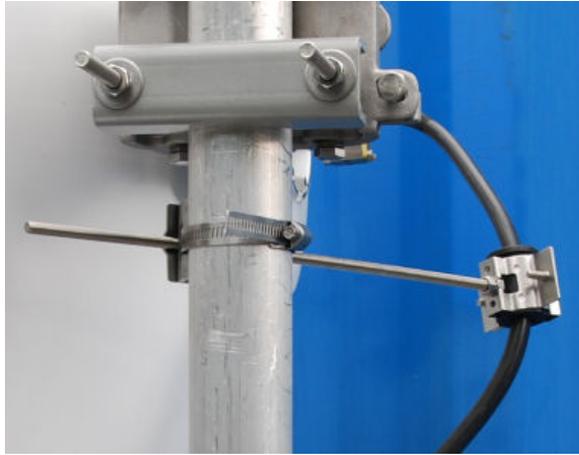


- 5** Apply silicone grease to the 'O' rings of the coupler transitions.

- 6** Fit the ODUs to the coupler transitions, ensuring that the waveguide interfaces align correctly for vertical or horizontal polarization. Both ODUs must be fitted with handles at the top and connectors at the bottom. For asymmetric couplers, check that the 'MAIN' and 'STANDBY' sides of the coupler can still be identified.



- 7** Support the flexible waveguide with the waveguide hangers. Do not exceed the flexible waveguide minimum bend radius.



- 8** Check the finished installation.



Installing the IF and ground cables

Perform this task to install the IF cable connection from the ODU to the CMU, and to provide grounding and lightning protection for the installation.

For a protected link, perform this task separately for each CMU/ODU pair in the installation.

This task consists of the following procedures:

- [Preparing IF cables](#) on page 5-39.
- [Fitting an N type connector to an IF cable](#) on page 5-39.
- [Connecting the ODU to the top LPU](#) on page 5-44.
- [Weatherproofing an N type connector](#) on page 5-47.
- [Hoisting the main IF cable](#) on page 5-51.
- [Installing and grounding the main IF cable](#) on page 5-55.
- [Making an IF cable ground point](#) on page 5-57.
- [Installing and grounding the IF cable at building entry](#) on page 5-61.

CAUTION

The IF and ground cable installation must meet the requirements defined in [Grounding and lightning protection](#) on page 2-7.

CAUTION

To provide effective protection against lightning induced surges, grounding cables must be installed without drip loops and pointing down towards the ground.

CAUTION

To ensure that IF connections are not damaged by water ingress, all outdoor IF connectors must be protected from the weather with self amalgamating and vinyl tape.

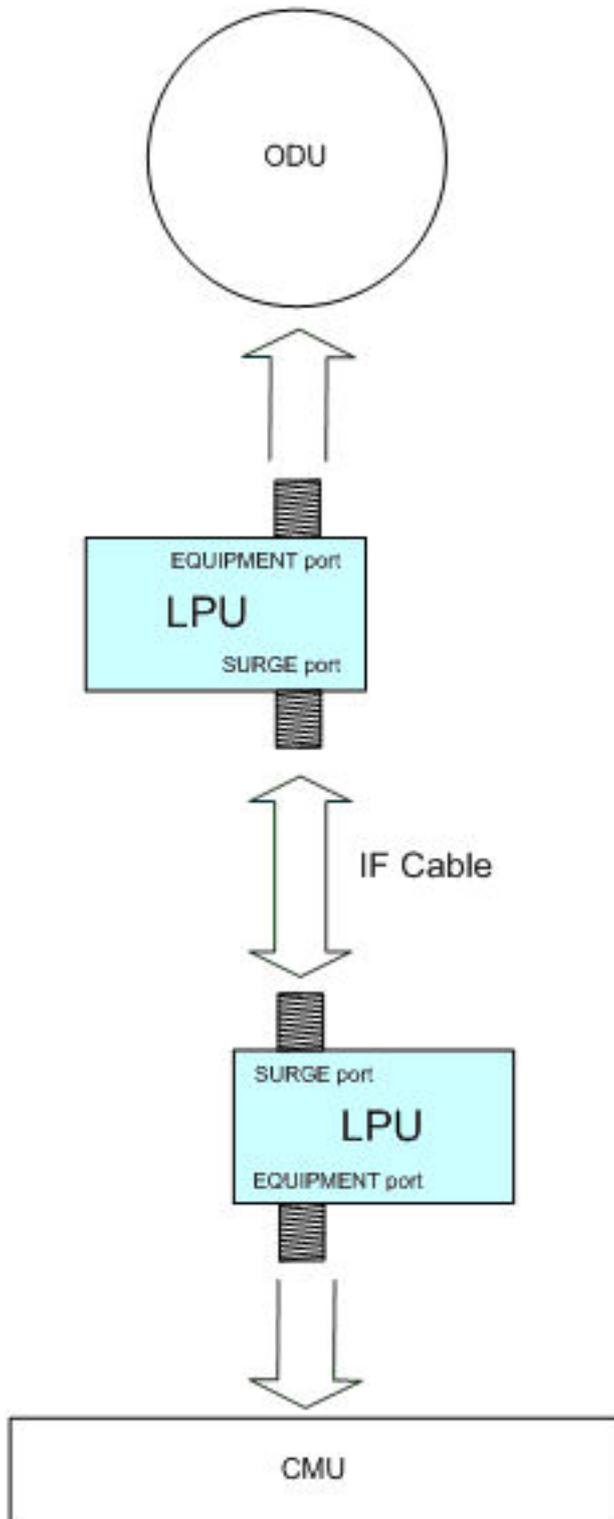
CAUTION

Do not connect or disconnect the IF cable when the -48 V supply is applied to the CMU.

CAUTION

Always ensure the lightning protection units are connected the correct way round ([Figure 5-2](#)).

Figure 5-2 Correct orientation of LPUs



Preparing IF cables

Prepare the following lengths of IF cable:

- **'ODU-LPU' IF cable:** Cut a short section of IF cable to connect the ODU to the top LPU. Fit N type connectors to both ends as described in [Fitting an N type connector to an IF cable](#) on page 5-39.
- **'Main' IF cable:** Prepare a long section of IF cable to connect the top LPU to the bottom LPU:
 - Cut this to the approximate length required (allowing a bit of surplus), or leave it on the drum so that it can be unwound as the cable is hoisted.
 - Slide one or more hoisting grips onto the top end of the main IF cable, as described in [Hoisting the main IF cable](#) on page 5-51.
 - Fit an N type connector to the top end only, as described in [Fitting an N type connector to an IF cable](#) on page 5-39.
- **'LPU-CMU' IF cable:** Prepare a short section of IF cable to connect the bottom LPU to the CMU:
 - Cut this to the approximate length required (allowing a bit of surplus).
 - Fit an N type connector to the LPU end only, as described in [Fitting an N type connector to an IF cable](#) on page 5-39.

Fitting an N type connector to an IF cable

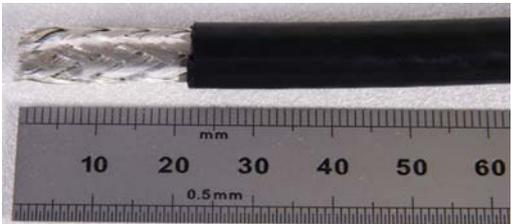
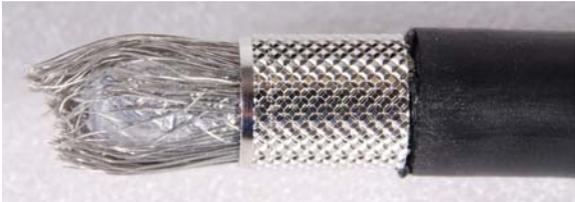
The crimp tool for the standard N type connector is available from Motorola, see [Table 4-5](#).

NOTE

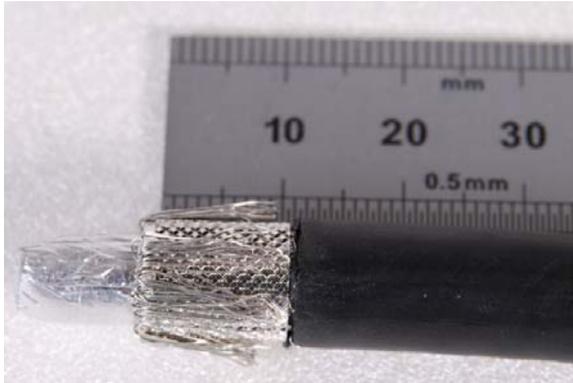
Not all connectors and crimp tools are compatible. If any other type of connector is to be installed, ensure that the correct crimp tool is used.

Preparing a cable end

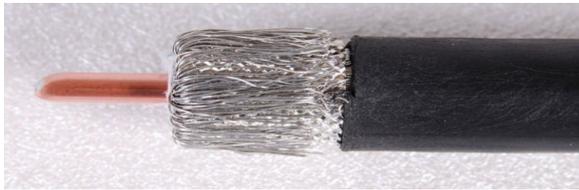
To prepare an IF cable to receive an N type connector, proceed as follows:

- | | |
|----------|---|
| 1 | Check that the correct IF cable crimp tool and connectors are available.
 A blue-handled crimp tool with 'CablePrep' written on the handle. Next to it are two small metal connectors and a section of black cable. |
| 2 | Remove 21mm (0.827 inch) of the outer jacket:
 A close-up of a cable with a section of the black outer jacket removed, exposing the braided shield. A ruler below shows the length of the removed section is approximately 21mm. |
| 3 | Slide ferrule over braid, ensure the chamfer is towards the braid:
 A close-up of a metal ferrule being slid over the braided shield of the cable. The ferrule has a chamfered edge that is positioned towards the braid. |
| 4 | Comb braid straight with wire brush:
 A close-up of a wire brush being used to comb the braided shield of the cable straight. |

- 5 Trim braid back to 9mm (0.354 inch):



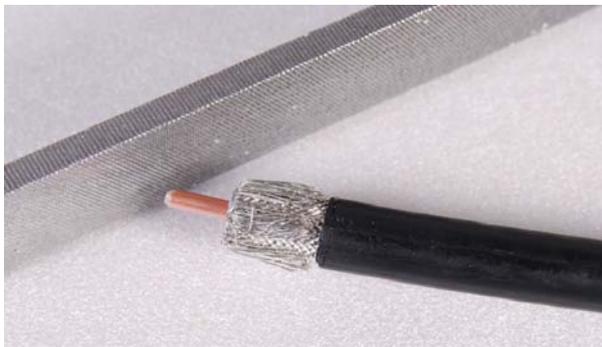
- 6 Remove foam insulation and trim centre conductor to 6mm (0.236 inch):



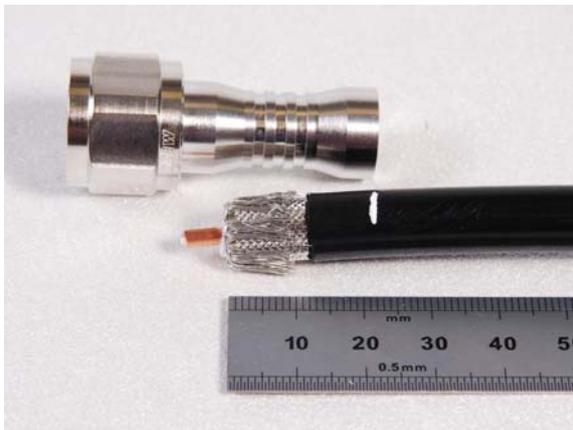
- 7 Chamfer the centre conductor at a angle of 45°:



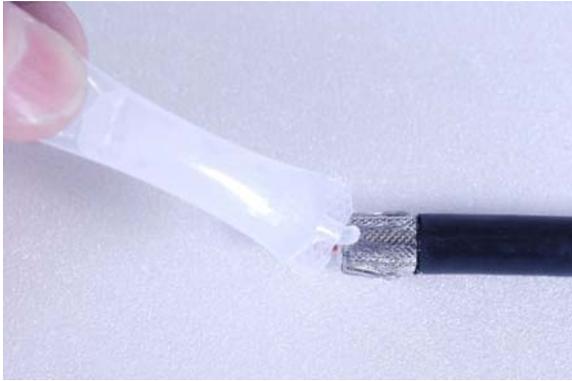
Failure to correctly chamfer the centre conductor will cause damage to the connector when assembling the cable into the connector.



- 8 Mark a line 22 mm from the end of the ferrule:



9 Daub grease onto the braid uniformly:



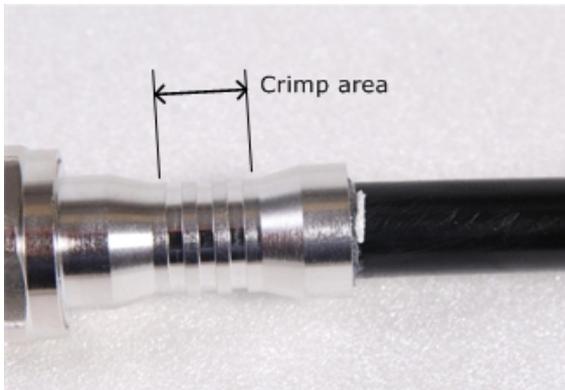
Crimping a connector

To crimp an N type connector to an IF cable, proceed as follows:

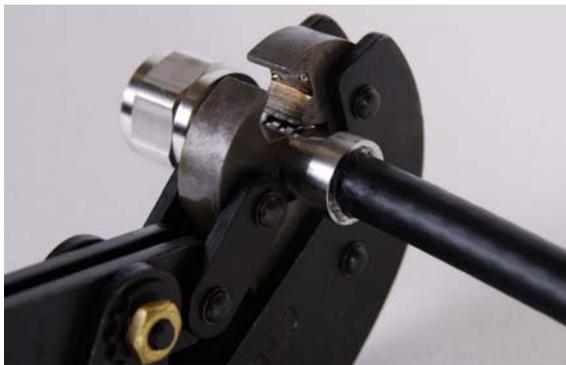
- 1 Insert the cable into connector. The cable centre conductor must be inserted into the inner contact fingers:



- 2 Ensure that the cable is not inserted beyond the line marked in Step 8. Crimp the connector body in the area shown:



- 3 Use the larger of the openings in the crimp tool:



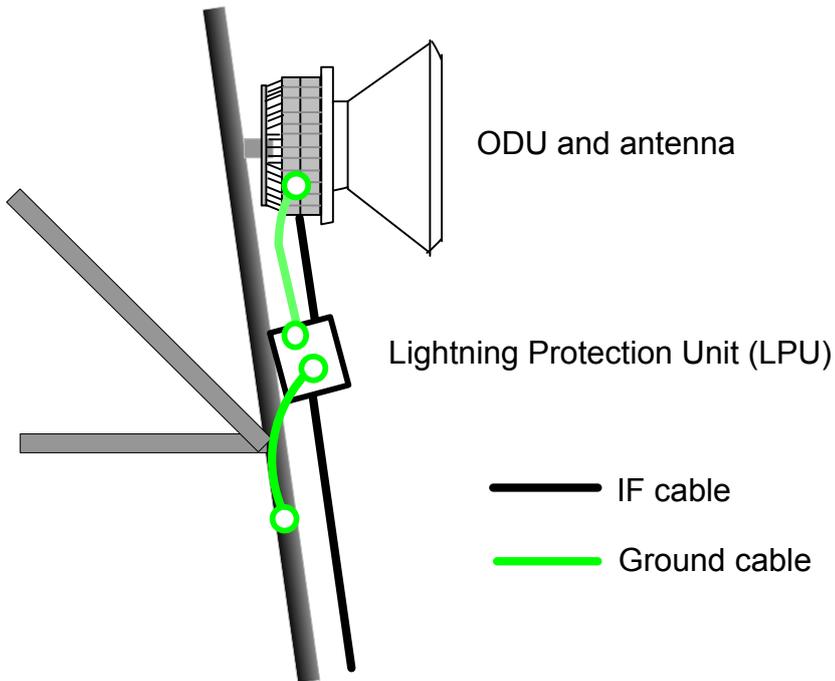
- 4 Check the finished part:



Connecting the ODU to the top LPU

Perform this procedure to connect the ODU to the top lightning protection unit (LPU) via ground and IF cables, and to ground the LPU to the supporting structure (Figure 5-3).

Figure 5-3 ODU and top LPU grounding

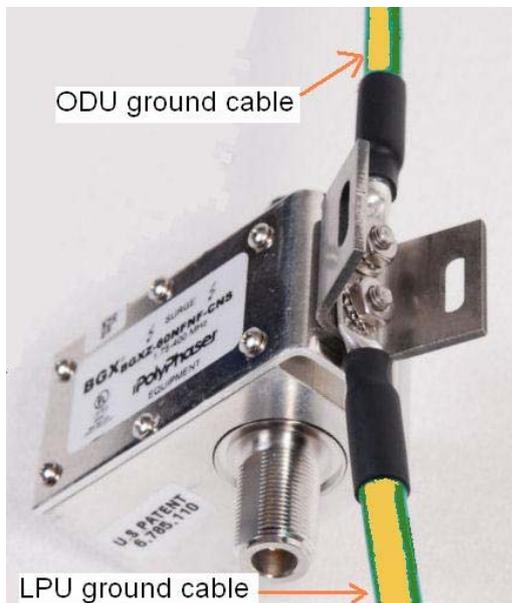


To connect and ground the ODU and top LPU, proceed as follows:

- 1 Attach one end of the ODU ground cable to the ODU.



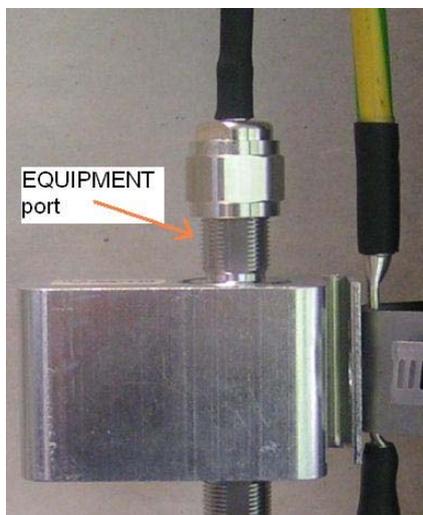
- 2 Attach the other end of the ODU ground cable to the top LPU, under the LPU mounting nut. Attach one end of the LPU ground cable to the LPU, under the LPU mounting nut.



- 3 Attach one end of the ODU-LPU IF cable to the ODU.



- 4** Attach the other end of the ODU-LPU IF cable to the EQUIPMENT port of the top LPU.

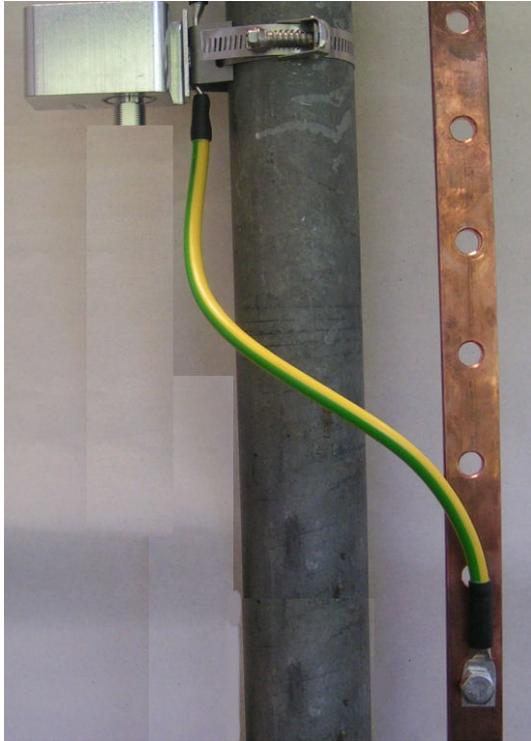


- 5** Mount the top LPU on the supporting structure.

- 6** Route the ODU-LPU IF cable along the ground cable.



- 7 Attach the other end of the LPU ground cable to the grounding bar of the supporting structure.



- 8 Protect the N type connector at the ODU from the weather by applying self-amalgamating and PVC tape, as described in [Weatherproofing an N type connector](#) on page 5-47.

Weatherproofing an N type connector

The following procedure should be used to weatherproof the N type connectors fitted to the ODU and LPU.

NOTE

Before weatherproofing the connectors, ensure that the installation has been tested as described in [Testing the installation](#) on page 5-63. These tests require connection and disconnection of the IF cables at various places.

NOTE

N type connectors should be tightened using a torque wrench, set to 15 lb in or 1.7 Nm. If a torque wrench is not available, N type connectors may be finger tightened.

To weatherproof an N type connector, proceed as follows:

- 1 Ensure the connection is tight. A torque wrench should be used if available:



- 2 Wrap the connection with a layer of 19 mm (0.75 inch) PVC tape, starting 25 mm (1 inch) below the connector body. Overlap the tape to half-width and extend the wrapping to the body of the LPU. Avoid making creases or wrinkles:



- 3 Smooth tape edges:



- 4** Cut a 125mm (5 inches) length of rubber tape (self amalgamating):



- 5** Expand the width of the tape by stretching it so that it will wrap completely around the connector and cable:



- 6** Press the tape edges together so that there are no gaps. The tape should extend 25mm (1inch) beyond the PVC tape:



- 7 Wrap a layer of 50 mm (2 inch) PVC tape from bottom to top, starting from 25 mm (1 inch) below the edge of the self-amalgamating tape, overlapping at half width.



- 8 Repeat with a further four layers of 19 mm (0.75 inch) PVC tape, always overlapping at half width. Wrap the layers in alternate directions:

Second layer: top to bottom.

Third layer: bottom to top.

Fourth layer: top to bottom.

Fifth layer: bottom to top.

The bottom edge of each layer should be 25 mm (1 inch) below the previous layer.



9 Completed weatherproof connection:

Hoisting the main IF cable

Hoisting grips are designed for hoisting cable safely up a tower or building and providing permanent support so that mechanical connection to an antenna can be made. A clamp is placed over the grip and secured to the cable with a special tool. When the cable is in position and the grip handle is fastened to a tower member, the hoist line can be removed.

A suitable hoisting grip for CNT-400 IF cable is Motorola part number 07009304001 used together with the correct crimp tool SG-IT (Andrew part number 243333).

⚠ WARNING**Failure to obey the following warnings may result in injury or death:**

- Use the hoisting grip to hoist one cable only. Attempting to hoist more than one cable may cause the hoisting grip to break or the cables to fall.
- Do not use the hoisting grip for lowering cable unless the clamp is securely in place.
- Do not reuse hoisting grips. Used grips may have lost elasticity, stretched, or become weakened. Reusing a grip can cause the cable to slip, break, or fall.
- Use hoisting grips at intervals of no more than 60 m (200 ft).
- Use the proper hoisting grip for the cable being installed. If the wrong hoisting grip is used, slippage or insufficient gripping strength will result.

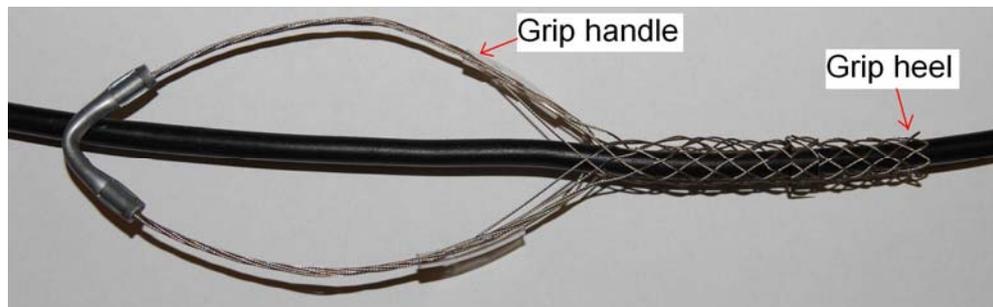
Attaching the hoisting grip

NOTE

Attach one or more hoisting grips to the main IF cable before fitting the N type connector to the top end (as described in [Preparing IF cables](#) on page 5-39). Attach one additional hoisting grip for each 60 m (200 ft) of cable.

To attach a hoisting grip to the main IF cable, proceed as follows:

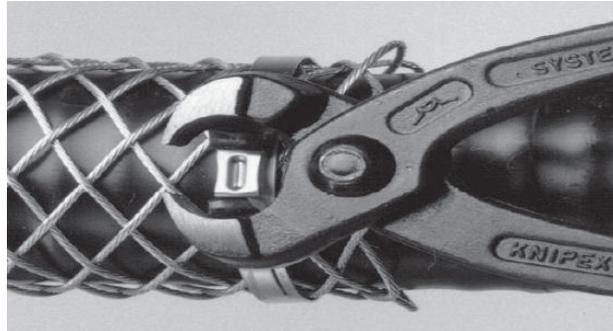
- 1 Compress the grip ends towards each other and slide the grip heel (woven end) onto the cable (see photo). Place the hoisting grip(s) at the proper location on the cable before attaching the connector. Allow a sufficient length of cable leader to reach the antenna connector when cable hoisting and attachment of the grip handle is completed. Hold the heel with one hand and firmly slide the other hand along the grip to tighten it.



- 2 Slide the clamp onto the grip and position it 25 mm (1") from the heel.



- 3 Crimp the clamp with Andrew crimping tool 243333 at each hoisting grip clamp location.



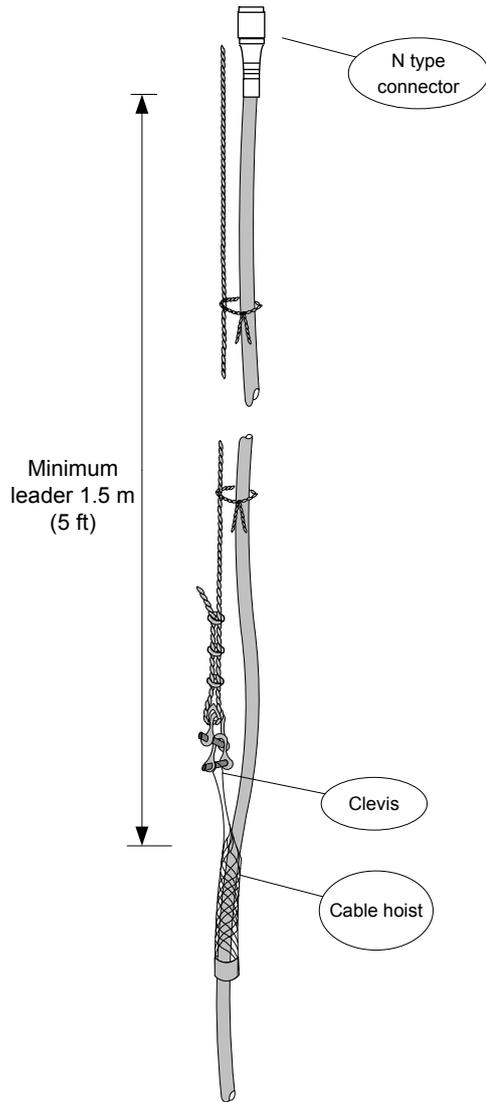
Using the hoist line

⚠ WARNING

Maintain tension on the hoisting grip during hoisting. Loss of tension can cause dangerous movement of the cable and result in injury or death to personnel on or near the tower. Also, do not release tension on the grip until after the cable has been fastened to the tower members.

Attach the hoist line to the grip (Figure 5-4). Tie the cable leader to the hoist line so that the leader does not dangle. Apply tension slowly to the hoist line, allowing the hoisting grip to tighten uniformly on the cable. Hoist the main IF cable up to the ODU.

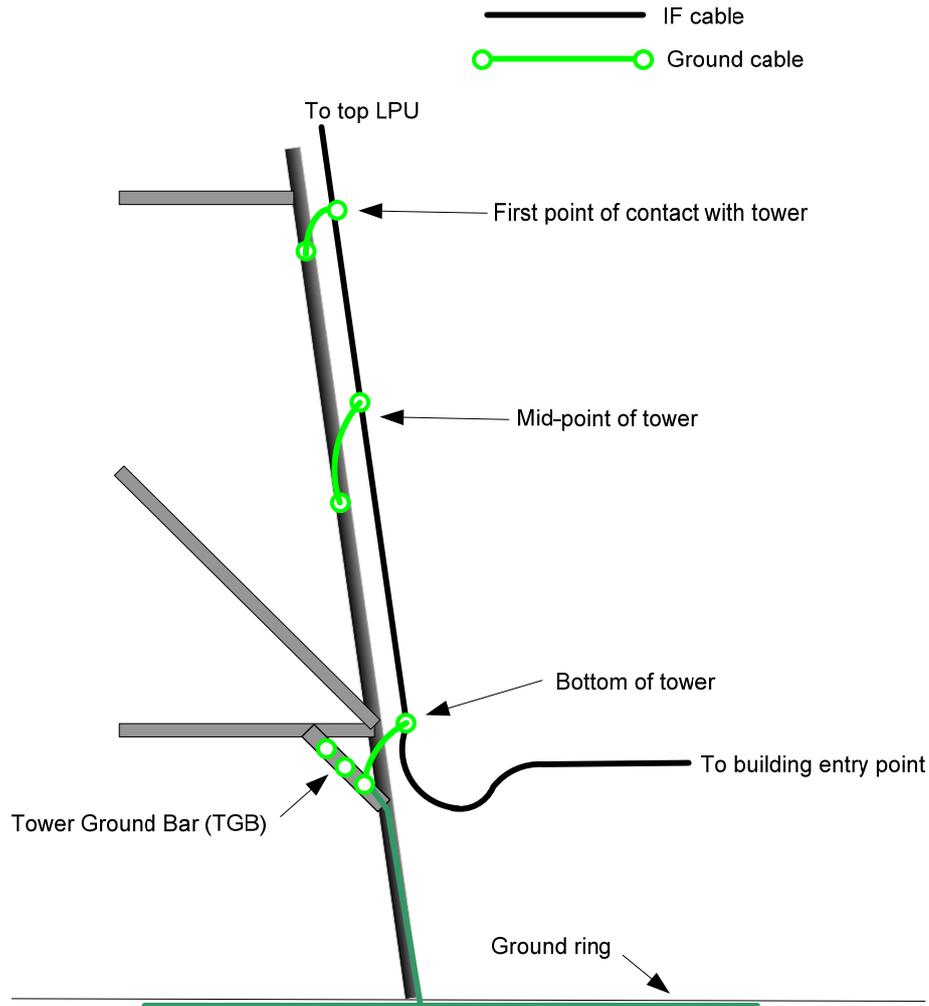
Figure 5-4 Using the hoist line



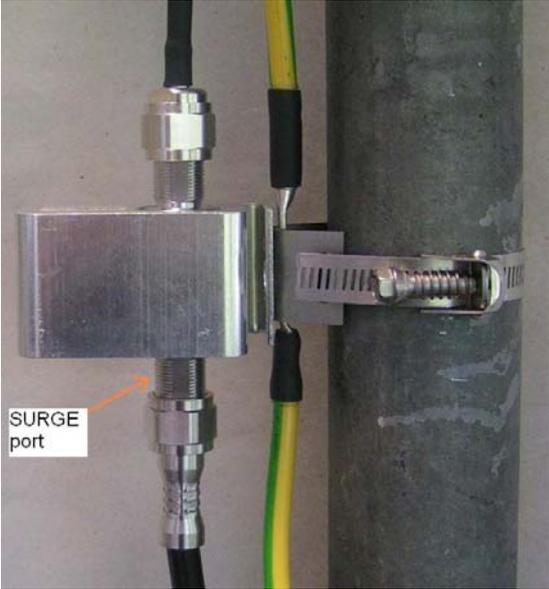
Installing and grounding the main IF cable

Perform this procedure to install and ground the IF cable from the top LPU to the building entry point (Figure 5-5). The IF cable must be grounded at the points specified in [Protection requirements for a mast or tower installation](#) on page 2-10.

Figure 5-5 IF cable grounding on a mast or tower



To install and ground the main IF cable, proceed as follows:

1	Attach the N type connector at the top end of the main IF cable to the SURGE port of the top LPU. 
2	Protect the N type connectors on the LPU from the weather by applying self-amalgamating and PVC tape, as described in Weatherproofing an N type connector on page 5-47.
3	Lay the main IF cable as far as the building entry point, ensuring there is enough length to extend through the wall of the building to the bottom LPU.
4	Attach the main IF cable to the supporting structure using the cable ties provided.
5	Ground the IF cable at the points specified in Protection requirements for a mast or tower installation on page 2-10. Follow the procedure Making an IF cable ground point on page 5-57.

Making an IF cable ground point

Perform this task to connect the screen of the IF cable to the metal of the supporting structure using a cable grounding kit.

The cable grounding kit for 1/4" and 3/8" cable ([Figure 1-13](#)) contains the following components:

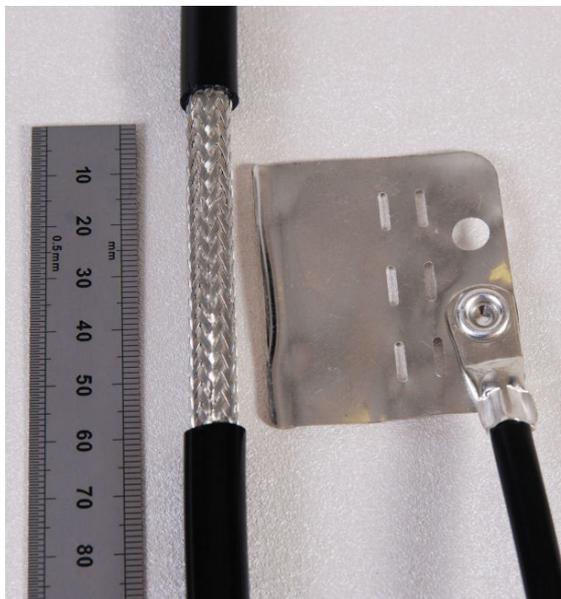
- 1 x grounding cable with grounding 2 hole lug fitted (M10)
- 1 x self Amalgamating tape
- 1 x PVC tape
- 3 x tie wraps
- 2 x bolt, washer and nut

CAUTION

Ground cables must be installed without drip loops and pointing down towards the ground, otherwise they may not be effective.

To ground the IF cable to a metal structure using the Motorola grounding kit (part number 01010419001), proceed as follows:

- 1 Remove 60 mm (2.5 inches) of the IF cable outer jacket:



- 2 Cut 38 mm (1.5 inches) of rubber tape (self amalgamating) and fit to the ground cable lug. Wrap the tape completely around the lug and cable:



- 3 Fold the ground wire strap around the drop cable screen and fit cable ties.



- 4 Tighten the cable ties with pliers.



Cut the surplus from the cable ties.

- 5** Cut a 38 mm (1.5 inches) section of self-amalgamating tape and fit to the ground cable lug. Wrap the self-amalgamating tape completely around the lug and cable.



- 6** Use the remainder of the self-amalgamating tape to wrap the complete assembly. Press the tape edges together so that there are no gaps:



- 7** Wrap a layer of PVC tape from bottom to top, starting from 25 mm (1 inch) below and finishing 25 mm (1 inch) above the edge of the self-amalgamating tape, over lapping at half width.



- 8** Repeat with a further four layers of PVC tape, always overlapping at half width. Wrap the layers in alternate directions:

Second layer: top to bottom.

Third layer: bottom to top.

Fourth layer: top to bottom.

Fifth layer: bottom to top.

The edges of each layer should be 25mm (1 inch) above (A) and 25 mm (1 inch) below (B) the previous layer.



- 9** Prepare the metal grounding point of the supporting structure to provide a good electrical contact with the grounding cable clamp. Remove paint, grease or dirt, if present. Apply anti-oxidant compound liberally between the two metals.

- 10** Clamp the bottom lug of the grounding cable to the supporting structure using site approved methods.

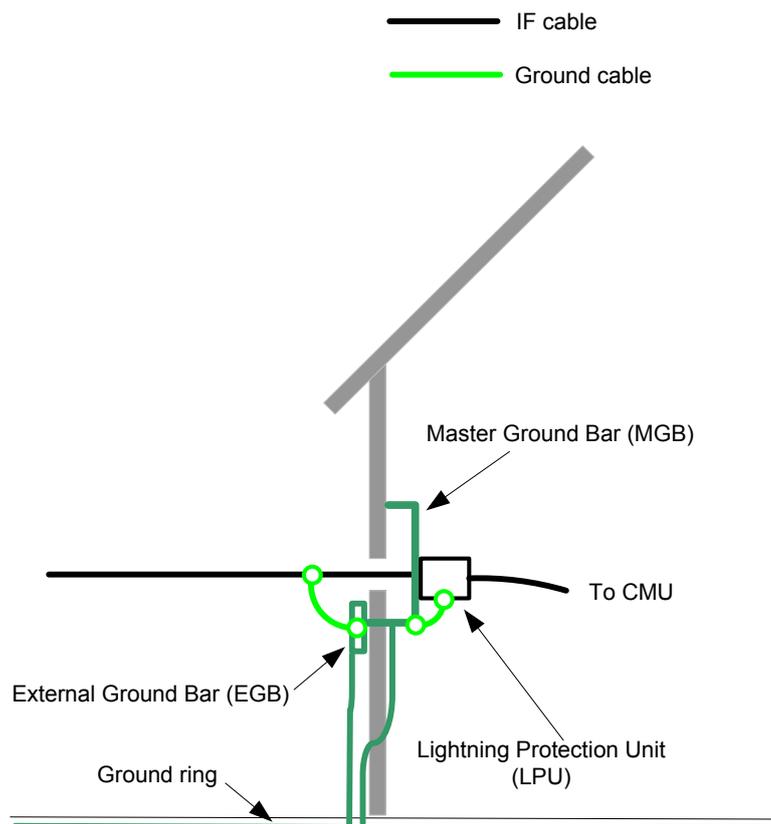
NOTE

The manual *R56 Standards And Guidelines For Communication Sites* (available for download at www.motorola.com/ptp/software) states that two-hole lugs secured with fasteners in both holes are preferred over single-hole lugs.

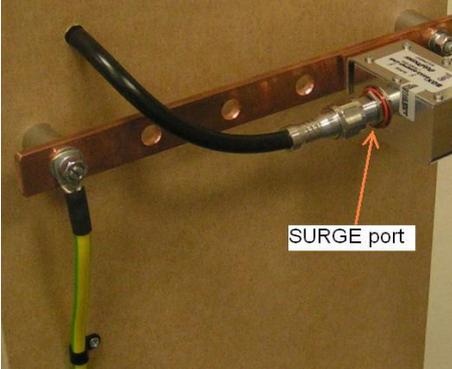
Installing and grounding the IF cable at building entry

Perform this procedure to install and ground the IF at the building (or cabinet) entry point (Figure 5-6).

Figure 5-6 Grounding at building entry



To run the IF cable into the building, proceed as follows:

1	Make an entry point into the building and run the main IF cable into the building.
2	Ground the IF cable to the external ground bar outside the building entry point, as described in Making an IF cable ground point on page 5-57. 
3	Install the bottom LPU inside the building entry point.
4	Ground the bottom LPU to the master ground bar.
5	Cut any surplus length from the bottom end of the main IF cable and fit an N type connector, as described in Fitting an N type connector to an IF cable on page 5-39.
6	Connect the main IF cable to the SURGE port of the bottom LPU. 
7	Connect the LPU-CMU IF cable to the EQUIPMENT port of the bottom LPU and run it to the location of the CMU. 

Testing the installation

Recommended pre-power tests

Following the installation of the ODU, LPUs and the IF cable, but before connecting and applying power to the CMU, the following tests are recommended:

- Cable loss with ODU disconnected:
This test will ensure that the total cable loss, including loss from the LPUs, is within acceptable limits.
- Cable loss with the ODU connected:
This test will confirm that the cable contains no short circuit or open circuit.
- Distance to fault (DTF) return loss with the ODU connected:
This test confirms the position of the LPUs in the cable run and confirms there are no other points of discontinuity in the cable. By comparing a current plot to a previously recorded plot, it is possible to detect any degradation over time.

Test equipment

An RF cable analyzer such as an Anritsu 'Site Master' can be used to confirm that the installed cable between the ODU and the CMU has the correct loss and does not have any short or open circuits. If the cable is faulty, this equipment can be used to identify the location of a fault in the cable.

Figure 5-7 is an example of a cable analyzer that is suitable for performing the tests described in this section.

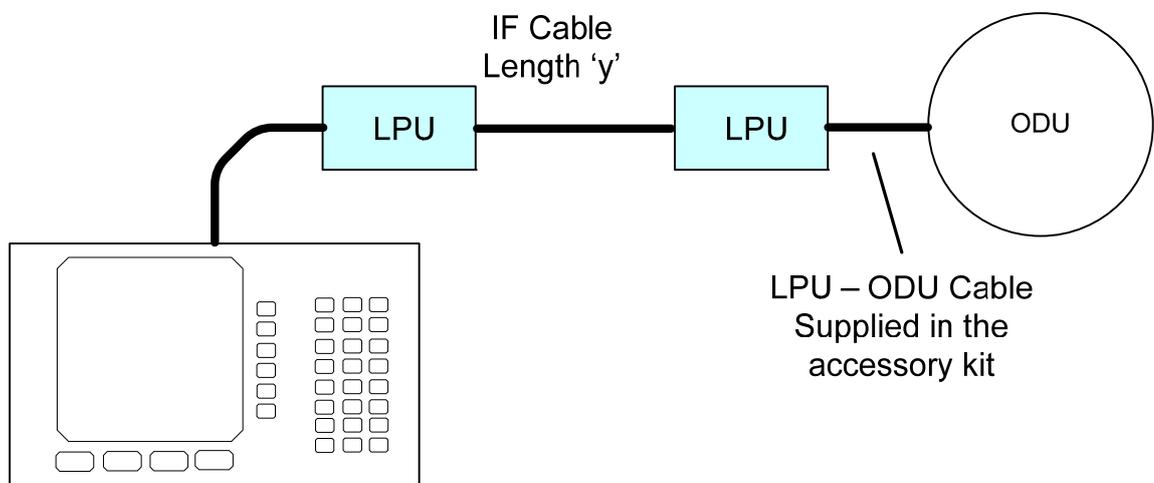
Figure 5-7 Example of a cable analyzer



Test preparation

Figure 5-8 is an example to show how the equipment should be set up to perform the pre-power tests. In this example, there is a short length of cable from the analyzer (in place of the CMU) to the first LPU, a length of cable 'y' from the first LPU to the second LPU (at the top of the tower) and a short length of cable from the second LPU to the ODU (0.7m long supplied in the accessory kit).

Figure 5-8 Example of the cable test



NOTE

These tests should be performed in conjunction with the test equipment manufacturer's instructions.

To prepare for pre-power testing, proceed as follows:

1	Connect the analyzer to the first LPU (Figure 5-8).
2	Connect the first LPU to the second (Figure 5-8).
3	Check that the second LPU is disconnected from the cable that leads to the ODU (Figure 5-8). The second LPU and ODU are reconnected during testing.
4	Power on the analyzer.

When these preparations are complete, perform the following tests:

- [Testing cable loss](#) on page 5-65.
- [Measuring distance to fault](#) on page 5-70.

Testing cable loss

The purpose of this test is to ensure that the total cable loss is within acceptable limits.

Before performing this test, ensure that the test equipment is set up as described in [Test preparation](#) on page 5-64.

To measure cable loss, proceed as follows:

1	Select the 'cable loss-one port' mode of the cable analyzer (Figure 5-7).
2	Set the frequency of measurement to: F1 = 350MHz F2 = 400MHz.
3	Calibrate the instrument for the selected frequencies, using the correct calibration kit.
4	Before connecting the ODU, obtain a plot of cable loss and check that it is within the expected limits for the given cable length (Table 5-2). Compare it to examples of good installations (Figure 5-9 and Figure 5-11).
5	Connect the ODU.
6	Observe the effect of the ODU connection on the plot of cable loss. Compare it to examples of good installations (Figure 5-10 and Figure 5-12). If there is little or no change to the plot when the ODU is connected, it indicates a short or open circuit on the cable.
7	Keep a copy of the cable loss plots so that they can be compared with subsequent plots to determine if there is any degradation with time.

Cable loss example using a 17 meter cable

This example is for a cable run consisting of the following:

- 0.7m cable from the test equipment to the first LPU.
- The first LPU.
- 17m of cable between the two LPUs (length 'y' in Figure 5-8).
- The second (mast mounted) LPU.
- 0.7m of cable from the LPU to ODU.

When performing steps 4 to 6 above, compare the 'before' and 'after' plots of cable loss:

- Figure 5-9 is a plot of cable loss taken before the ODU was connected. The plot shows an average cable loss of 1.96 dB. This can be compared with the expected result in Table 5-2. For a cable length of approximately 19m (17m + 0.7m + 0.7m) with two LPUs, the table result is 1.9 dB, which is within the expected tolerance of +/- 10%.
- Figure 5-10 is a plot of cable loss taken after the ODU was connected.

Figure 5-9 Cable loss plot for a 17 meter cable with no ODU

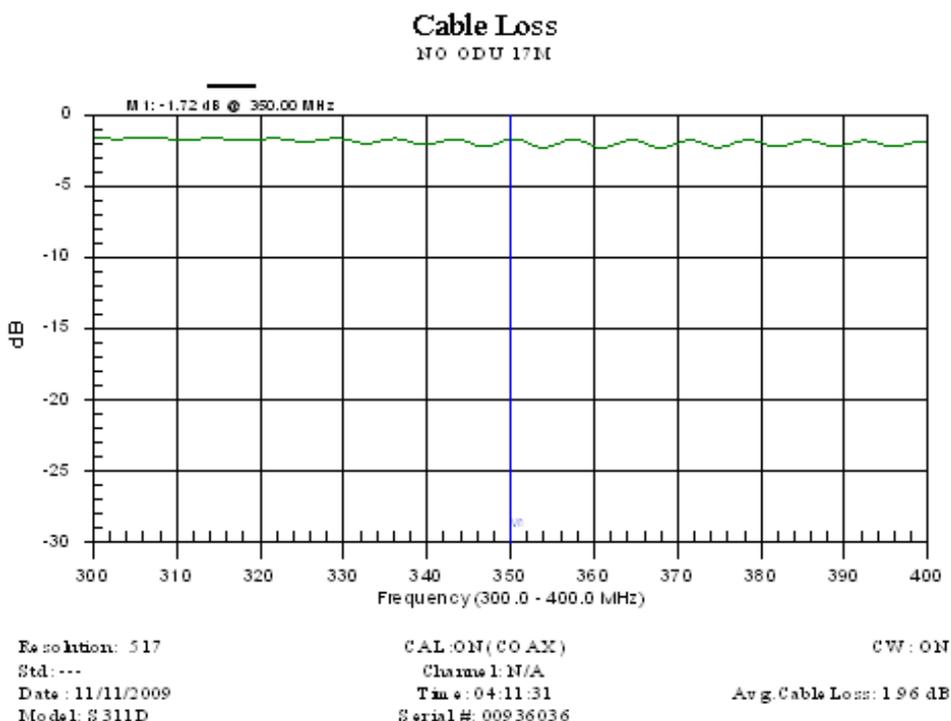
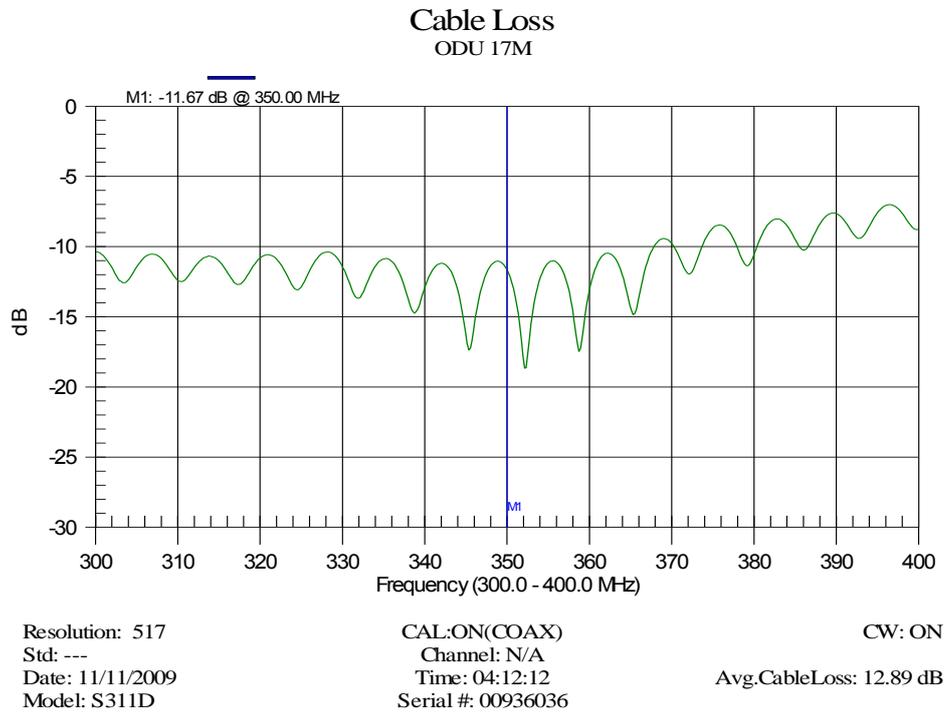


Figure 5-10 Cable loss plot for a 17 meter cable with ODU connected

Cable loss example using a 100 meter cable

This is similar to the above example, except that there is now 100m of cable between the two LPUs (length 'y' in [Figure 5-8](#)). It shows similar results:

- [Figure 5-11](#) is a plot of cable loss taken before the ODU was connected.
- [Figure 5-12](#) is a plot of cable loss taken after the ODU was connected.

Figure 5-11 Cable loss plot for a 100 meter cable with no ODU

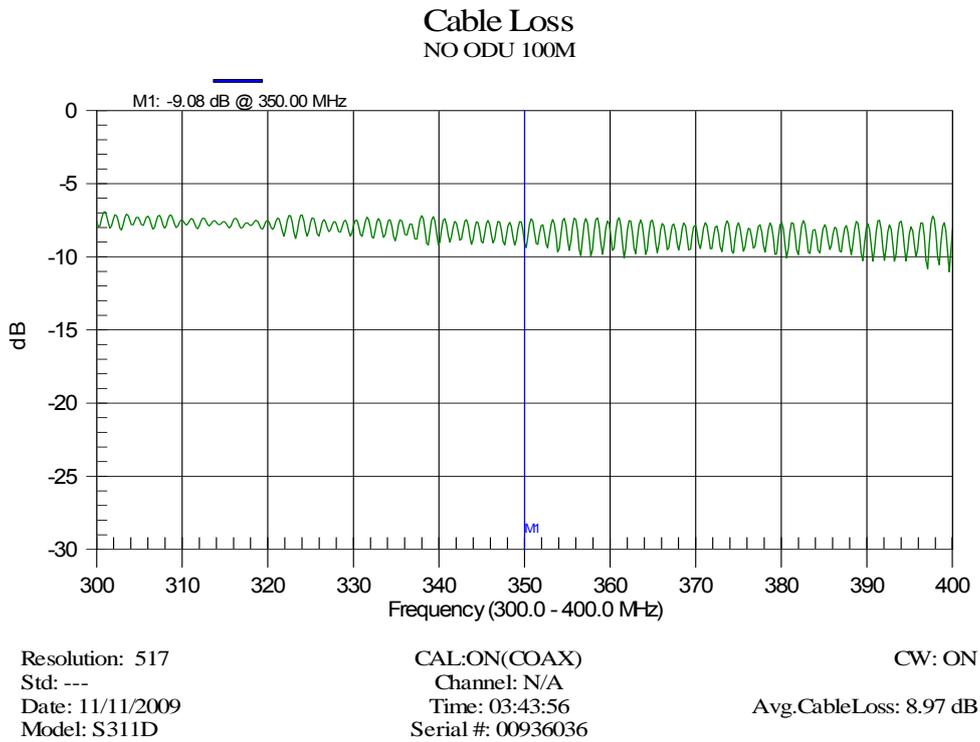
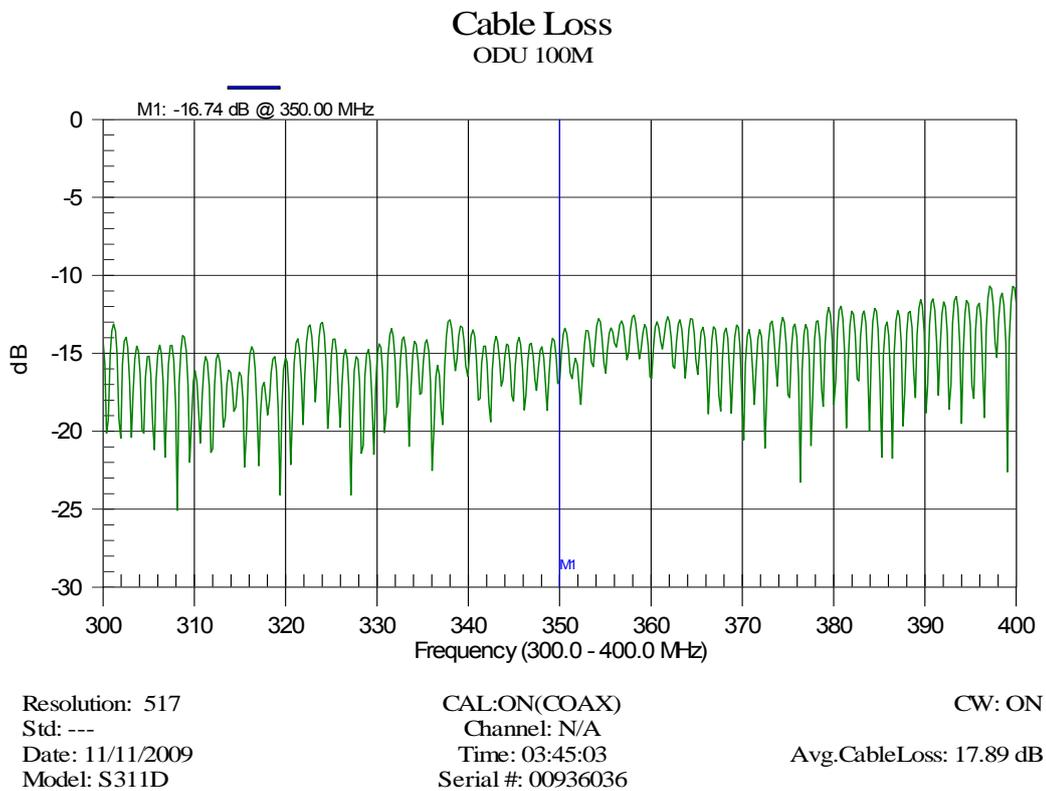


Figure 5-12 Cable loss plot for a 100 meter cable with ODU connected



Expected cable loss

[Table 5-2](#) quotes the expected cable loss for given cable lengths when the ODU is not connected. All loss figures have a tolerance of plus or minus 10%, for example, 1.76 dB means that the loss is expected to be between 1.58 and 1.94 dB.

Table 5-2 Expected cable loss when ODU is not connected

Cable Length (meters)	Cable Loss (+/- 10%) at 350 MHz (dB)	Cable Loss (+/- 10%) with two Lightning Protection Units fitted, at 350 MHz (dB)
1	0.08	0.3
2	0.15	0.37
3	0.23	0.45
4	0.31	0.53
5	0.39	0.61
6	0.46	0.68
7	0.54	0.76
8	0.62	0.84
9	0.69	0.91
10	0.77	0.99
20	1.54	1.76
30	2.31	2.53
40	3.08	3.3
50	3.85	4.1
100	7.7	7.92

Measuring distance to fault

The distance to fault (DTF) test is used as a means of characterizing the cable installation, but can also be used to determine the location of a fault in an installation.

Before performing this test, ensure that the test equipment is set up as described in [Test preparation](#) on page 5-64.

To measure distance to fault, proceed as follows:

1	Select the 'DTF-return loss' mode of the cable analyzer (Figure 5-7).
2	Select 'DTF Aid'.
3	Use the up/down key to select and set the following: Cable type - select LMR400 (similar to CNT-400). F2 - select the highest frequency possible for the greatest resolution, 1600 MHz. D1 and D2 - set as appropriate for the specific installation.
4	Recalibrate the instrument.
5	Before connecting the ODU, obtain a plot of DTF loss. Compare it to an example of a good installation (Figure 5-13).
6	Connect the ODU.
7	Observe the effect of the ODU connection on the DTF plot. Compare it to an example of a good installation (Figure 5-14).
8	Keep a copy of the DTF plots so that they can be compared with subsequent plots to determine if there is any degradation with time.

NOTE

The absolute readings of DTF should be read with care, as many different variables affect both distance and amplitude accuracy.

DTF return loss example

This example shows typical DTF return loss in a good installation. The distances from the test equipment to first LPU (marker M2), and then the second LPU (marker M3) are clearly shown. The cable between them shows **no** discontinuity. There are two plots:

- [Figure 5-13](#) is a plot of DTF return loss before the ODU is connected. The final peak (marker M1) is the position of the cable open circuit.
- [Figure 5-14](#) is a plot of DTF return loss after the ODU is connected. The final peak remains in the same position but is now reduced in amplitude because less signal is reflected, as a consequence of the better match of the ODU.

Figure 5-13 DTF plot for a 17 meter cable with no ODU

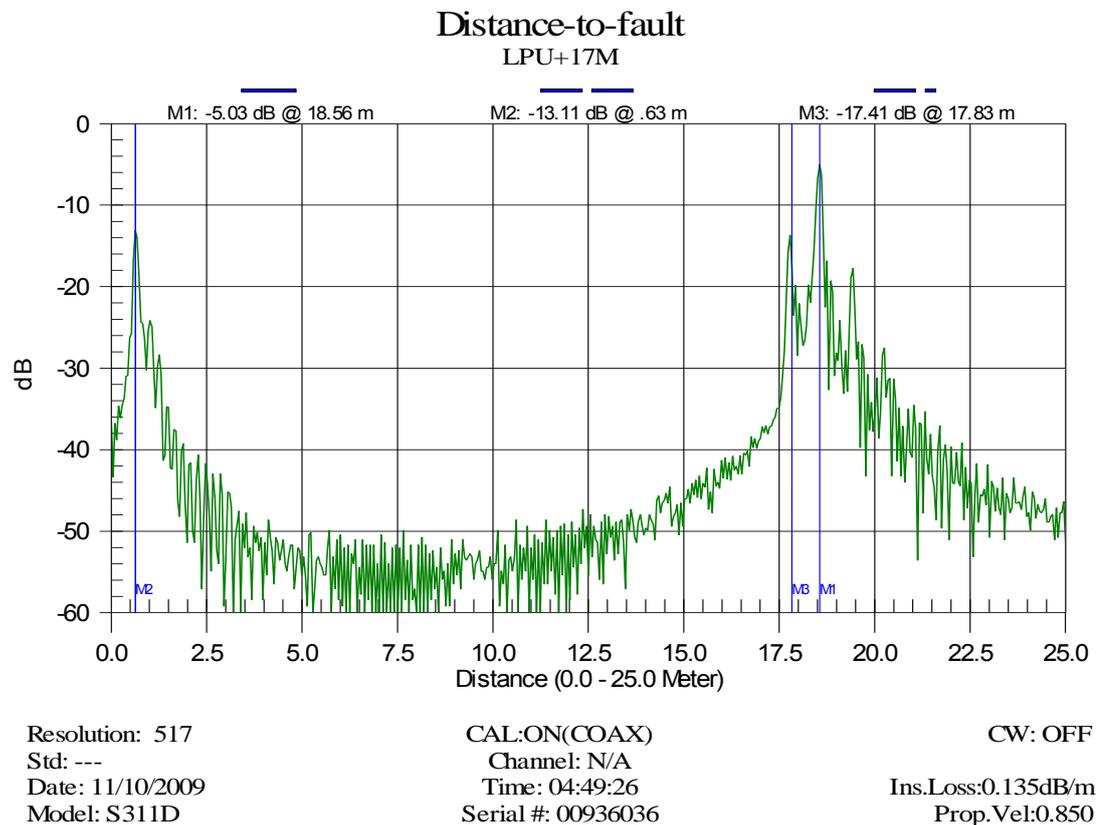
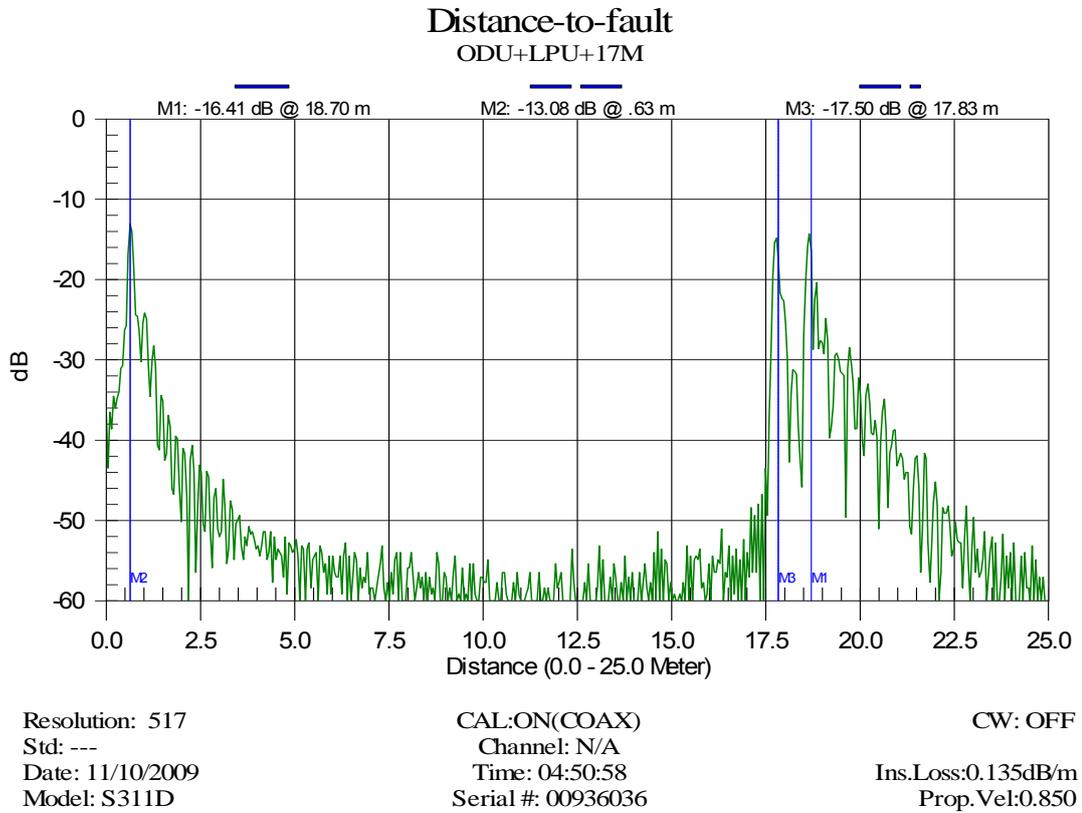


Figure 5-14 DTF plot for a 17 meter cable with ODU connected



Installing the CMU

Perform this task to mount the CMU in the building or cabinet, and to connect it to ground, power supply and PC.

CAUTION

To minimise radiated emissions, use screened Ethernet cable for all copper connections from the CMU Ethernet ports. This includes the Data port connection to any network switch and the Management port to the splitter WB3807 (if fitted) and onwards to any network switch.

Connect the CMU protection interface for either out-of-band or in-band management, as required.

Maximum operating ambient temperature for the CMU

WARNING

HOT SURFACES: care should be taken when handling an operating CMU.

The CMU must be mounted on either a horizontal or vertical surface. The supplied mounting bracket must be used. The CMU must not be operated in ambient temperatures exceeding 40 deg C unless mounted in a Restricted Access Location.

At ambient temperatures over this limit, the temperature of the external metal case parts of the CMU may exceed a touch temperature of 70 deg C. Heat warning labels are fixed adjacent to the hottest parts, on the top of the unit adjacent to the rear face and to the front panel mounted N type connector.

Operation of CMU in a Restricted Access Location

The CMU may be operated in ambient temperatures up to 55°C when it is housed in a Restricted Access Location. Under these conditions the temperature of the external metal case parts of the CMU may exceed a touch temperature of 70°C, but will be less than 90°C.

A Restricted Access Location is defined (in EN 90650-1) as one where access may only be gained by use of a tool or lock and key, or other means of security, and access is controlled by the authority responsible for the location.

Examples of permissible Restricted Access Locations are:-

- A lockable equipment room.
- A lockable cabinet.

Access must only be gained by persons who have been instructed about the reasons for the restrictions applied to the location and about any precautions that must be taken.

Mounting the CMU

The CMU can be mounted in three ways:

- On a shelf or bench top.
- On a wall.
- In a cabinet rack.

The CMU kit contains the CMU, CMU bracket, power connector and ground lug (Figure 5-15).

Figure 5-15 CMU kit contents



CAUTION

To prevent the CMU from overheating, ensure that the ventilation holes on the side of the CMU are not obstructed and that there is room for air flow across the back of the CMU (the end opposite the connector face).

Shelf or bench top mounting

If the CMU is installed on a shelf or bench top (Figure 5-16), the CMU bracket must be used to secure the CMU. The bracket screws to the base of the CMU.

Figure 5-16 CMU mounted on bench

Wall mounting

The CMU bracket also acts as a wall mounting bracket ([Figure 5-17](#)). The bracket may be placed against the wall to allow fixing holes to be made. The bracket should then be secured to the CMU using the screws supplied, before offering the assembly up to the wall for fixing.

⚠ WARNING

In order to comply with safety certification, mount the CMU with the connectors facing upwards or downwards; do not mount the CMU with the connectors facing sideways.

Figure 5-17 CMU mounted with bracket

Rack mounting

A rack mounting kit allows one or two CMUs to be installed in a 19 inch cabinet rack ([Figure 5-18](#) and [Figure 5-19](#)). The kit contains a blanking plate and CMU securing screws.

Figure 5-18 CMU with rack mount kit and blanking plate



Figure 5-19 CMU mounted in rack



CAUTION

To avoid damaging the RF cable, route it in such a way that the minimum bend radius for the selected cable is always exceeded.

If cables are laid in an air-handling cavity, they must be Plenum rated.

NOTE

A right angle IF cable connector (Motorola part number 01010589001) can make it easier to install the CMU in the rack ([Figure 5-20](#)).

Figure 5-20 Rack mounted CMU with a right angled IF cable connector



Grounding the CMU

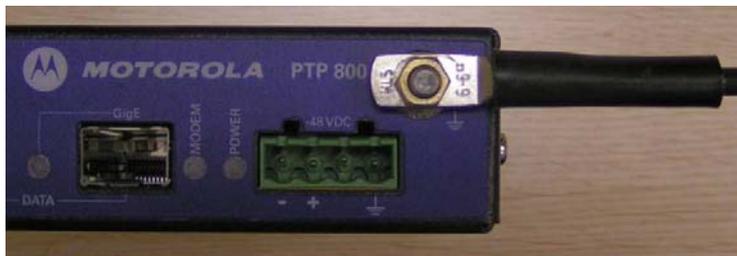
Ground the CMU to a rack ground bar, master ground bar or other suitable ground using a minimum cable cross section of 10 mm² (6AWG) (Figure 2-5). It is a condition of the safety approval that the unit is grounded.

NOTE

For a protected link, ground both CMUs to the same grounding point (Figure 2-6).

Attach the ground cable to the CMU ground connector (Figure 5-21).

Figure 5-21 CMU ground connector



Connecting the CMU to the IF cable

Cut any surplus length from the CMU end of the LPU-CMU IF cable and fit an N type connector, as described in [Fitting an N type connector to an IF cable](#) on page 5-39.

NOTE

For a protected link with an asymmetric coupler, ensure that the following connections are made:

- The IF cable from the 'MAIN' side of the ODU coupler is connected to the CMU labelled 'Primary'.
- The IF cable from the 'STANDBY' side of the ODU coupler is connected to the CMU labelled 'Secondary'.

Connecting the CMU power supply

Connect the CMU to a minus 48 Volt (-48V) supply capable of supplying a maximum of 2 amps.

The Motorola supplied AC to DC converter is shown in [Figure 5-22](#). For specifications of the converter, mains cables and DC connectors, refer to [AC to DC converter specifications](#) on page 4-15.

Figure 5-22 Motorola AC to DC converter



For details of alternative power supply arrangements, refer to [Power supply considerations](#) on page 2-16. If an alternative power supply is to be installed, it must include the following safeguards:

- The DC supply must have over current protection that does not exceed 3 amps
- A means of isolating the CMU from the DC supply must also be provided.

If a DC connector has to be attached to the DC output cable, use the following pin connections:

- Pin 1: -48 Volts
- Pin 2: 0 Volts
- Pin 3: Not Connected
- Pin 4: Chassis ground

Pin 1 is the left most pin on the CMU power connector when looking at the front panel.

Preparing the network connections (unprotected)

For unprotected ends, perform this task to prepare the cables to connect the CMU to router ports, switch ports or other equipment in the customer and (optionally) management networks. The CMU is not normally connected to the network equipment until antenna alignment is complete. See [Task 13: Connecting link to the network](#) on page 6-70.

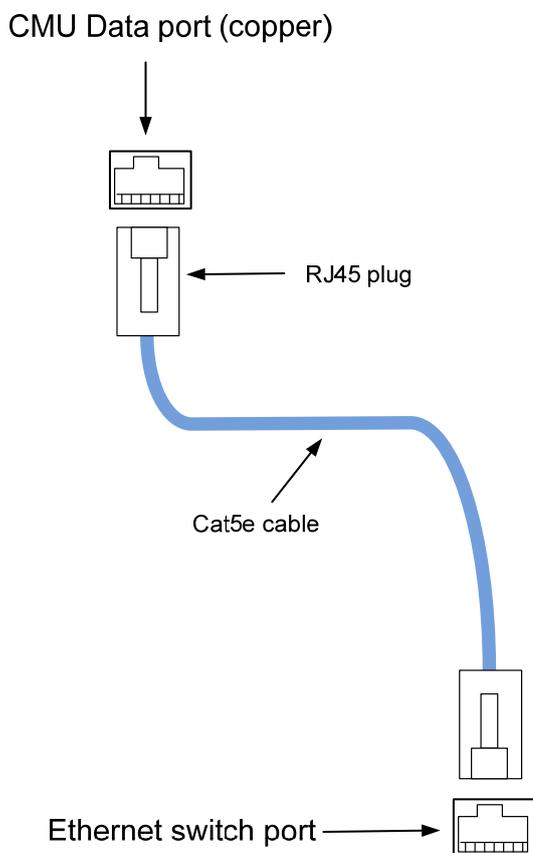
For all management modes (out-of-band and in-band), decide whether the data network connection is to be copper or fiber, then perform either [Installing a copper data interface](#) on page 5-80 or [Installing a fiber data interface](#) on page 5-81.

For out-of-band management modes (but not in-band), perform [Installing a management interface](#) on page 5-82.

Installing a copper data interface

If an unprotected configuration requires a copper data interface, connect the CMU Data port (copper) to the network as shown in [Figure 5-23](#).

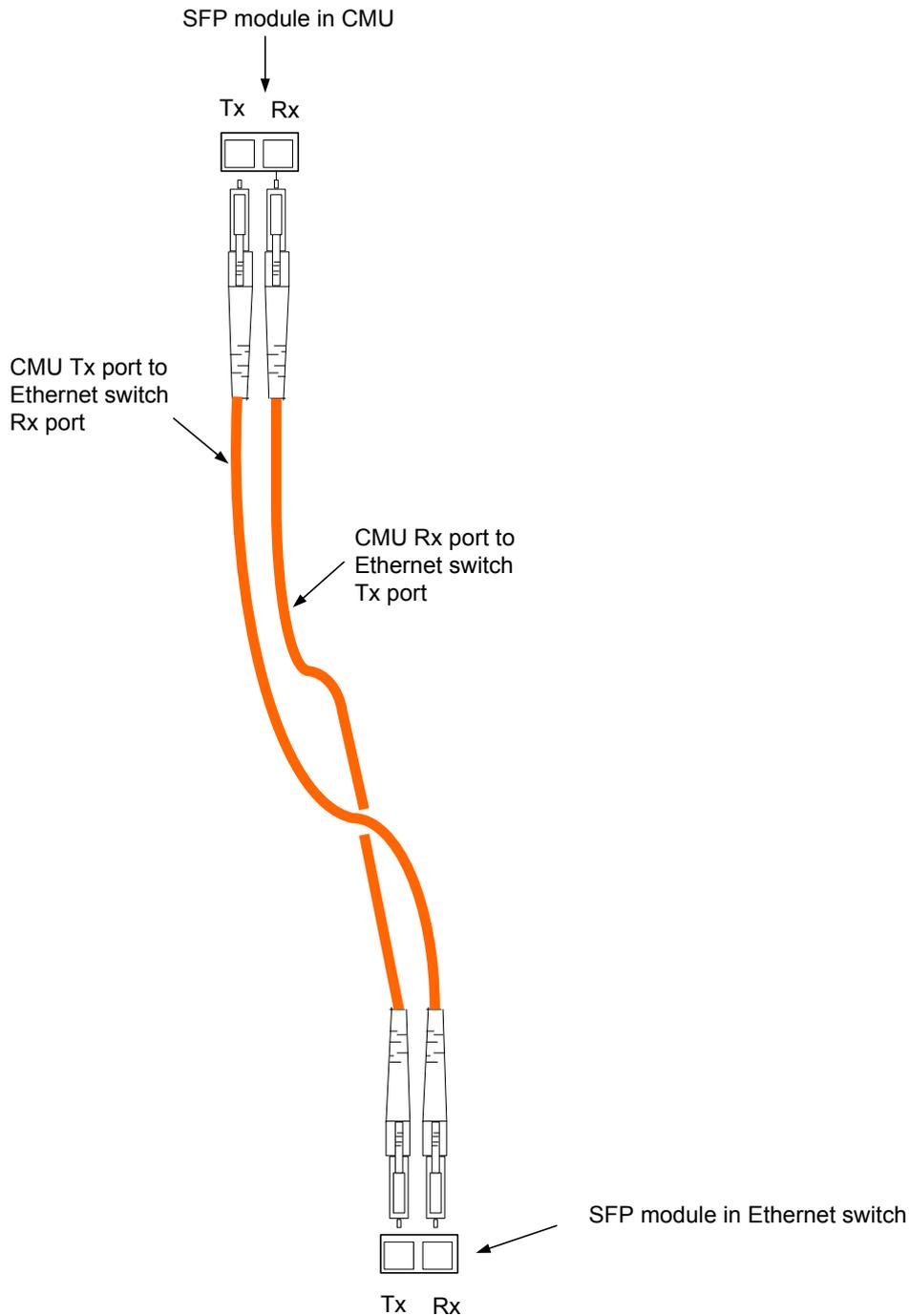
Figure 5-23 Copper data interface connections



Installing a fiber data interface

If an unprotected configuration requires a fiber data interface, connect the CMU Fiber SFP (GigE) port to the network as shown in [Figure 5-24](#).

Figure 5-24 Fiber data interface connections



Refer to [Connecting fiber cables to the CMU](#) on page 5-83.

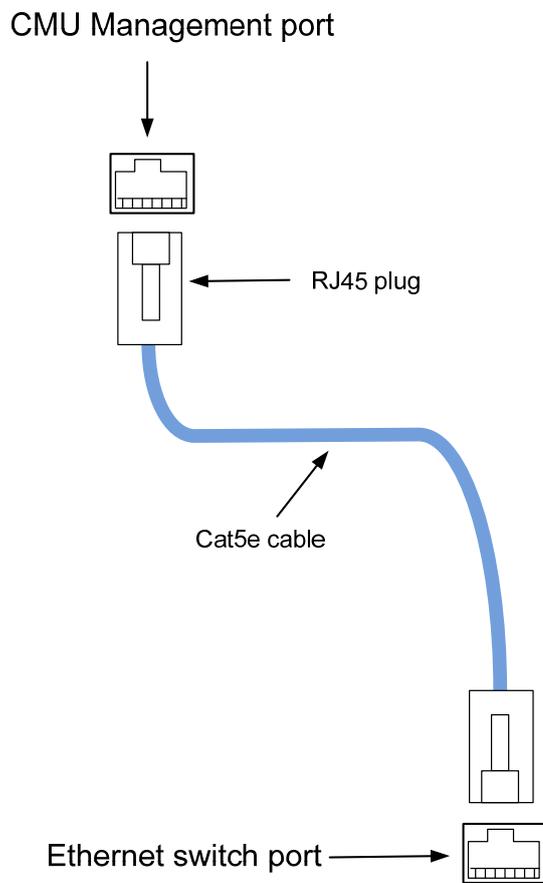
Installing a management interface

If an unprotected configuration requires a management interface, connect the CMU Management port to the network as shown in [Figure 5-25](#).

NOTE

At the edge of a network, it is possible that no management network equipment is reachable. In this case the CMU management port may be left disconnected.

Figure 5-25 Management interface connections



Connecting fiber cables to the CMU

To connect fiber cables to the CMU, proceed as follows:

- 1 Insert an SFP module into the GigE port of the CMU with the PCB connector down and label up.



- 2 Remove the protective caps from the LC connectors.



- 3 Plug the LC connectors into the SFP module, ensuring they snap home.



Preparing the network connections (protected)

For 1+1 protected ends, perform this task to prepare the cables to connect the CMU to the Ethernet switch in the customer and (optionally) management networks. The CMU is not normally connected to the network equipment until antenna alignment is complete. See [Task 13: Connecting link to the network](#) on page 6-70.

Select and install the required interfaces depending on the choice of management mode and network connection ([Table 5-3](#)).

Table 5-3 Selecting network interfaces for protected links

Management mode	Network connection	Procedures
Out-of-band (Figure 1-18)	Customer	Either: Installing a redundant copper interface on page 5-86; Or: Installing a redundant fiber interface on page 5-87; Or: one copper and one fiber (*1).
	Management (not 'last hop')	Installing an out-of-band protection splitter on page 5-85
	Management ('last hop') (*2)	Either: Installing an out-of-band protection splitter on page 5-85, but connect the two LAN ports together using a protection cable; Or: Installing a protection cable on page 5-88.
In-band (Figure 1-21)	Customer	Either: Installing a redundant copper interface on page 5-86; Or: Installing a redundant fiber interface on page 5-87; Or: one copper and one fiber (*1).
	Management	Installing a protection cable on page 5-88

(*1) It is possible to combine the two types of redundant interface at one link end, that is, connect one CMU to the network via copper and the other CMU via fiber.

(*2) 'Last hop' link ends are those that are at the edge of the network, where access to the management network is not always available.

Installing an out-of-band protection splitter

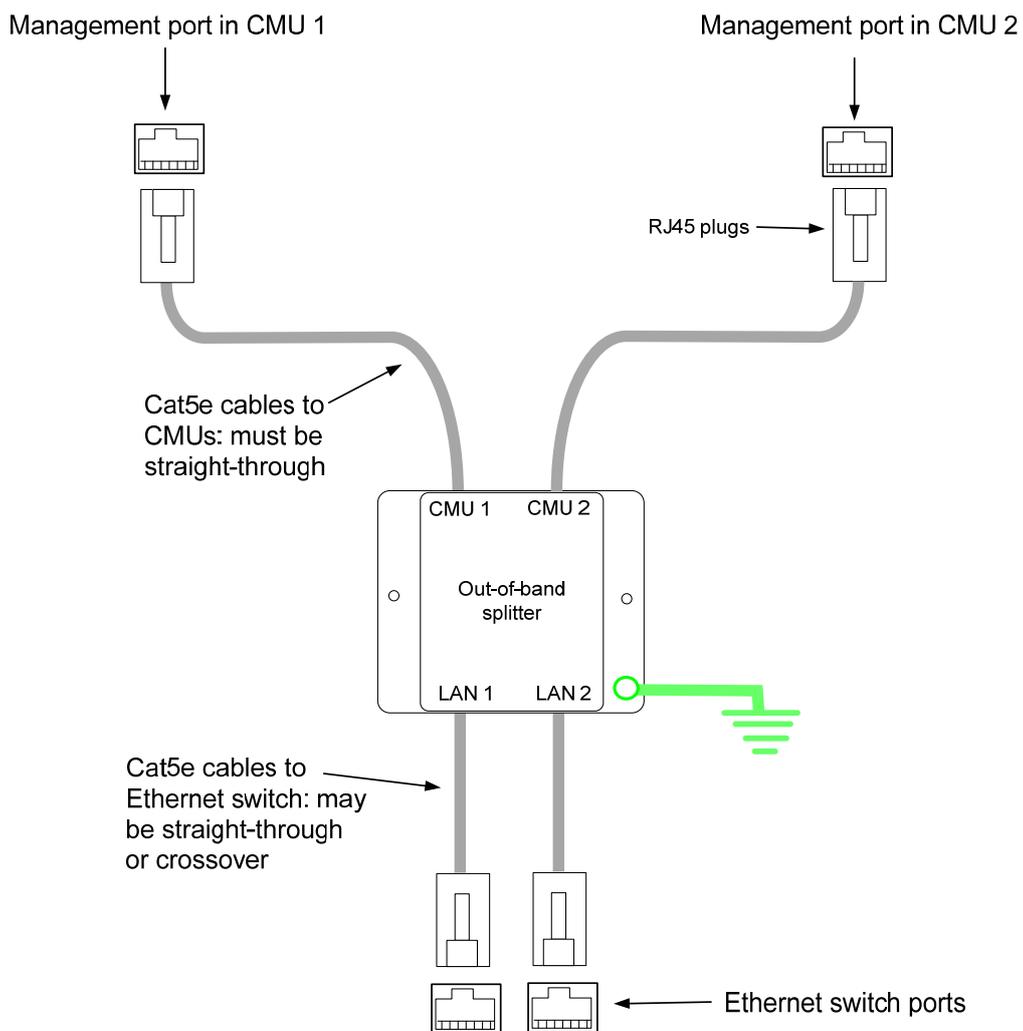
If a 1+1 protected configuration requires an out-of-band protection splitter, connect the CMU Management ports to the management network as shown in [Figure 5-26](#).

Use straight-through Cat5e cables with a maximum length of 2 m to connect the CMUs to the splitter.

NOTE

At the edge of the network (the 'last hop'), if no management network equipment is available, the two LAN ports can be connected using a protection cable. The cable pin outs are specified in [Protection cable](#) on page [4-54](#).

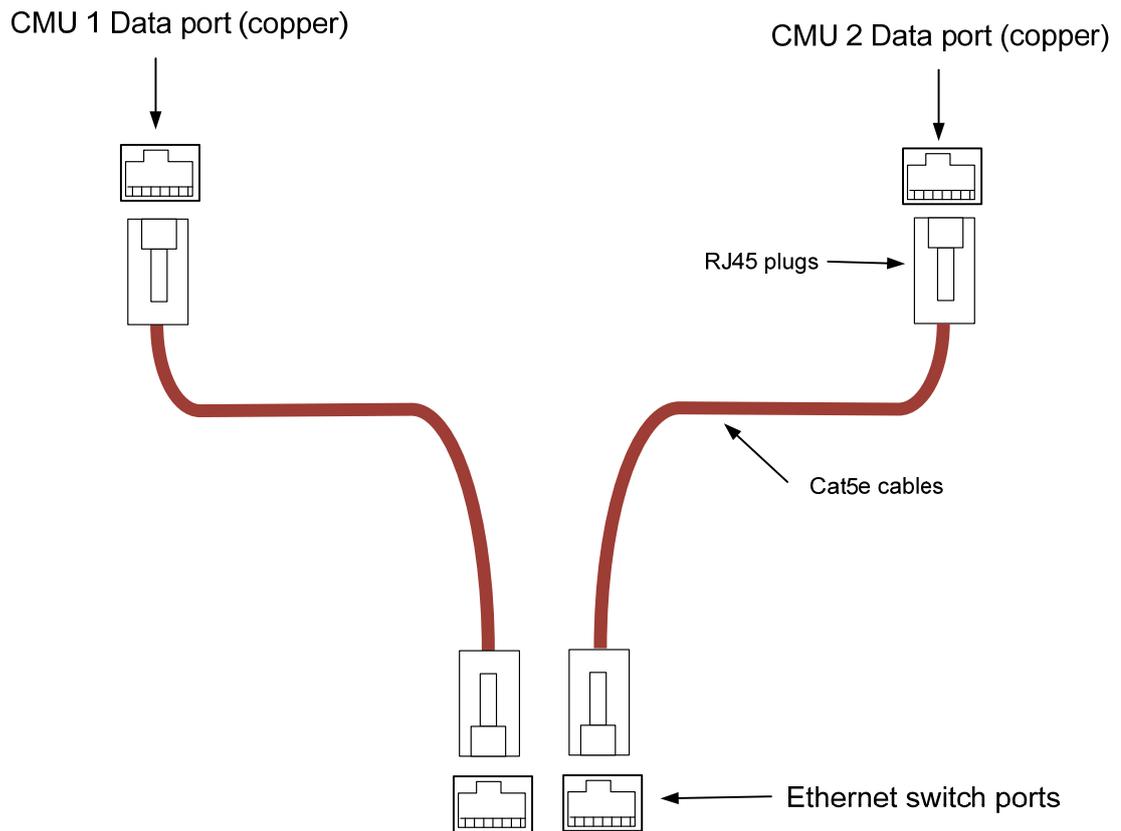
Figure 5-26 Out-of-band protection splitter connections



Installing a redundant copper interface

If a 1+1 protected configuration requires a redundant copper interface, connect the CMU Data ports (copper) to the network as shown in [Figure 5-27](#).

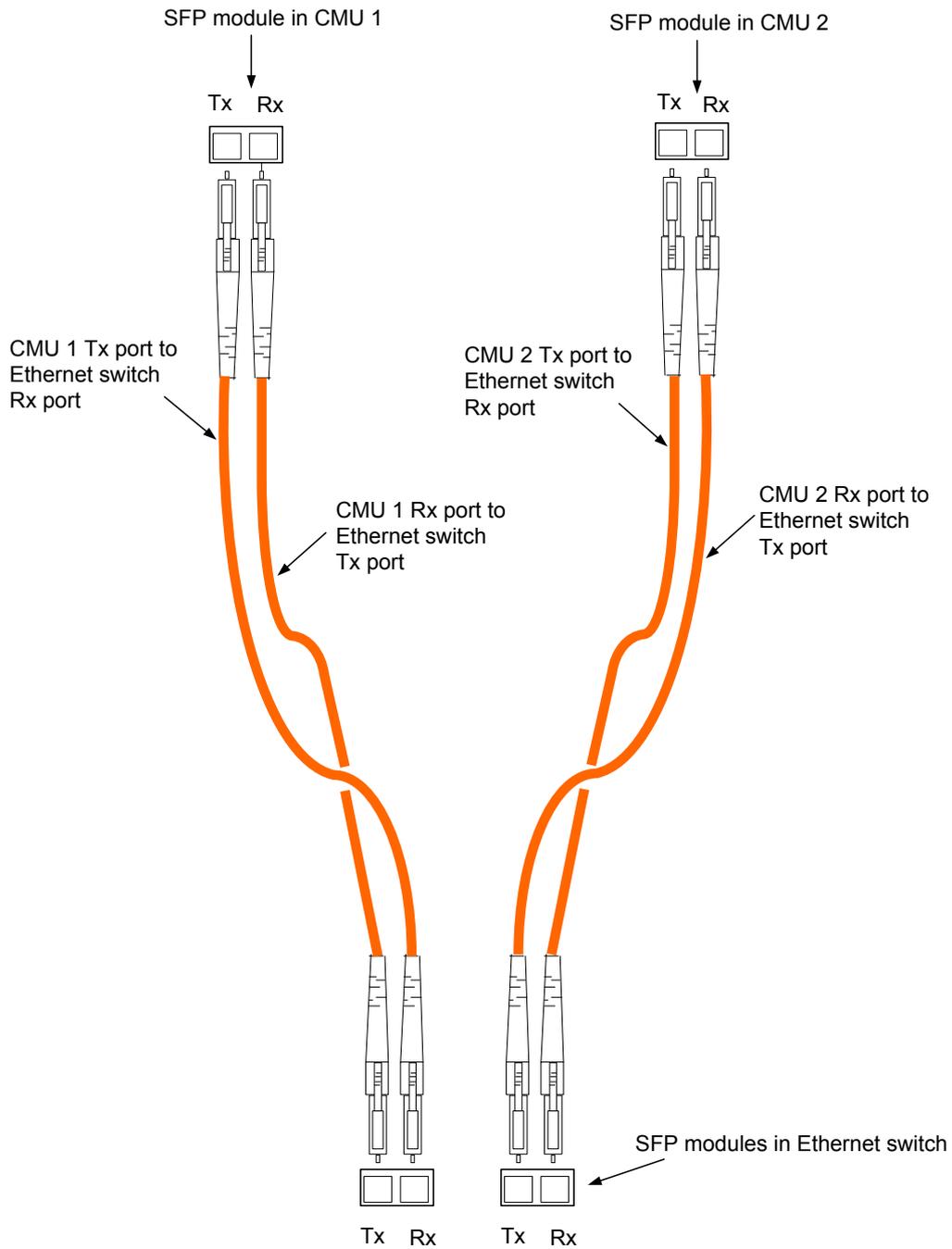
Figure 5-27 Redundant copper interface connections



Installing a redundant fiber interface

If a 1+1 protected configuration requires a redundant fiber interface, connect the CMU Fiber SFP (GigE) ports to the network as shown in [Figure 5-28](#).

Figure 5-28 Redundant fiber interface connections



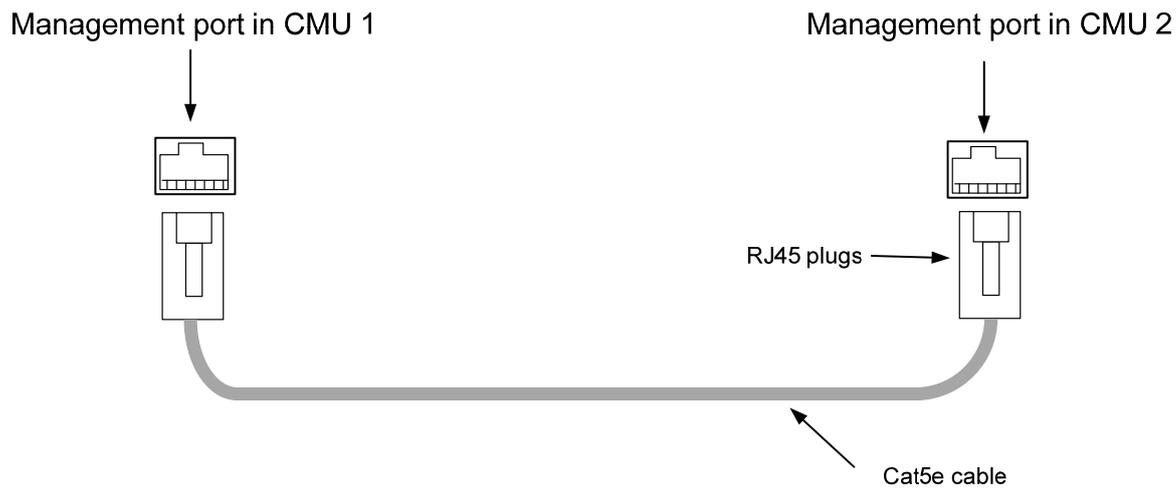
Refer to [Connecting fiber cables to the CMU](#) on page 5-83.

Installing a protection cable

If a 1+1 protected configuration requires a protection cable, connect the CMU Management ports together as shown in [Figure 5-29](#).

The cable pin outs are specified in [Protection cable](#) on page 4-54.

Figure 5-29 Protection cable connections



Chapter 6 Configuration and alignment

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This chapter describes all configuration and alignment tasks that are performed when a PTP 800 link is deployed.

The following tasks are usually performed during staging before site installation:

- [Task 1: Connecting to the unit](#) on page 6-2
- [Task 2: Configuring IP and Ethernet interfaces](#) on page 6-7
- [Task 3: Configuring quality of service](#) on page 6-19
- [Task 4: Installing license keys](#) on page 6-21
- [Task 5: Upgrading software version](#) on page 6-24
- [Task 6: Configuring security](#) on page 6-31
- [Task 7: Setting passwords](#) on page 6-34
- [Task 8: Configuring alarms and messages](#) on page 6-36
- [Task 9: Configuring protection interface](#) on page 6-42
- [Task 10: Configuring wireless interface](#) on page 6-47

The following tasks are always performed after installation is complete at both sites:

- [Task 11: Aligning antennas](#) on page 6-59
- [Task 12: Reviewing configuration and performance](#) on page 6-67
- [Task 13: Connecting link to the network](#) on page 6-70

Task 1: Connecting to the unit

This task consists of the following procedures:

- [Configuring the management PC](#) on page 6-2
- [Updating the ARP table](#) on page 6-5
- [Connecting to the PC and powering up](#) on page 6-5
- [Logging into the web interface](#) on page 6-6

Configuring the management PC

To configure the local management PC to communicate with the PTP 800, proceed as follows:

1	<p>Display the Local Area Connection Properties dialog (Figure 6-1).</p> <p> NOTE</p> <p>The path to this dialog depends on Windows version and PC configuration, for example select: Control Panel, Network Connections, Local Area Connection, Properties.</p>
2	<p>Select Internet Protocol (TCP/IP) and click on Properties. The Internet Protocol (TCP/IP) Properties dialog is displayed (Figure 6-2).</p>
3	<p>Enter an IP address that is valid for the 169.254.X.X network, avoiding: 169.254.0.0 and 169.254.1.1</p> <p>A good example is 169.254.1.3 as shown in Figure 6-2.</p>
4	<p>Enter a subnet mask of 255.255.0.0.</p> <p>Leave the default gateway blank.</p>
5	<p>Click on OK.</p>
6	<p>If the network adaptor supports advanced properties then ensure that Ethernet Speed and Duplex are both configured for automatic negotiation. One example, based on a Broadcom™ adaptor, is shown in Figure 6-3.</p>

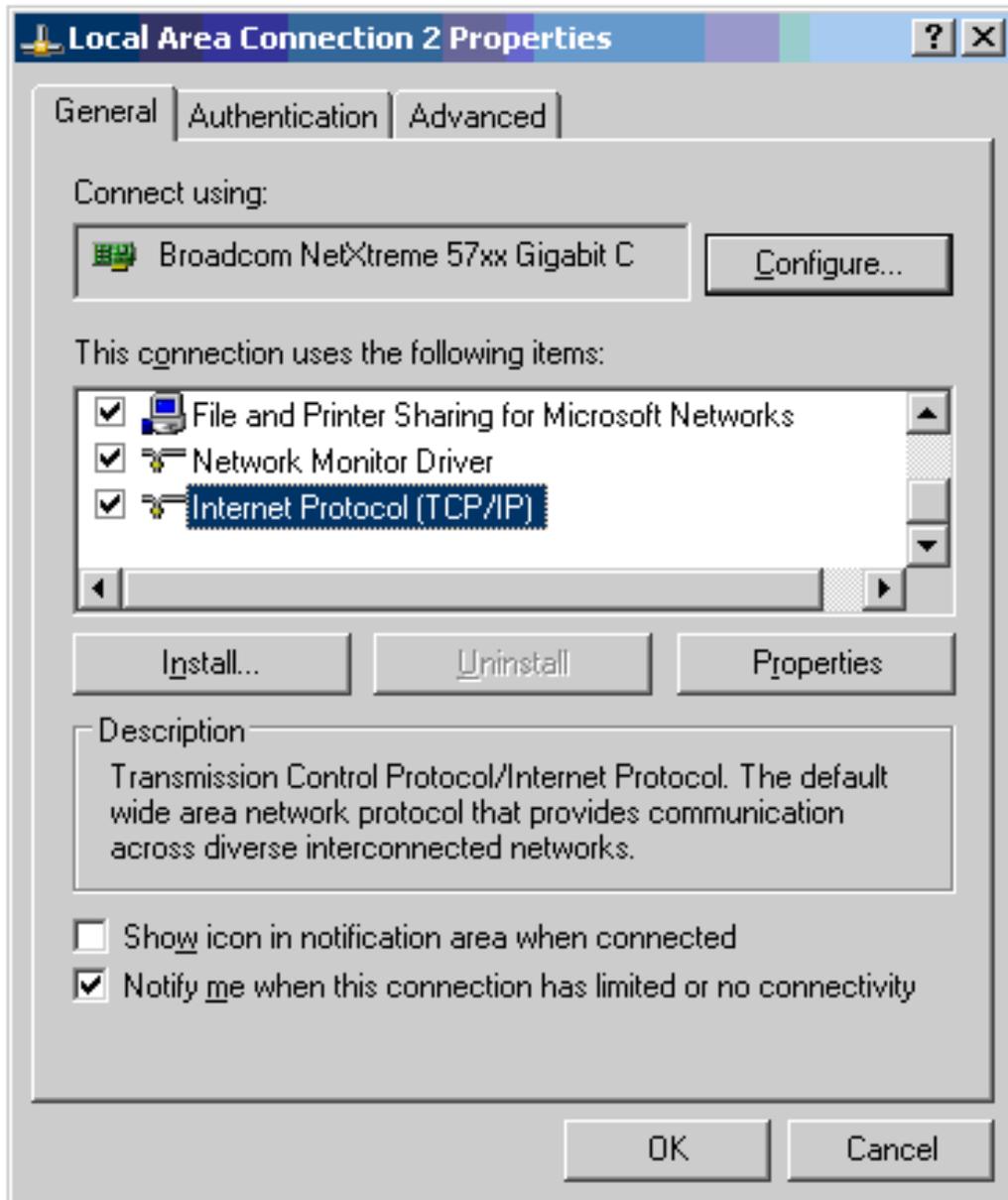
Figure 6-1 Local Area Connection Properties dialog

Figure 6-2 Internet Protocol (TCP/IP) Properties dialog

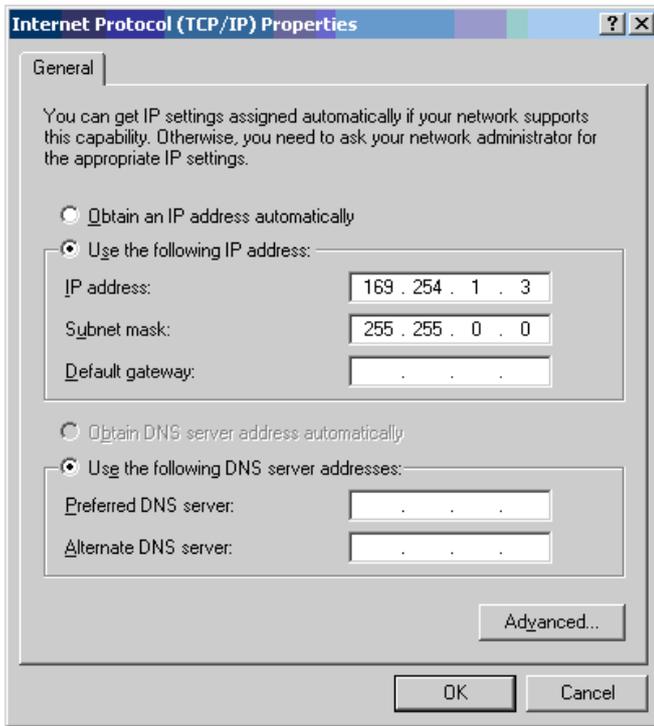
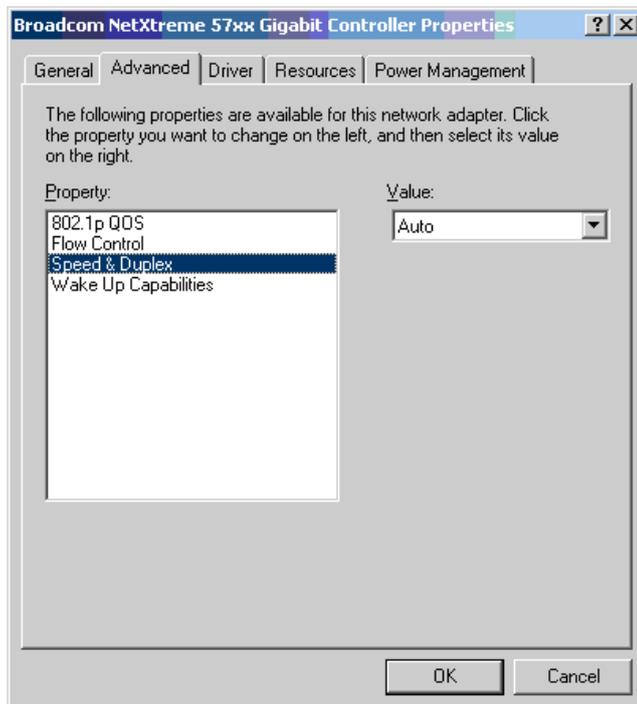


Figure 6-3 Setting Speed & Duplex (Broadcom adaptor)



Updating the ARP table

All PTP 800 units are supplied with the same default IP address. When the management PC is connected to a PTP 800 unit, it creates an association between the default IP address (169.254.1.1) and the MAC address of the PTP 800. If two or more PTP 800 units are being configured, this association must be removed after each unit has been configured.

To remove the association between IP address and MAC address in the ARP table of the management PC, proceed as follows:

1	Open a command prompt window on the PC.
2	Input the command: <code>arp -d 169.254.1.1</code>

When this address is next used, the PC will connect it with the MAC address of the unit being configured and update the ARP table with the new association.

Connecting to the PC and powering up

To connect the CMU to the PC and power up the unit, proceed as follows:

1	Connect the PC Ethernet port to the Management port of the CMU using a straight-through or crossed Cat5e cable.
2	Switch on the CMU power supply.
3	Wait until the CMU status indicator shows green steady or green slow blink. This normally occurs within 60 seconds from applying power.

Logging into the web interface

NOTE

If the management PC is connected to another LAN it may need to be configured to not use proxy servers for this IP address.

To log into the CMU web interface, proceed as follows:

1	Start the web browser from the management PC.
2	Type this IP address of the unit into the address bar: 169.254.1.1
3	Press ENTER. The web interface menu and System Summary page are displayed (Figure 6-4).
3	Select menu option System Administration . The login page is displayed (Figure 6-5).
4	Leave the Password blank and select Login .

Figure 6-4 Web interface Home page

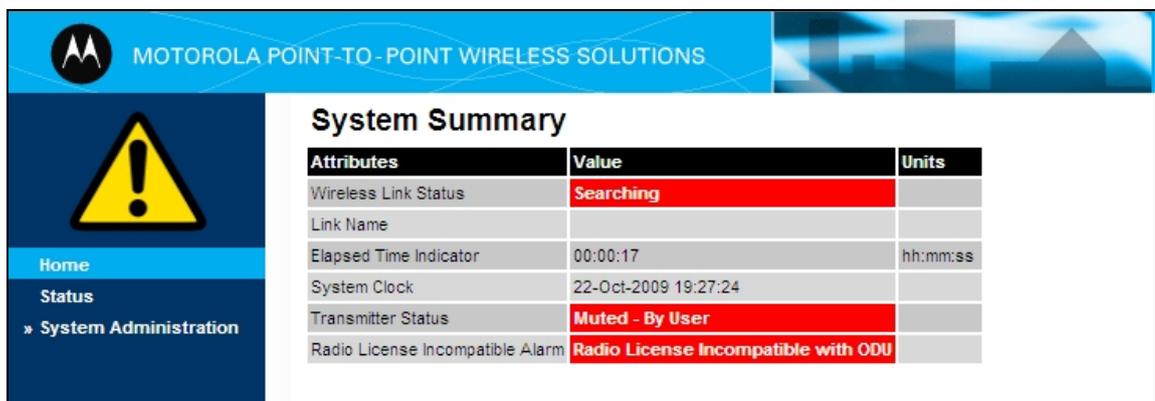


Figure 6-5 Login page



Task 2: Configuring IP and Ethernet interfaces

This task consists of the following procedures:

- [Managing the units during configuration and alignment](#) on page 6-7
- [Configuring the IP interface and management mode](#) on page 6-9
- [Reconnecting to the management PC](#) on page 6-18

Managing the units during configuration and alignment

Choose the best way to manage the PTP 800 units during the configuration and alignment process.

Out-of-band management

Where out-of-band management is chosen, the management port is active and a PC can be locally connected. Once the wireless link is operational, the remote PTP 800 unit may also be accessed across the wireless link.

In a 1+1 protected link with out-of-band management, the commissioning engineer can connect to both PTP 800s in the following ways:

- Locally from the Ethernet port of the protection splitter
- From a PC connected to a local switch where routing and connectivity exist for accessing the Ethernet port of the protection splitter.
- Before the protection splitter is installed, locally from the management port.

In-band management

Where in-band management is chosen, the choice of scheme depends on the available data network and the method of network connectivity.

With in-band management, there is a risk that a configuration error could lead to loss of management connectivity. If connectivity is lost, recover the units to a known working saved configuration, as described in [Using recovery mode](#) on page 7-50.

In a 1+1 protected link with in-band management, the commissioning engineer can connect to both PTP 800s in the following ways:

- **On the bench, via a local router:** Configure and test the final data port configuration “on the bench”. Access for commissioning will be available from a port on a locally connected switch or router. This has the advantage that simultaneous access is possible to both the CMUs being installed.
- **On the bench, via the management network:** As above, but with a connection to a management centre (not across the wireless link being installed) where a co-worker is able to configure and control the PTP 800 units.
- **Using out-of-band:** Install the CMUs using out-of-band management and configure in-band management on site. However, a protection splitter is required and the management setup needs to be reconfigured. Errors could cause loss of the management connection.
- **Using a local PC:** Use in-band management and connect a PC locally to the copper data port. This is possible if VLAN tagging is disabled. Some reconfiguration may be needed, but if the data network is not fully commissioned this could be an alternative. It is recommended that in the final configuration VLAN tagging is enabled.

Configuring the IP interface and management mode

The IP interface allows users to connect to the PTP 800 web interface, either from a locally connected computer or from a management network.

CAUTION

Before setting Management Mode to 'Out-of-Band' or 'In-Band', ensure that the local and remote CMUs are configured with different IP addresses, otherwise the management agent will not be able to distinguish the two CMUs.

Similarly for a 1+1 protected link all four CMUs must be configured with different IP addresses so that the active and inactive units may be distinguished as well as the local and remote CMUs.

NOTE

Forcing Ethernet configuration is a last resort that should only be selected if problems are experienced with auto-negotiation.

The Ethernet Auto Negotiation and Auto Neg Advertisement attributes must have the same settings in the CMU and in connected network equipment. If they are not consistent, then a duplex mismatch will occur, resulting in greatly reduced data capacity.

The Auto Neg Advertisement data rate must be within the capability of the connected network equipment, otherwise loss of service will occur.

NOTE

To configure the Ethernet link to run at a fixed speed and duplex, leave Ethernet Auto Negotiation set to 'Enabled' and set Auto Neg Advertisement to the required speed.

To configure the IP interface, proceed as follows:

1	Select menu option Configuration, LAN Configuration . The LAN Configuration page is displayed (Figure 6-6 or Figure 6-7).
2	Review and update the IP interface attributes (Table 6-1).
3	If Management Mode has been set to 'Out-of-Band Local' or 'Out-of-Band', review and update the management port attributes (Table 6-2).
4	Review and update the data port attributes (Table 6-3).
5	Review and update the bridging attributes (Table 6-4).
6	Select Submit Updated System Configuration . The Confirm LAN configuration page is displayed (Figure 6-8).
7	Select Confirm Changes .

NOTE

If the IP address is updated, then selecting **Submit Updated System Configuration** will change the IP address and communication between the management PC and the CMU will be terminated. To continue configuration, re-connect to the new IP address as described in [Reconnecting to the management PC](#) on page 6-18. In case of error see [Resetting IP and Ethernet configuration to factory defaults](#) on page 7-54.

NOTE

The SFP Configuration page is only displayed when an SFP module is installed.

Figure 6-6 LAN Configuration page with VLAN disabled

LAN Configuration

This page controls the LAN configuration of the PTP wireless unit.

Attributes	Value	Units
IP Interface		
IP Address	169 . 254 . 1 . 1	
Subnet Mask	255 . 255 . 0 . 0	
Gateway IP Address	169 . 254 . 0 . 0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Management Mode	<input checked="" type="radio"/> Out-of-Band Local <input type="radio"/> Out-of-Band <input type="radio"/> In-Band	
Management Port		
Management Port Auto Negotiation	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Management Port Auto Neg Advertisement	<input checked="" type="checkbox"/> 100 Mbps Full Duplex <input checked="" type="checkbox"/> 10 Mbps Full Duplex	
Data Port		
Data Port Wireless Down Alert	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
Data Port Ethernet Media Type To Use	Auto with Fiber Preference	
Data Port Copper Auto Negotiation	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Data Port Copper Auto Neg Advertisement	<input checked="" type="checkbox"/> 1000 Mbps Full Duplex <input checked="" type="checkbox"/> 100 Mbps Full Duplex	
Bridging		
Local Packet Filtering	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Data Port Pause Frames	<input type="radio"/> Tunnel <input checked="" type="radio"/> Discard	
<input type="button" value="Submit Updated System Configuration"/> <input type="button" value="Reset Form"/>		

Figure 6-7 LAN Configuration page with VLAN enabled

LAN Configuration			
This page controls the LAN configuration of the PTP wireless unit.			
Attributes	Value	Units	
IP Interface			
IP Address	169 . 254 . 1 . 1		
Subnet Mask	255 . 255 . 0 . 0		
Gateway IP Address	169 . 254 . 0 . 0		
Use VLAN For Management Interfaces	IEEE 802.1ad Tagged (S-Tag or B-Tag, Type 88a8)		
VLAN Management VID	1		
VLAN Management Priority	0		
Management Mode	<input checked="" type="radio"/> Out-of-Band Local <input type="radio"/> Out-of-Band <input type="radio"/> In-Band		
Management Port			
Management Port Auto Negotiation	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled		
Management Port Auto Neg Advertisement	<input checked="" type="checkbox"/> 100 Mbps Full Duplex		
	<input checked="" type="checkbox"/> 10 Mbps Full Duplex		
Data Port			
Data Port Wireless Down Alert	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled		
Data Port Ethernet Media Type To Use	Auto with Fiber Preference		
Data Port Copper Auto Negotiation	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled		
Data Port Copper Auto Neg Advertisement	<input checked="" type="checkbox"/> 1000 Mbps Full Duplex		
	<input checked="" type="checkbox"/> 100 Mbps Full Duplex		
Bridging			
Local Packet Filtering	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled		
Data Port Pause Frames	<input type="radio"/> Tunnel <input checked="" type="radio"/> Discard		
<input type="button" value="Submit Updated System Configuration"/> <input type="button" value="Reset Form"/>			

Table 6-1 IP interface attributes

Attribute	Meaning
IP Address	Internet protocol (IP) address. This address is used by the family of internet protocols to uniquely identify the unit on a network. The default IP address of the management agent is 169.254.1.1.
Subnet Mask	Defines the address range of the connected IP network.
Gateway IP Address	The IP address of a computer on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Use VLAN For Management Interface	<p>This controls whether or not the management interfaces (WWW/SNMP/SMTP/SNTP) use VLAN tags.</p> <p> CAUTION</p> <p>Ensure that the configured VLAN is accessible, otherwise it will not be possible to access the unit following the next reboot.</p>
VLAN Management VID	<p>Only displayed when 'Use VLAN for Management Interfaces' is enabled (Figure 6-7).</p> <p>Enter the VLAN VID (range 0 to 4094) that will be included in Ethernet frames generated by the management interfaces.</p>
VLAN Management Priority	<p>Only displayed when 'Use VLAN for Management Interfaces' is enabled (Figure 6-7).</p> <p>Enter the VLAN priority (range 0 to 7) that will be included in Ethernet frames generated by the management interfaces.</p>

Attribute	Meaning
Management Mode	<p>‘Out-of-Band Local’ means that the web interface can be reached from the management port at the local CMU only. This mode allows the construction of a management network that is isolated from the customer network. This is the default mode. For more information, see Out-of-band local management on page 1-38.</p> <p>‘Out-of-Band’ means that the web interface can be reached from the management port at both the local and remote CMUs (assuming that the wireless link is established). For a protected link, configuration access to the remote inactive unit requires connectivity between the management ports. For more information, see Out-of-band management on page 1-37.</p> <p>NOTE</p> <p>If ‘Out-of-Band’ is selected, remember to set the Management Committed Information Rate (Table 6-4).</p> <p>‘In-Band’ means that the web interface can be reached from the data port at both the local and remote CMUs (assuming that the wireless link is established). In this mode, the management port is disabled. For a protected link, connectivity must be provided between the CMU data ports by the customer’s network. For more information, see In-band management on page 1-38.</p> <p>NOTE</p> <p>For in-band and out-of-band remote management after installation, all four units providing a protected link are accessible from the user interface of each unit.</p>

Table 6-2 Management port attributes

Attribute	Meaning
Management Port Auto Negotiation	<p>'Enabled' means that configuration of the out-of-band management Ethernet interface is automatically negotiated. This is the default setting.</p> <p>'Disabled' means that configuration is forced.</p> <p>Use the same setting for both ends of the link.</p>
Management Port Auto Neg Advertisement	<p>Select the data rate that the auto-negotiation mechanism will advertise as available on the out-of-band management Ethernet interface. Use the same setting for both ends of the link.</p> <p>Only select a data rate that is within the capability of connected network equipment, otherwise loss of service may occur.</p>
Management Port Wireless Down Alert	<p>Only displayed when the Management Mode attribute is set to 'Out-of-Band Local' or 'Out-of-Band'.</p> <p>When enabled, this causes the Ethernet link to be dropped briefly when the wireless link drops. This signals to the connected network equipment that this link is no longer available. Connected Ethernet switches can be configured to forward Ethernet frames on an alternate path identified using the Spanning Tree Protocol (STP).</p>

Table 6-3 Data port attributes

Attribute	Meaning
Data Port Wireless Down Alert	When enabled, this causes the Ethernet link to be dropped briefly when the wireless link drops. This signals to the connected network equipment that this link is no longer available. Connected Ethernet switches can be configured to forward Ethernet frames on an alternate path identified using the Spanning Tree Protocol (STP).
Data Port Ethernet Media Type To Use	<p>Only displayed when an SFP module is installed.</p> <p>'Auto with Fiber Preference' means that if a supported SFP module is present and is working, and the fiber carrier is present, the Ethernet service connects through fiber and the copper data port is not used. If the fiber link fails or loses the carrier signal, the Ethernet service falls back to the copper LAN connection.</p> <p>'Force Copper' means that the Ethernet service connects through the copper port only and the Fiber SFP interface is disabled.</p>
Data Port Copper Auto Negotiation	<p>'Enabled' means that configuration is automatically negotiated. This is the default setting.</p> <p>'Disabled' means that configuration is forced.</p> <p>Use the same setting for both ends of the link.</p>
Data Port Copper Auto Neg Advertisement	<p>Select the data rate that the auto-negotiation mechanism will advertise as available. Use the same setting for both ends of the link.</p> <p>Only select a data rate that is within the capability of connected network equipment, otherwise loss of service may occur.</p>

Table 6-4 Bridged Ethernet traffic attributes

Attribute	Meaning
Local Packet Filtering	<p>If Local Packet Filtering is enabled, the management agent learns the location of end stations from the source addresses in received management frames. The agent filters transmitted management frames to ensure that the frame is transmitted at the Ethernet (data or management) port, or over the wireless link as appropriate. If the end station address is unknown, then management traffic is transmitted at the Ethernet port and over the wireless link.</p> <p>In out-of-band local management mode, management frames are not transmitted over the wireless link, and so address learning is not active.</p>
Management Committed Information Rate	<p>Only displayed when Management Mode is set to 'Out-of-Band'.</p> <p>Select the minimum data rate (range 200 to 2000 Kbit/s) that the network will guarantee to be available for management traffic.</p>
Data Port Pause Frames	<p>'Tunnel' means that the bridge tunnels Layer 2 PAUSE frames arriving at the Data Port.</p> <p>'Discard' means that the bridge discards Layer 2 PAUSE frames arriving at the Data Port.</p> <p>Pause frames are identified by the destination MAC Address being equal to 01-80-C2-00-00-01</p>

Figure 6-8 Confirm LAN configuration

Confirm LAN Configuration

Please confirm that these changes are correct.

Attributes	Value	Units
IP Interface		
IP Address	10.10.10.50	
Subnet Mask	255.255.0.0	
Gateway IP Address	10.10.0.0	
Use VLAN For Management Interfaces	No VLAN Tagging	
Management Mode	Out-of-Band Local	
Management Port		
Management Port Wireless Down Alert	Disabled	
Management Port Auto Negotiation	Enabled	
Management Port Auto Neg Advertisement	<input checked="" type="checkbox"/> 100 Mbps Full Duplex	
	<input checked="" type="checkbox"/> 10 Mbps Full Duplex	
Data Port		
Data Port Wireless Down Alert	Disabled	
Data Port Copper Auto Negotiation	Enabled	
Data Port Copper Auto Neg Advertisement	<input checked="" type="checkbox"/> 1000 Mbps Full Duplex	
	<input checked="" type="checkbox"/> 100 Mbps Full Duplex	
Bridging		
Local Packet Filtering	Enabled	
Management Committed Information Rate	2000	kbps
Data Port Pause Frames	Discard	
<input type="button" value="Confirm changes"/>		
◀◀ Back		

Reconnecting to the management PC

If the IP Address, Subnet Mask and Gateway IP Address of the unit have been updated to meet network requirements, then reconfigure the local management PC to use an IP address that is valid for the network. Refer to [Configuring the management PC](#) on page 6-2.

When the IP address of the unit has been reconfigured, log in using the new IP address. Refer to [Logging into the web interface](#) on page 6-6.

Access to the CMU can be recovered using Recovery mode as described in [Resetting IP and Ethernet configuration to factory defaults](#) on page 7-54.

Task 3: Configuring quality of service

Configuring QoS

To configure the classification of Layer 2 Control Protocol frames and priority encoded Ethernet frames into up to eight traffic classes, proceed as follows:

- 1 Select menu option **Configuration, Bridge Configuration**. The Bridge Configuration page is displayed (Figure 6-9).
- 2 Review and update the quality of service attributes (Table 6-5).
- 3 To use IEEE 802.1Q classification rules, select **Set Default 802.1Q Priority Mappings**.
- 4 If any attributes have been updated, select **Submit Updated Values**.

Figure 6-9 Bridge Configuration page

Bridge Configuration

This page controls the bridging function and classification of tagged Ethernet frames into priority queues. Q0 is the lowest priority queue.

Layer 2 Control Protocol Frames

Protocol	Bridge	GARP
L2CP Queue Mapping	Q7	Q7

Tagged Ethernet Frames

VLAN Priority	P0	P1	P2	P3	P4	P5	P6	P7	Untagged
VLAN Priority Queue Mapping	Q1	Q0	Q2	Q3	Q4	Q5	Q6	Q7	Q1

Table 6-5 Quality of service attributes

Attribute	Meaning
L2CP Queue Mapping	<p>Specifies the layer 2 control protocol bridge and GARP frame queue mapping.</p> <p>Bridge frames have destination addresses in the range 01-80-c2-00-00-00 to 01-80-c2-00-00-0f.</p> <p>GARP/MRP frames have destination addresses in the range 01-80-c2-00-00-20 to 01-80-c2-00-00-2f.</p> <p>Q0 is the lowest priority queue.</p>
Priority Queue Mapping	<p>Specifies the VLAN priority flag to packet queue mapping.</p> <p>Q0 is the lowest priority queue.</p>

Task 4: Installing license keys

This task consists of the following procedures:

- [Checking licensed capabilities](#) on page 6-21
- [Generating a new license key](#) on page 6-23
- [Entering a new license key](#) on page 6-23

Some PTP 800 products are supplied with two license keys: one installed at the factory and one alternative key.

NOTE

A license key is not required in order to enable the 1+1 protection capability. Each of the PTP 800s in the protection scheme is individually licensed and configured with its own license key for the capacity of the link.

Checking licensed capabilities

To check that the capabilities of the installed license key meet the operator's requirements, proceed as follows:

1	Select menu option License Key . The Software License Key page is displayed (Figure 6-10).
2	Check the attributes in the Capability summary section (Table 6-6).
3	If the current capabilities do not meet the operator's requirements, then determine the new requirements.

Figure 6-10 Software License Key page

Software License Key

Install a new license key to enable additional capabilities.

License key data entry

Attributes	Value	Units
License Key	<input type="text" value="1b49-cc32-a965-8206-bdc2-d8de-7670-c247"/>	

Capability summary

Attributes	Value	Units
Product Name	Motorola PTP 800	
MAC Address	00:04:56:30:00:bf	
Encryption Algorithm	AES 128 & 256-bit (Rijndael)	
Transmit Capacity	100 Mbps	

Table 6-6 Capability summary attributes

Attribute	Meaning
Product Name	The name of the PTP 800 product variant.
MAC Address	The MAC address of the PTP 800.
Encryption Algorithm	<p>The encryption algorithms available for use at the wireless interface of the CMU. Encryption algorithm and keys must be the same at BOTH ends of the link for it to function correctly. This attribute is only displayed if the current license key permits encryption.</p> <p>To determine upgrade requirements, see Security on page 1-49.</p>
Transmit Capacity	<p>Maximum transmit data rate for Ethernet frames. To determine upgrade requirements, see Capacity upgrades on page 1-49.</p>

Generating a new license key

To generate a new license key to activate new licensed capabilities (for example activate AES encryption or increase transmit capacity), proceed as follows:

- | | |
|----------|---|
| 1 | Purchase the required new capabilities from the Motorola authorized Point-To-Point dealer who supplied the link.
The dealer will supply one or more access keys. |
| 2 | Go to the PTP web support page at http://www.motorola.com/ptp/support and select Key Generator . The PTP License Key Generator form should be displayed. |
| 3 | Enter the required details, including the access keys supplied by the dealer. |
| 4 | Submit the web form.
The PTP License Key Generator will respond with the new license key. |

Entering a new license key

To upgrade the unit to a new license key, proceed as follows:

- | | |
|----------|---|
| 1 | Select menu option System, License Key . The Software License Key page is displayed (Figure 6-10). |
| 2 | Enter the new License Key. |
| 3 | Select Validate license key . If the license key is valid, a confirmation message is displayed. |
| 4 | Select OK to confirm. The new license key is installed in the unit. |

Task 5: Upgrading software version

This task consists of the following procedures:

- [Checking the installed software version](#) on page 6-24
- [Saving the system configuration](#) on page 6-25
- [Upgrading software in an operational protected link](#) on page 6-27
- [Upgrading to a new software version](#) on page 6-28

CAUTION

Ensure that the correct units are upgraded, as units cannot easily be downgraded afterwards.

If the link is operational, ensure that the remote end of the link is upgraded first using the wireless connection, and then the local end can be upgraded. Otherwise, the remote end may not be accessible.

Checking the installed software version

To check the installed software version, proceed as follows:

Procedure 6-1 Check software version

1	Select menu option Status . The System Status page is displayed. Software Version is in the Modem section (Figure 6-11).
2	Go to http://www.motorola.com/ptp/support and find Point-to-Point software updates. Check that the latest software version (for example 800-03-00) is the same as the installed Software Version.
3	If the software needs to be upgraded to the latest version, perform Saving the system configuration on page 6-25 and Upgrading to a new software version on page 6-28.

Figure 6-11 Software Version in System Status page

System Status			System Status		
Attributes	Value	Units	Attributes	Value	Units
Link			Wireless		
Link Name	Bolinas Ridge to Mount Tamalpais		Wireless Link Status	Up	
Site Name	Bolinas Ridge		Maximum Transmit Power	15.0	dBm
Remote MAC Address	00:04:56:30:00:c7		Remote Maximum Transmit Power	15.0	dBm
Remote IP Address	10.10.10.51		Channel Bandwidth	40	MHz
ODU			Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
ODU Status	OK		Receive Power	-49.0, -49.0, -49.0, -49.0	dBm
Transmitter Status	Transmitting		Vector Error	-35.9, -36.3, -36.5, -36.3	dB
ODU Type	23GHz TR1008 Hi 23002-23338MHz		Link Loss	134.4, 134.4, 134.4, 134.4	dB
ODU Serial	R35094182		Transmit Link Capacity	236	Mbps
ODU Version Bank 1	105/200509		Receive Link Capacity	236	Mbps
Modem			Transmit Capacity Limit	Unlimited	
MAC Address	00:04:56:30:00:bf		Transmit Capacity Limit Detail	Running At Unlimited Capacity	
Software Version	PTP800-B286+ wdog		Transmit Modulation Mode	256QAM 0.80	
Hardware Version	05.00		Receive Modulation Mode	256QAM 0.80	
Elapsed Time Indicator	00:31:03		Transmit Modulation Selection Det	Acquiring Link	
Ethernet					
Data Port Link Status	Copper Link Up				
Data Port Speed And Duplex	1000 Mbps Full Duplex				
Management Port Link Status	Copper Link Up				
Management Port Speed And Duplex	100 Mbps Full Duplex				
Automatic page refresh period in seconds	60	Seconds	<input type="button" value="Update Page Refresh Period"/> <input type="button" value="Reset form"/>		

Saving the system configuration

Before performing a software upgrade, save the current system configuration. In the unlikely event that a unit has to be replaced in the field, the replacement unit can be reconfigured by restoring the saved configuration file as described in [Restoring the configuration file](#) on page 7-57.

To save the current configuration before upgrading to a new software version, proceed as follows:

Procedure 6-2 Save configuration file

- 1 Select menu option **Configuration, Save And Restore**. The Save & Restore Configuration page is displayed ([Figure 6-12](#)).
- 2 Select **Save Configuration File**.
- 3 Save the configuration file to a PC hard drive.

The configuration file format is:

MAC-mm-mm-mm_IP-iii-iii-iii-iii.cfg

Where:

mm-mm-mm

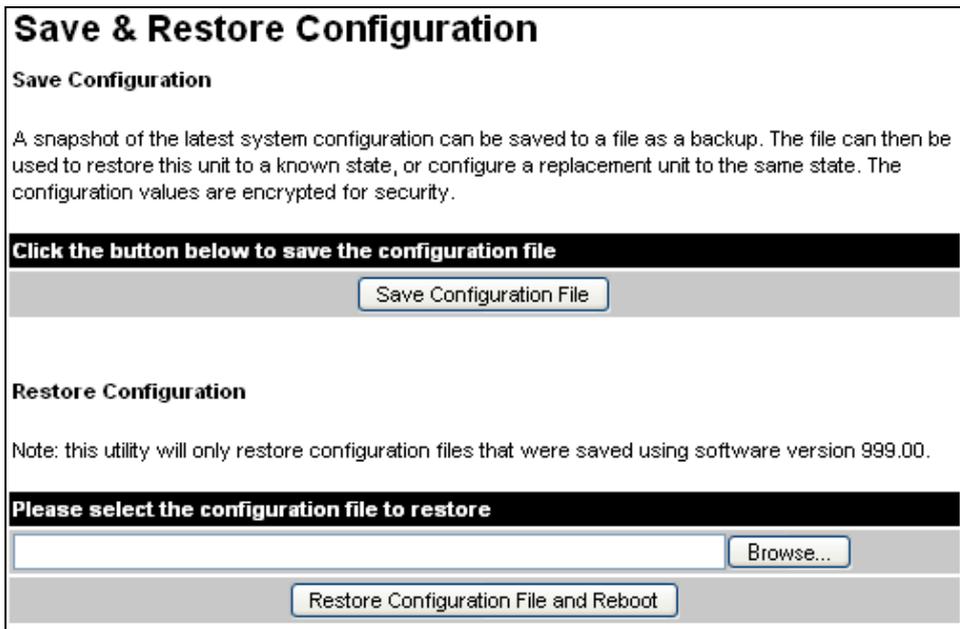
iii-iii-iii-iii

Is:

MAC address of unit

IP address of unit.

Figure 6-12 Save & Restore Configuration page



Upgrading software in an operational protected link

In protected links, the forced protection switch minimizes the link down time, since all units are inactive when upgraded. Protection switching to the newly upgraded units allows a fallback path should the upgrade have problems.

CAUTION

Upgrading in a different order could make the remote end of the protected link inaccessible and therefore require an engineer to visit the site to perform the upgrade.

NOTE

Before upgrading the software, check that no alarms are outstanding for the units to be upgraded. See [Managing alarms](#) on page 7-13.

It is expected that upgrades will normally take place from an initial status of Primary to Primary, especially for an asymmetric coupler or for a protected antenna when the inactive unit has a lower capacity.

If the 1+1 protected link is operational, upgrade the units in the following order:

1	Disable local and remote protection switching. See Enabling and disabling fault protection on page 7-33.
2	If link planning indicates that the inactive units are able to operate a link of satisfactory quality, go to step 3. Otherwise, force a protection switch at one end of the wireless link, as described in Forcing protection switches on page 7-31, so that the link is operating between a primary and a secondary unit.
3	Upgrade software on the remote inactive CMU, then on the local inactive CMU.
4	Force a protection switch at both ends to inactive CMUs and check that the link is working.
5	Upgrade software on the remote (formerly active) CMU, then on the local (formerly active) CMU.

6	<p>Test that the upgrade is successful as follows:</p> <p>If the coupler is symmetric, or if the coupler is asymmetric but the secondary units provide a good quality link, perform these tests:</p> <ol style="list-style-type: none">a. Force a local protection switch and check that the link is working.b. Force a protection switch at the other end of the wireless link to return to the initial configuration. <p>If the coupler is asymmetric, or if the antenna is protected and the inactive neighbor has a lower capacity:</p> <ol style="list-style-type: none">a. Force a combined protection switch and check that the link is working.b. Force a local end protection switch so that the optimum performing units are in use, that is, Primary to Primary.
7	<p>Re-enable local and remote protection switching.</p>

Upgrading to a new software version

Perform this task to upgrade the units to a new version of PTP 800 operational software.

NOTE

The CMU application software image contains an embedded software image for the ODU. If a CMU software upgrade introduces a new ODU software version, then the ODU software is upgraded automatically following reboot of the CMU.

NOTE

CMU software version must be the same at both ends of the link. Limited operation may sometimes be possible with dissimilar software version, but such operation is not supported by Motorola.

NOTE

Upgrade the remote end of a link before upgrading the local end, and for a protected link upgrade the inactive units and force a protection switch to them before upgrading the active units. This approach maximizes system availability.

To upgrade the software, proceed as follows:

1	Download and save the new software image (PTP 800-nn-mm.dld2).
2	Select menu option Software Upgrade . The Software Upgrade page is displayed (Figure 6-13).
3	Select Browse . Navigate to the folder containing the downloaded software image and select Open .
4	Select Upload Software Image . The Software Upgrade Confirmation page is displayed (Figure 6-14).
5	Select Program Software Image into Non-Volatile Memory . The Progress Tracker page is displayed. On completion, the Software Upgrade Complete page is displayed (Figure 6-15).
6	Select Reboot Wireless Unit . Select OK to confirm. The unit reboots with the new software installed.

Figure 6-13 Software Upgrade page

Software Upgrade

This utility allows an operator to upgrade a PTP wireless unit's operational software.

Current software image description *

Software Version: 800-01-00

Boot monitor :: Boot-01-01

Recovery software image :: Recovery-01-02

Please select a new software image (.dld2)

Figure 6-14 Software Upgrade Confirmation page

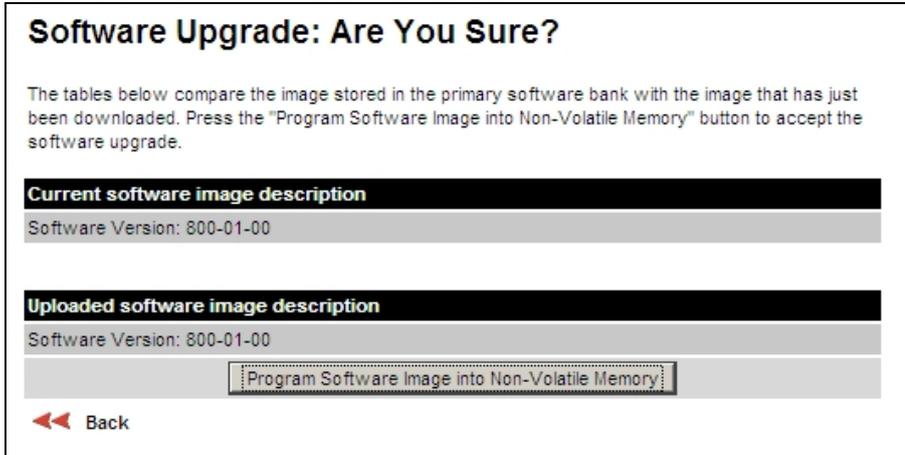


Figure 6-15 Software Upgrade Complete page



Task 6: Configuring security

This task is only performed when the PTP 800 link requires AES encryption.

This task consists of the following procedures:

- [Configuring encryption in an operational protected link](#) on page 6-31
- [Configuring AES encryption](#) on page 6-32

Configuring encryption in an operational protected link

If pre-configuring CMUs during staging, follow the procedure [Configuring AES encryption](#) on page 6-32, taking care to use the same key for each unit configured.

If configuring the units after installation of the CMUs:

- Configure licence keys on all CMUs, if required to permit use of encryption. See [Task 4: Installing license keys](#) on page 6-21.
- Follow the procedure [Changing AES encryption keys](#) on page 7-36.

Configuring AES encryption

This procedure is only performed when the link requires AES encryption.

CAUTION

Before connecting the unit to the network, ensure that access to the web-based management interface is controlled in accordance with the network operator's security policy.

AES link encryption is only available to users who have purchased an appropriate license key. Refer to [Checking licensed capabilities](#) on page 6-21.

To configure AES link encryption (before the link is operational), proceed as follows:

1	Select menu option Configuration . The System Configuration page is displayed (Figure 6-16).
2	Select the Encryption Algorithm, either 'AES 128-bit' or 'AES 256-bit'. The same algorithm must be used at both ends of the link.
3	Enter and confirm the encryption key. The key consists of 32 or 64 case insensitive hexadecimal characters. The same key must be used at both ends of the link.
4	Select Submit Updated System Configuration . The reboot confirmation dialog is displayed (Figure 6-17).
5	Select Reboot Wireless Unit and then OK to confirm.

NOTE

To enable AES encryption over an established link: open two browsers, log into the web interfaces at each end of the link, perform the above procedure at each unit, then reboot both ends of the link. The software is designed to allow five seconds so that a user can command both ends of the link to reboot before the wireless link drops.

CAUTION

Configuring link encryption over an established link will necessitate a service outage. Therefore, the configuration process should be scheduled during a period of low link utilization.

Figure 6-16 System Configuration page

System Configuration

This page controls the day to day configuration of the PTP wireless unit.

Attributes	Value	Units
Transmitter	Enabled	
<input type="button" value="Mute Transmitter"/>		

Attributes	Value	Units
Link		
Link Name	Test of AM Installation Wizard	
Site Name	<input type="text" value="Cool wall"/>	
Antenna		
Antenna Gain	38.0	dBi
RF Feeder Loss	0.0	dB
IF Cable		
IF Cable Length	0	m
Modem		
Short Power Cycle For Recovery	Disabled	
Radio License		
Radio License Identifier		
Radio License Band	18 GHz	
Radio License Region	ETSI	
Radio License Channel Separation	7 MHz	
Radio License Max EIRP	90.0	dBm
Radio License Tx Freq	18192.500	MHz
Radio License Rx Freq	19202.500	MHz
Radio License Modulation Selection	Adaptive Modulation	
Radio License Ref. Modulation	128QAM 0.76	
Wireless		
Maximum Transmit Power (Max 17.0, Min 7.0)	<input type="text" value="17.0"/>	dBm
EIRP	55.0	dBm
User ACM Highest Mod Mode	<Please re-select the Maximum Mod Mode>	
User ACM Lowest Mod Mode	<input type="text" value="64QAM 0.82"/>	
Encryption Algorithm	<input checked="" type="radio"/> None <input type="radio"/> AES 128-bit (Rijndael)	
Encryption Key	<input type="text"/>	
Automatic Transmitter Power Control	Enabled	
<input type="button" value="Submit Updated System Configuration"/> <input type="button" value="Reset Form"/>		

Figure 6-17 Configuration Reboot dialog

The Configuration Changes Require a System Reboot

The configuration changes you requested can only be activated via a system reboot. Would you like to reboot the wireless unit now?

Task 7: Setting passwords

This task consists of the following procedures:

- [Changing password](#) on page 6-34
- [Protecting access to the summary and status pages](#) on page 6-35

Changing password

Perform this task to introduce password protection, or to change an existing password.

The administrator password is an optional feature that may be used to restrict access to the System Administration pages of the web interface. PTP 800 units are shipped without pre-set passwords.

To change the password, proceed as follows:

1	Select menu option Change Password . The Change System Administrator Password page is displayed (Figure 6-18).
2	Enter the current and new passwords (Table 6-7).
3	Select Change Administration Password .

Figure 6-18 Change System Administrator Password page

Table 6-7 Change System Administrator Password attributes

Attribute	Meaning
Current Password	Enter the current password, or leave blank if not yet set.
New Password	Enter the new password. It may contain any combination of characters, up to 31 characters in length.
Confirm New Password	Retype the new password.

Protecting access to the summary and status pages

By default, the Home and Status menu items are not protected by password. If a higher level of system security is required, password protection can be extended to these pages.

To apply password access to the System Summary and System Status pages, proceed as follows:

- 1 Select menu option **Properties**. The Webpage Properties page is displayed (Figure 6-19).
- 2 In the Web Properties attribute, uncheck the 'Disable FrontPage login' box.
- 3 Select **Apply Properties**.
- 4 If the System Administration Password has not yet been set, see [Changing password](#) on page 6-34.

Figure 6-19 Webpage Properties page

Webpage Properties		
Properties		
Attributes	Value	Units
Web Properties	<input checked="" type="checkbox"/> Disable FrontPage login	
	<input type="checkbox"/> Disable HTTP NO-CACHE META data	
Auto Logout Timer	<input type="text" value="60"/>	Minutes
Distance Units	<input checked="" type="radio"/> Metric <input type="radio"/> Imperial	
Use Long Integer Comma Formatting	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Popup Help	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
<input type="button" value="Apply Properties"/> <input type="button" value="Reset Form"/>		

Task 8: Configuring alarms and messages

This task consists of the following procedures:

- [Configuring generation of SNMP notifications](#) on page 6-36
- [Configuring generation of email messages](#) on page 6-39
- [Configuring generation of diagnostics alarms](#) on page 6-40

Configuring generation of SNMP notifications

Perform this task to enable the CMU to generate Simple Network Management Protocol (SNMP) traps.

If SNMP is enabled, then the CMU generates SNMP traps when certain events occur, and sends the traps to the network SNMP management agent, which notifies the system administrator. The CMU may be configured to generate SNMP notifications for the following events:

- Cold start
- Link status change
- Diagnostic alarms

To configure SNMP notifications, proceed as follows:

1	From the left hand menu, select Remote Management . The Remote Management page is displayed (Figure 6-20).
2	Update the SNMP attributes (Table 6-8).
3	Select Submit Updated Configuration .

NOTE

A reboot is required when SNMP State attribute is changed, but not when traps are enabled.

Figure 6-20 Remote Management page

Remote Management		
HTTP and Telnet		
Attributes	Value	Units
HTTP Access Enabled	<input type="radio"/> No <input checked="" type="radio"/> Yes	
Telnet Access Enabled	<input checked="" type="radio"/> No <input type="radio"/> Yes	
Simple Network Management Protocol (SNMP)		
SNMP State	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
SNMP Enabled Traps	<input checked="" type="checkbox"/> Cold Start	
	<input checked="" type="checkbox"/> Wireless Link Up Down	
	<input checked="" type="checkbox"/> Data Port Up Down	
	<input checked="" type="checkbox"/> Management Port Up Down	
	<input checked="" type="checkbox"/> Enabled Diagnostic Alarms	
SNMP Trap Version	<input type="radio"/> SNMP version 1 <input checked="" type="radio"/> SNMP version 2c	
SNMP Trap IP Address	0 . 0 . 0 . 0	
SNMP Trap Port Number	162	
SNMP Community String	public	
SNMP Port Number	161	
Simple Mail Transfer Protocol (SMTP)		
SMTP Email Alert	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
SMTP Enabled Messages	<input checked="" type="checkbox"/> Wireless Link Up Down	
	<input checked="" type="checkbox"/> Data Port Up Down	
	<input checked="" type="checkbox"/> Management Port Up Down	
	<input type="checkbox"/> Enabled Diagnostic Alarms	
SMTP Server IP Address	0 . 0 . 0 . 0	
SMTP Server Port Number	25	
SMTP Source Email Address		
SMTP Destination Email Address		
Send SMTP Test Email	<input type="checkbox"/> Yes	
Clock		
SNTP State	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
Set Time	20 : 09 : 38	
Set Date	2009 Oct 22	
Time Zone	GMT 00.00	
Daylight Saving	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
<input type="button" value="Submit Updated Configuration"/> <input type="button" value="Reset Form"/>		

Table 6-8 Remote Management page SNMP attributes

Attribute	Meaning
SNMP State	<p>'Disabled' means that SNMP traps are not generated.</p> <p>'Enabled' means that SNMP traps will be generated in response to selected events, and sent to the network management system.</p>
SNMP Enabled Traps	Select the events that will generate SNMP traps.
SNMP Trap Version	Select the SNMP protocol version to be used for SNMP traps.
SNMP Trap IP Address	<p>Enter the IP address that will receive all SNMP traps. This will normally be the network management system, but it may be a separate trap receiver.</p> <p>To disable trap generation, enter 0.0.0.0 in the IP Address.</p>
SNMP Trap Port Number	Enter the port number of either the networked SNMP manager or trap receiver. By convention, the default port number is 162.
SNMP Community String	The SNMP community string acts like a password between the network management system and the distributed SNMP clients (PTP 800 CMUs). Only if the community string is configured correctly on all SNMP entities can the flow of management information take place. By convention the default value is set to 'public'.
SNMP Port Number	Enter the port that the SNMP agent is listening to for commands from a management system. By convention, the default port number is 161.

Configuring generation of email messages

Perform this task to enable the CMU to generate Simple Mail Transfer Protocol (SMTP) email messages.

If SMTP is enabled, then the CMU will generate email messages to alert the system administrator when certain events occur. The CMU may be configured to generate Email messages for the following events:

- Link status change
- Diagnostic alarms

To configure SMTP email messages, proceed as follows:

1	From the left hand menu, select Remote Management . The Remote Management page is displayed (Figure 6-20).
2	Update the SMTP attributes (Table 6-9).
3	Select Submit Updated Configuration . The Configuration Change Reboot dialog is displayed.
4	Select Reboot Wireless Unit . The Reboot Confirmation dialog is displayed.
5	Select OK . The reboot progress message is displayed. On completion, the unit restarts.

Table 6-9 Remote Management page SMTP attributes

Attribute	Meaning
SMTP Email Alert	'Disabled' means that SMTP emails are not generated. 'Enabled' means that SMTP emails can be generated in response to selected events.
SMTP Enabled Messages	Select the events that will generate SMTP emails.
SMTP Server IP Address	Enter the IP address of the server that is to generate emails.
SMTP Server Port Number	Enter the port number used by the networked SMTP server. By convention the default value for the port number is 25.
SMTP Source Email Address	Enter the 'from' email address used when constructing the automatically generated email message.
SMTP Destination Email Address	Enter the 'to' email address for the system administrator to receive messages.
Send SMTP Test Email	Select 'Yes' to generate and send an email in order to test the SMTP settings. The tick box will self-clear after the submit button is pressed.

Configuring generation of diagnostics alarms

Perform this task to select which diagnostic alarms will be notified to the system administrator via the network SNMP management agent or SMTP email server.

Before performing this task, ensure that the 'Enabled Diagnostic Alarms' box has been ticked in either the SNMP or SMTP sections of the Remote Management page.

To configure the generation of diagnostic alarms, proceed as follows:

1	From the left hand menu, select Diagnostic Alarms . The Diagnostic Alarms page is displayed (Figure 6-21).
2	Tick the boxes against the required alarms. These alarms are described in Managing alarms on page 7-13.
3	Select Submit Updated Configuration .

Figure 6-21 Diagnostic Alarms page

Diagnostic Alarms		
Attributes	Value	Units
Enabled Diagnostic Alarms	<input checked="" type="checkbox"/> Alignment Mode	
	<input checked="" type="checkbox"/> Link Name Mismatch	
	<input checked="" type="checkbox"/> Unit Out Of Calibration	
	<input checked="" type="checkbox"/> Encryption Enabled Mismatch	
	<input checked="" type="checkbox"/> SNTP Synchronization Failed	
	<input checked="" type="checkbox"/> Wireless Link Status	
	<input checked="" type="checkbox"/> Wireless Link Disabled Warning	
	<input checked="" type="checkbox"/> Data Port Configuration Mismatch	
	<input checked="" type="checkbox"/> Data Port Disabled Warning	
	<input checked="" type="checkbox"/> Data Port Fiber Status	
	<input checked="" type="checkbox"/> Management Port Configuration Mismatch	
	<input checked="" type="checkbox"/> Management Port Disabled Warning	
	<input checked="" type="checkbox"/> ODU Status	
	<input checked="" type="checkbox"/> Data Port Status	
	<input checked="" type="checkbox"/> Management Port Status	
<input checked="" type="checkbox"/> FCC Capacity Check		
Enabled Diagnostic Protection Alarms	<input checked="" type="checkbox"/> Protection Availability Status	
	<input checked="" type="checkbox"/> Protection Configuration Status	
	<input checked="" type="checkbox"/> Wireless Receive Signal Status	
	<input checked="" type="checkbox"/> Licensed Transmit Capacity Status	
	<input checked="" type="checkbox"/> Data Port Ethernet Speed Status	
	<input checked="" type="checkbox"/> Management Port Ethernet Speed Status	
	<input checked="" type="checkbox"/> Protection Interface Status	

Task 9: Configuring protection interface

If the PTP 800 link is to be unprotected, perform [Configuring unprotected links](#) on page 6-42. If the PTP 800 link is to be protected using the 1+1 Hot Standby feature, perform [Configuring protected links](#) on page 6-43.

Configuring unprotected links

To ensure that protection is disabled, select menu option **Configuration, Protection**. When the Protection Configuration page is displayed ([Figure 6-22](#)), confirm that the Protection attribute is set to 'Disabled'.

Figure 6-22 Protection Configuration page (protection disabled)

Protection Configuration

Do not enable the transmitter unless it is safe for the ODU to radiate!

Attributes	Value	Units
Transmitter	Muted	

Attributes	Value	Units
Protection	<input checked="" type="radio"/> Disabled <input type="radio"/> Protection 1+1	

The Status page ([Figure 6-23](#)) shows details of the PTP 800 at the other end of the link with no protection information.

Figure 6-23 Status page with protection disabled (extract)

System Status

Attributes	Value	Units	Att
Link			
Link Name	Clawton to Tavistock		Wir
Site Name	Clawton		Max
Remote MAC Address	00:04:56:30:00:d4		Ren
Remote IP Address	169.254.1.2		Che
ODU			
ODU Status	OK		Red

Configuring protected links

Configure the CMUs as two pairs of protected units prior to site installation. Each link end should have one primary (normally active) and one secondary (normally inactive) CMU.

For background information, see [1+1 Hot Standby link protection](#) on page 1-25.

Before configuring link protection for new links, complete the following prerequisites:

- Decide which CMUs are to be primary and which are secondary, and attach 'Primary' or 'Secondary' labels to the CMUs.
- Decide whether or not antenna protection is to be used.
- Decide whether the primary unit, if the secondary takes over, should switch back to active operation automatically and if so, after what period of stable operation.

Before upgrading existing links from unprotected to protected, complete the following prerequisites:

- Configure the new CMUs as primary or secondary units by setting the Primary Secondary Mode attribute.
- For a new primary CMU, ensure that wireless transmission is disabled by selecting **Mute Transmitter**. This prevents possible interference with the existing operational unit.
- Attach 'Primary' or 'Secondary' labels as appropriate to the new CMUs.
- Set Fault Protection Switching to 'Disabled'. This prevents fault protection switches occurring during installation.

To configure protection, proceed as follows:

1	Select menu option Configuration, Protection . The Protection Configuration page is displayed (Figure 6-22).
2	If the Transmitter attribute is set to 'Enabled', there may be a safety requirement to disable wireless transmission. If so, select Mute Transmitter . The Transmitter attribute changes to 'Muted'.
3	Set the Protection attribute to 'Protection 1+1'. The Protection Configuration page is displayed with protection attributes for either a primary unit (Figure 6-24) or a secondary unit (Figure 6-25).
4	Review and update the Protection Configuration attributes (Table 6-10).
5	Select Submit Updated configuration .

NOTE

If a CMU is set to primary when a coupler is used, it must be connected to the ODU on the MAIN side of the coupler. This is especially important for an asymmetric coupler where the performance of the MAIN unit will be enhanced. In this case, Primary Recovery Period should be set to a non-zero value to maximize the use of the Main Path.

NOTE

If antenna protection is used and the two antennas are not the same, then the CMU connected to the more powerful antenna must be the primary. In this case, for optimum link performance, Primary Recovery Period must also be set to a non-zero value.

Figure 6-24 Protection Management page (primary with protection enabled)

Protection Configuration

Do not enable the transmitter unless it is safe for the ODU to radiate!

Attributes	Value	Units
Transmitter	Muted	

Attributes	Value	Units
Protection	<input type="radio"/> Disabled <input checked="" type="radio"/> Protection 1+1	
Fault Protection Switching	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Primary Secondary Mode	<input checked="" type="radio"/> Primary <input type="radio"/> Secondary	
Antenna Protection	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	

Figure 6-25 Protection Management page (secondary with protection enabled)

Protection Configuration

Do not enable the transmitter unless it is safe for the ODU to radiate!

Attributes	Value	Units
Transmitter	Muted	

Attributes	Value	Units
Protection	<input type="radio"/> Disabled <input checked="" type="radio"/> Protection 1+1	
Fault Protection Switching	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Primary Secondary Mode	<input type="radio"/> Primary <input checked="" type="radio"/> Secondary	
Antenna Protection	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
Primary Recovery	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
Primary Recovery Period	<input style="width: 80px;" type="text" value="15"/>	Minutes

Table 6-10 Protection Configuration attributes

Attribute	Meaning
Transmitter	Indicates whether wireless transmission from the ODU is 'Muted' (for safety) or 'Enabled'.
Protection	<p>'Disabled' means that the link is unprotected and the other attributes are not displayed.</p> <p>'Protection 1+1' means that the link may be configured for protection and the other attributes are displayed.</p>
Fault Protection Switching	<p>This is used to allow or prevent automatic fault protection switching by this unit.</p> <p>During configuration and alignment, set this attribute to 'Disabled'.</p> <p>For normal operation, set this attribute to 'Enabled'.</p>
Primary Secondary mode	Indicates whether the CMU is to be the primary or secondary unit. A primary unit will be the active unit, excepting after a protection switchover when the secondary unit has taken over.

Attribute	Meaning
Antenna Protection	Indicates whether both ODUs at the protected link are to be connected to the same antenna using a coupler or to two separate antennas, one per ODU.
Primary Recovery	Only available when Primary Secondary Mode is 'Secondary'. Indicates whether or not the Primary unit, if the Secondary takes over, should switch back to active operation automatically.
Primary Recovery Period	Only available when Primary Secondary Mode is 'Secondary' and Primary Recovery is 'Enabled'. The period of fault-free time that must elapse on the Primary unit before a protection switch back to the Primary can occur.

Task 10: Configuring wireless interface

The Installation Wizard handles the important configuration settings that must be set to comply with the individual license conditions. These settings can only be changed using the Installation Wizard.

This task consists of the following procedures:

- [Prerequisites for the Installation Wizard](#) on page 6-47
- [Step 1: Configuring equipment parameters](#) on page 6-48
- [Step 2: Configuring radio license parameters](#) on page 6-51
- [Step 3: Configuring wireless parameters](#) on page 6-54
- [Step 4: Confirming installation configuration](#) on page 6-55
- [Step 5: Skipping antenna alignment](#) on page 6-57
- [Step 6: Completing configuration without alignment](#) on page 6-58

Prerequisites for the Installation Wizard

Before performing Steps 1 to 4 of the Installation Wizard, check that the following requirements have been met:

- All license details are available, including maximum EIRP, antenna gain, transmit and receive frequencies, channel bandwidth.
- A unique link name has been assigned to this link.

CAUTION

Link Name must be the same at both link ends, otherwise the link will not work.

Step 1: Configuring equipment parameters

To configure link equipment, proceed as follows:

1	From the left hand menu, select System Administration . The System Administration Login page (Figure 7-1) is displayed.
2	The System Administration Password is blank by default. Leave it blank and select Login . The System Administration menu (Figure 7-3) is displayed.
3	Select menu option Installation Wizard . The Step 1: Equipment Configuration page is displayed (Figure 6-26).
4	Enter the equipment configuration attributes (Table 6-11).
5	Select Next .

Figure 6-26 Step 1: Equipment Configuration page

Step 1: Enter equipment details

Equipment configuration data entry

Attributes	Value	Units
Link		
Link Name	Bolinas Ridge to Mount Tamalpais	
Site Name	Bolinas Ridge	
Antenna		
Antenna Gain	35.2	dBi
RF Feeder Loss	0.0	dB
ODU		
ODU Status	OK	
ODU Type	26GHz TR1008 HI 25557-25893MHz	
ODU Serial	R30090928	
ODU Tx Power Max	25.0	dBm
ODU Tx Power Min	2.0	dBm
IF Cable		
IF Cable Length	0	m
Modem		
Short Power Cycle For Recovery	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	

Next ▶▶

Table 6-11 Step 1: Equipment Configuration attributes

Attribute	Value
Link	
Link Name	Enter a meaningful name for the PTP link. It is used to establish a connection with the PTP 800 at the other link end (site). The Link Name must be the same at both ends of the link.
Site Name	Enter a descriptive name for the site together with any additional notes. This is used for reference only.
Antenna	
Antenna Gain	Enter the antenna gain (dBi), as specified in Antenna specifications on page 4-31.
RF Feeder Loss	Enter the loss (dB) in the feeder (waveguide) between the ODU and antenna, including loss of couplers. This should be zero for a direct mount configuration with no coupler. Waveguide specifications are provided in Flexible waveguide specifications on page 4-41
ODU	
ODU Status	The status of the ODU. If the ODU is not connected to the CMU, this attribute is set to “No Response” with a red background.
ODU Type	This is set in the factory. It consists of frequency band, Tx-Rx frequency spacing, Hi or Lo band and transmit frequency range.
ODU Serial	This is set in the factory. It uniquely identifies the ODU.
ODU Tx Power Max	This is set in the factory. It is the absolute maximum transmitter power level.
ODU Tx Power Min	This is set in the factory. It is the absolute minimum transmitter power level.
IF Cable	

Attribute	Value
IF Cable Length	<p>Enter the total length of the IF cable from the ODU to the CMU in meters or feet as appropriate. The maximum permitted length is 190 meters (620 ft) for standard IF cable.</p> <p> NOTE</p> <p style="padding-left: 40px;">If the required IF cable length is between 190 and 300 meters (620 ft and 980 ft), contact Technical Support.</p> <p style="text-align: right;">The units can be changed using the Properties web page.</p>

Modem

Short Power Cycle For Recovery	<p>If set to 'Enabled', a short power cycle will cause the CMU to boot in recovery mode.</p> <p>If set to 'Disabled', the CMU will boot in recovery mode only through use of the front panel recovery switch.</p> <p>If it is reasonably easy to access the CMU to press the Recovery button then set to 'Disabled'. Set to 'Enabled' only if the CMU will be installed in a location that is difficult to access. The short power cycle provides an additional way to start the CMU in recovery mode for remote operation.</p> <p>For more information, see Using recovery mode on page 7-50.</p>
--------------------------------	--

 **NOTE**

Ensure that Link name is the same at both ends of the link. If the Link name is not the same, the link will not establish.

Step 2: Configuring radio license parameters

When the Step 2: Radio License Configuration page is displayed ([Figure 6-27](#) or [Figure 6-28](#) or [Figure 6-29](#)), enter the radio license attributes ([Table 6-12](#)). These parameters are normally obtained from the individual license. Select **Next**.

Figure 6-27 Step 2: Radio License Configuration page (fixed modulation)

Step 2: Enter details of the Radio License		
Radio license data entry		
Attributes	Value	Units
Radio License Identifier	86X1958L3	
Radio License Band	26 GHz	
Radio License Region	ETSI	
Radio License Channel Separation	56 MHz	
Radio License Modulation Selection	<input type="radio"/> Adaptive Modulation <input checked="" type="radio"/> Fixed Modulation	
Radio License Mod Mode	256QAM 0.91	
Radio License Max EIRP	60.0	dBm
Radio License Tx Freq	24997.000	MHz
Radio License Rx Freq	26005.000	MHz

◀ Back Next ▶▶

Figure 6-28 Step 2: Radio License Configuration page (FCC adaptive modulation)

Step 2: Enter details of the Radio License

Radio license data entry

Attributes	Value	Units
Radio License Identifier	<input type="text" value="86X1958L3"/>	
Radio License Band	18 GHz ▼	
Radio License Region	FCC ▼	
Radio License Bandwidth	40 MHz ▼	
Radio License Modulation Selection	<input checked="" type="radio"/> Adaptive Modulation <input type="radio"/> Fixed Modulation	
Radio License Max Mod Mode	256QAM 0.80 ▼	
Radio License Min Mod Mode	QPSK 0.80 ▼	
Radio License Max EIRP	<input type="text" value="60.0"/>	dBm
Radio License Tx Freq	<input type="text" value="18192.500"/>	MHz
Radio License Rx Freq	<input type="text" value="19202.500"/>	MHz

◀ Back
Next ▶▶

Figure 6-29 Step 2: Radio License Configuration page (ETSI adaptive modulation)

Step 2: Enter details of the Radio License

Radio license data entry

Attributes	Value	Units
Radio License Identifier	<input type="text" value="86X1958L3"/>	
Radio License Band	18 GHz ▼	
Radio License Region	ETSI ▼	
Radio License Channel Separation	13.75 MHz ▼	
Radio License Modulation Selection	<input checked="" type="radio"/> Adaptive Modulation <input type="radio"/> Fixed Modulation	
Radio License Ref. Modulation	64QAM 0.82 ▼	
Radio License Max EIRP	<input type="text" value="90.0"/>	dBm
Radio License Tx Freq	<input type="text" value="18192.500"/>	MHz
Radio License Rx Freq	<input type="text" value="19202.500"/>	MHz

◀ Back
Next ▶▶

Table 6-12 Step 2: Radio License Configuration attributes

Attribute	Meaning
Radio License Identifier	Enter an identifier for the radio license, for example a certificate number, if one was provided by the licensing authority. This attribute is for reference only.
Radio License Band	Select the licensed band (GHz). When an ODU is attached, this attribute is set automatically.
Radio License Region	Select the license region.
Radio License Bandwidth	Select the licensed bandwidth (MHz). This attribute is only displayed when Radio License Region is set to FCC or Canada.
Radio License Channel Separation	Select the licensed spacing between channels (MHz). This attribute is only displayed when Radio License Region is set to ETSI or Brazil.
Radio License Modulation Selection	'Fixed Modulation' is the default. 'Adaptive Modulation' may be available, if permitted by the license.
Radio License Mod Mode	Select the licensed modulation mode. This attribute is only displayed when Radio License Modulation Selection is set to 'Fixed Modulation'.
Radio License Ref. Modulation	Reference modulation mode specified by the license. This control is only visible for certain regions when Radio License Modulation Selection is set to 'Adaptive'.
Radio License Max Mod Mode	Select the highest modulation mode allowed by the license. This control is only visible for certain regions when Radio License Modulation Selection is set to 'Adaptive'.
Radio License Min Mod Mode	Select the lowest modulation mode allowed by the license. This control is only visible for certain regions when Radio License Modulation Selection is set to 'Adaptive'.
Radio License Max EIRP	Enter the maximum permitted strength of the radio signal in dBm EIRP.
Radio License Tx Frequency	Enter the licensed transmit frequency (MHz).

Attribute	Meaning
Radio License Rx Frequency	Enter the licensed receive frequency (MHz).

Step 3: Configuring wireless parameters

When the Step 3: Wireless Configuration page is displayed (Figure 6-30 or Figure 6-31), enter the wireless configuration attributes (Table 6-13). Select **Next**.

Figure 6-30 Step 3: Wireless Configuration page

Step 3: Enter wireless configuration

Wireless configuration data entry

Attributes	Value	Units
Maximum Transmit Power (Max 15.0, Min 7.0)	<input type="text" value="15"/>	dBm

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Next ▶

Figure 6-31 Step 3: Wireless Configuration page (ETSI adaptive modulation)

Step 3: Enter wireless configuration

Wireless configuration data entry

Attributes	Value	Units
Maximum Transmit Power (Max 17.0, Min 7.0)	<input type="text" value="12.0"/>	dBm
Max Mod Mode (Max 128QAM 0.76)	<input type="text" value="32QAM 0.87"/> ▼	
Min Mod Mode	<input type="text" value="8PSK 0.86"/> ▼	

◀ Back
Next ▶

Table 6-13 Step 3: Wireless Configuration attributes

Attribute	Meaning
Maximum Transmit Power	Enter the maximum transmit power the wireless unit is permitted to use when establishing and maintaining the wireless link. This defaults to the lowest of the maximum allowed by the equipment, the maximum allowed by the license or the user maximum set in a previous installation.
User ACM Highest Mod Mode	This is the maximum modulation mode the radio can use when ACM is enabled. The valid range depends on the region, license and Tx Max Power. This attribute is only visible for certain regions when Radio License Modulation Selection is set to 'Adaptive'.
User ACM Lowest Mod Mode	This is the minimum modulation mode the radio can use when ACM is enabled. The valid range depends on the region, license and Tx Max Power. This attribute is only visible for certain regions when Radio License Modulation Selection is set to 'Adaptive'.

Step 4: Confirming installation configuration

When the Step 4: Confirm Installation Configuration page is displayed ([Figure 6-32](#)), review the attributes. If any are incorrect, select **Back** and return to the appropriate step to correct them. If all attributes are correct, select **Submit Updated Installation Configuration** or **Next**.

NOTE

If the ODU is not connected to the CMU, the ODU Type attribute is set to 'Not Present'.

Changed parameters are shown in bold.

Figure 6-32 Step 4: Confirm Installation Configuration page

Step 4: Confirm Installation

Below is a summary of the configuration. If any of the configuration items are incorrect please use the 'Back' button and apply your corrections.

Once the configuration is correct, press the 'Submit Updated Installation Configuration' button. This will commit the parameters to non-volatile memory.

Installation configuration summary

Attributes	Value	Units
Link		
Link Name	Bolinas Ridge to Mount Tamalpa	
Site Name	Bolinas Ridge	
Link ID	8698524	
Antenna		
Antenna Gain	35.2	dBi
RF Feeder Loss	0.0	dB
ODU		
ODU Type	26GHz TR1008 Hi 25557-25893MHz	
IF Cable		
IF Cable Length	0	m
Modem		
Short Power Cycle For Recovery	Disabled	
Radio License		
Radio License Identifier	86X1958L3	
Radio License Band	26 GHz	
Radio License Region	ETSI	
Radio License Bandwidth	56 MHz	
Radio License Max EIRP	60.0	dBm
Radio License Tx Freq	25585.000	MHz
Radio License Rx Freq	24577.000	MHz
Radio License Mod Mode	256QAM 0.91	
Wireless		
Maximum Transmit Power	15.0	dBm
EIRP	50.2	dBm

◀◀ **Back**

Step 5: Skipping antenna alignment

If the Installation Wizard is being run during pre-configuration before site installation, then antenna alignment must be deferred until site installation is complete at both link ends. If the Installation Wizard is being run after site installation is complete, then antenna alignment can begin immediately.

WARNING

Do not start antenna alignment until it is safe for the antennas to radiate RF, that is, until the antennas and ODUs have been installed on the masts or poles and no personnel are in front of the antennas.

When the Step 5: Start Antenna Alignment page is displayed ([Figure 6-33](#)), choose whether to defer or start alignment:

- If alignment is to be deferred, select **Skip Alignment**. This cancels the Install Wizard without doing alignment, but configuration changes are saved.
- If alignment is to be started now, continue at [Task 11: Aligning antennas](#) on page 6-59.

NOTE

If the ODU is not connected to the CMU, then the **Start Alignment** option is disabled. The Installation Wizard does not allow progress to antenna alignment.

Figure 6-33 Step 5: Start Antenna Alignment page

Step 5: Start Antenna Alignment

You have successfully entered all of the configuration information necessary to install a wireless link.

Click 'Start Alignment' to start the antenna alignment process.

Click 'Skip Alignment' to defer antenna alignment until later.

 Do not proceed to the next step unless it is safe for the ODU to radiate!

ODU is ready for alignment

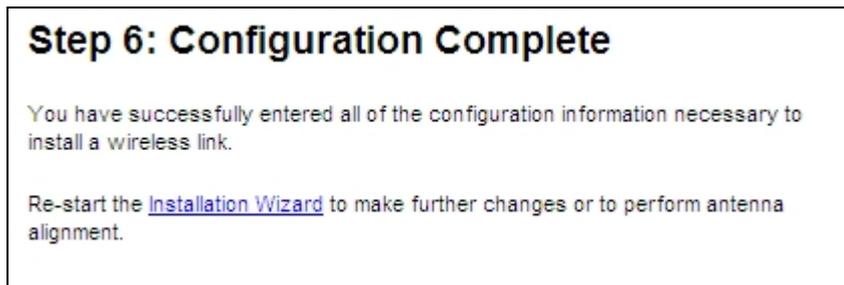
Attributes	Value	Units
ODU Status	OK	
ODU Type	26GHz TR1008 HI 25557-25893MHz	

 Back

Step 6: Completing configuration without alignment

The Step 6: Configuration Complete page is displayed ([Figure 6-34](#)). If the pre-configuration of the PTP 800 system is complete, then close the web interface.

Figure 6-34 Step 6: Configuration Complete page (step 5 cancelled)



Task 11: Aligning antennas

Use the Installation Wizard to set the system into alignment mode, to achieve the lowest possible link loss through correct antenna alignment, and to report on the performance of the configured link.

WARNING

Do not start antenna alignment until it is safe for the antennas to radiate RF, that is, until the antennas and ODUs have been installed on the masts or poles and no personnel are in front of the antennas.

For background on the alignment process, refer to [Introduction to antenna alignment](#) on page 6-59.

Check that the requirements in [Prerequisites for alignment](#) on page 6-60 have been met.

For a protected link with two antennas at each end of the link, perform [Aligning protected antennas](#) on page 6-60.

For an unprotected link, or for a protected link that uses ODU couplers, perform [Aligning a pair of antennas](#) on page 6-61.

Introduction to antenna alignment

Licensed microwave links use parabolic dish antennas which have narrow beam widths ranging from 4.7° down to 0.5°. Beam width depends on antenna gain, larger gain antennas having narrower beam widths. It is most important that all PTP 800 antennas are precisely aligned at the centre of the main beam. If antennas are not aligned at the centre of the main beam, performance will be dramatically reduced.

The alignment process requires the elevation angle (vertical plane) and azimuth angle (horizontal plane) to be adjusted. Antenna assemblies provide a mechanism for independently adjusting in both planes whilst the antenna mounting bracket is securely mounted to the mast. Please refer to the instructions provided with the antenna.

Alignment is achieved by monitoring the receive signal strength indicator (RSSI). This is provided at the ODU BNC socket in the form of a dc voltage (RSSI Voltage).

Prerequisites for alignment

Before starting alignment, check that the following requirements have been met:

- The antennas, cables and CMUs have been installed at both ends of the link.
- A link planning report is available (for example, from LINKPlanner). It should include predicted RSSI voltage ranges (or received signal levels) and bearings for both ends of the link. If the report specifies predicted receive signal levels (dBm) but not voltages, then convert dBm to volts using the formula or graph in [RSSI output](#) on page 4-17.
- Two voltmeters with BNC connectors are available.
- No personnel are in front of the antennas.

Aligning protected antennas

For a protected link with two antennas at each end of the link, align each of the following three pairs by following [Aligning a pair of antennas](#) on page 6-61:

1	Align the 'Tx Hi' primary antenna to the 'Tx Lo' primary antenna. Do not make any further adjustments to the two primary antennas.
2	Align the 'Tx Hi' secondary antenna to the (now fixed) 'Tx Lo' primary antenna.
3	Align the 'Tx Lo' secondary antenna to the (now fixed) 'Tx Hi' primary antenna.

Step 1 should be performed first, but step 3 can be performed before step 2, if preferred.

Aligning a pair of antennas

Connect the CMUs to a management PC and open the web interfaces at both ends of the link. For more information, see [Connecting to the PC and powering up](#) on page 6-5 and [Logging into the web interface](#) on page 6-6.

NOTE

When the **Start Alignment** option is selected, the Installation Wizard automatically enables wireless transmission in alignment mode.

Antennas are aligned by monitoring ODU output voltage and receive power.

Align each pair of antennas by using Step 5, Step 6 and Step 7 of the Installation Wizard, as described in the following procedures:

- [Step 5: Starting antenna alignment](#) on page 6-61
- [Step 6: Aligning antennas](#) on page 6-61
- [Step 7: Completing alignment](#) on page 6-66

Step 5: Starting antenna alignment

At both link ends, check that the Step 5: Start Antenna Alignment page is displayed ([Figure 6-33](#)). If necessary, select menu option **Installation Wizard** and click through Steps 1 to 4 of the wizard.

Step 6: Aligning antennas

Select **Start Alignment** at both link ends. The Step 6: Antenna Alignment page is displayed ([Figure 6-35](#)).

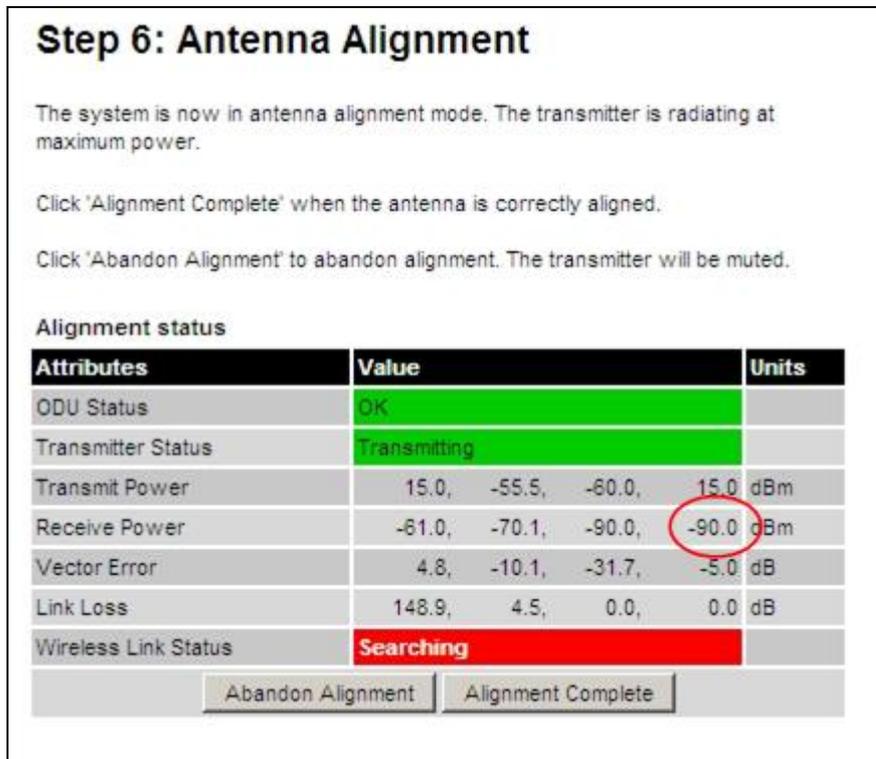
NOTE

In the Step 6: Antenna Alignment page ([Figure 6-35](#) and [Figure 6-39](#)), Transmit Power, Receive Power, Vector Error and Link Loss are presented as an array of four elements. These elements represent the maximum, mean, minimum and latest values respectively. The maximum, mean and minimum are calculated over a running one hour period.

CAUTION

During the alignment process, ensure that antenna waveguide and coaxial components are not strained beyond their minimum bend radii.

Figure 6-35 Step 6: Antenna Alignment page (searching for link)



Preparing for alignment

To prepare the antennas for alignment, proceed as follows at both link ends:

- 1 Using the instructions provided with the antenna, set the elevation and azimuth adjustment mechanisms to the centre of the range.
- 2 Using the instructions provided with the antenna, adjust the position of the antenna mounting bracket such that the antenna is pointing at the other end of the link. Use a compass and the bearing provided by the planning report.
- 3 Once the antenna is in position, resecure the mounting bracket.
- 4 Connect a suitable voltmeter to the ODU RSSI connector (Figure 6-36). Ensure that the centre of the RSSI connector is connected to the positive terminal of the voltmeter. This will be used to monitor the RSSI voltage.

Figure 6-36 Testing ODU voltage output

Aligning one end

Align the antenna at one end of the link while keeping the antenna at the other end of the link stationary.

To find the correct elevation and azimuth angles at one end, proceed as follows:

- 1 Perform a complete sweep of the elevation range of the antenna by adjusting the elevation angle incrementally. The extent of the sweep depends upon antenna gain. Measure RSSI voltage at each point in the sweep.
- 2 The resulting plot of voltage against elevation should be symmetrical. Record the elevation angle that appears to be at the axis of symmetry, as this is likely to be the correct angle for aligning with the other antenna (Figure 6-37).

NOTE

Figure 6-37 shows the axis of symmetry occurring at a voltage 'peak'. However, it is possible for the axis of symmetry (and therefore the correct elevation angle) to occur at a voltage 'trough' (Figure 6-38).

- 3 Set the elevation angle to the axis of symmetry, as identified in the plot.
- 4 Perform a complete sweep of the azimuth range of the antenna and record the resulting plot of voltage against azimuth.
- 5 Set azimuth angle to the centre of the range over which the maximum RSSI voltage is recorded.

Figure 6-37 Symmetrical relationship between voltage and alignment

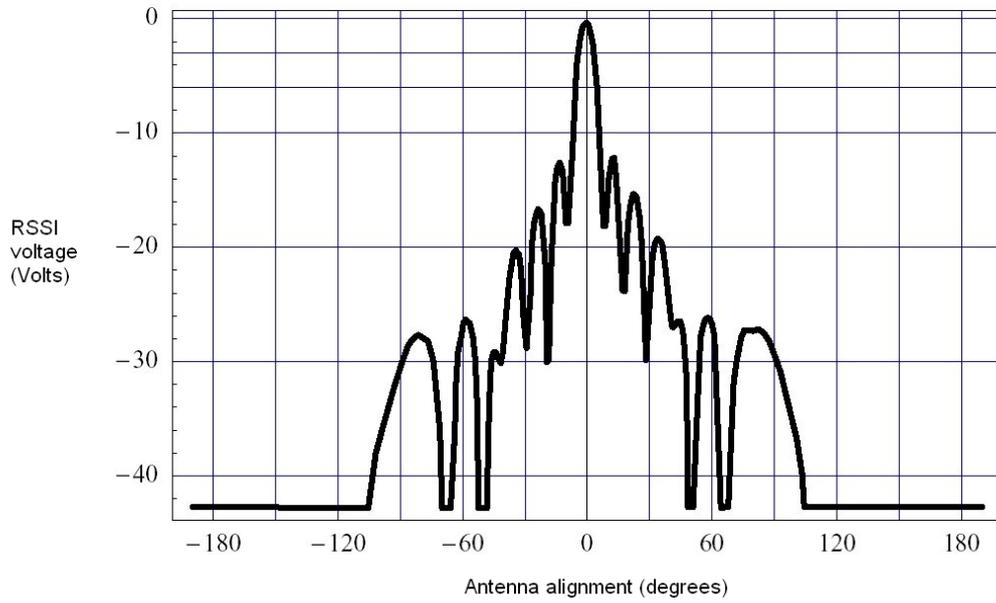
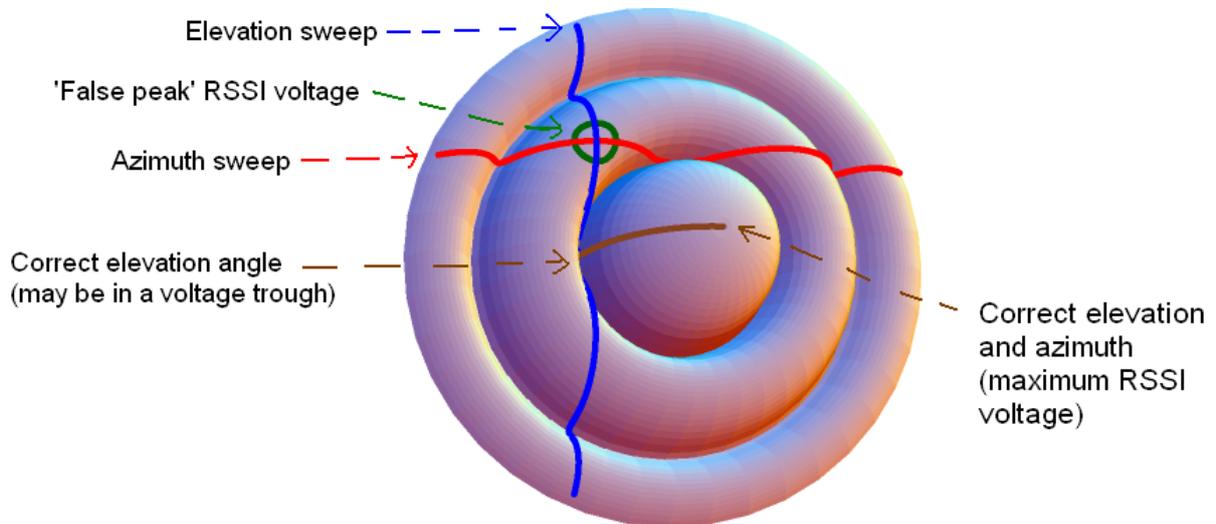


Figure 6-38 Typical RSSI voltage peaks and troughs



Aligning the other end

Repeat the above procedure at the other end of the link.

Record the RSSI voltage at both ends of the link. If the voltage at either end of the link is not in the range predicted by the planning report, repeat alignment until this is the case.

Post-alignment actions

NOTE

In a protected link, the tolerances in the ODUs may result in the Receive Power delta between the primary and secondary units at same end of the link being different from the delta predicted by the network designer. Configurations using a single antenna may have up to ± 5 dB additional delta when compared with the design value. Where separate antennas are used, the tolerances may increase if either path incurs any Excess Path Loss.

When alignment is complete at both ends, proceed as follows:

1	At each end of the link in turn, lock off and tighten all the adjustment bolts as per the instructions provided with the antenna and check that the RSSI voltage does not change. If it does change, repeat alignment for the affected end.
2	Check that the following requirements are met: <ol style="list-style-type: none"> a. RSSI voltage at both ends is within the range predicted by the planning report. b. Wireless Link Status is 'Up' (green) (Figure 6-39). c. Receive Power at both end is within the range predicted by the planning report (Figure 6-39).
3	If any of the above requirements are not met, antenna alignment is not complete; refer to troubleshooting section Installing the link on page 8-9.
4	If all of the above requirements are met, select Alignment Complete (Figure 6-39).
5	If antenna alignment cannot be performed now and must be deferred, select Abandon Alignment . This cancels the Install Wizard without doing alignment. The transmitter is muted and the Step 7: Alignment Abandoned page is displayed (Figure 6-40).

Figure 6-39 Step 6: Antenna Alignment page (link established)

Step 6: Antenna Alignment

The system is now in antenna alignment mode. The transmitter is radiating at maximum power.

Click 'Alignment Complete' when the antenna is correctly aligned.

Click 'Abandon Alignment' to abandon alignment. The transmitter will be muted.

Alignment status

Attributes	Value	Units
ODU Status	OK	
Transmitter Status	Transmitting	
Transmit Power	15.0, -50.5, -60.0, 15.0	dBm
Receive Power	-61.0, -70.8, -90.0, -61.3	dBm
Vector Error	4.8, -10.4, -31.7, -31.6	dB
Link Loss	148.9, 7.7, 0.0, 135.2	dB
Wireless Link Status	Up	

Figure 6-40 Alignment Abandoned

Step 7: Alignment Abandoned

The installation process has been abandoned. The transmitter is now muted.

Re-start the [Installation Wizard](#) to make further changes or to perform antenna alignment.

Step 7: Completing alignment

The Step 7: Installation Complete page is displayed ([Figure 6-41](#)).

Figure 6-41 Step 7: Installation Complete page

Step 7: Installation Complete

The installation process has been completed. The transmitter is now enabled.

You may wish to make further changes with the [Configuration](#) pages.

It is recommended that you save a [backup](#) copy of the link configuration.

To review the current link status, go to the [System Status](#) page.

Task 12: Reviewing configuration and performance

Perform this task after antenna alignment is complete.

This task consists of the following procedures:

- [Reviewing system configuration attributes](#) on page 6-67
- [Comparing actual to predicted performance](#) on page 6-69

Reviewing system configuration attributes

To review and update the system configuration of a PTP 800 link, proceed as follows:

1	From the left hand menu, select Configuration . The System Configuration page is displayed (Figure 7-8).
2	Review and update the system configuration attributes (Table 6-14).
3	If any attributes have been updated, select Submit Updated System Configuration .

Table 6-14 System Configuration attributes

Attribute	Meaning
Transmitter	The transmitter can be enabled as described in Enabling wireless transmission on page 7-27, or disabled as described in Disabling wireless transmission on page 7-25.
Link	
Link Name	Read only. This attribute is set in the Installation wizard (Table 6-11).
Site Name	The Site Name can be updated.
Antenna	
Antenna Gain	Read only. This attribute is set in the Installation wizard (Table 6-11).
RF Feeder Loss	Read only. This attribute is set in the Installation wizard (Table 6-11).
IF Cable	
IF Cable Length	Read only. This attribute is set in the Installation wizard (Table 6-11).
Modem	

Attribute	Meaning
Short Power Cycle for Recovery	Read only. This attribute is set in the Installation wizard (Table 6-11).
Radio License	
These attributes are read only, as they are set in the Installation wizard (Table 6-12).	
Wireless	
Maximum Transmit Power	Enter the maximum transmit power that the local wireless unit is permitted to use to sustain a link.
EIRP	The actual EIRP in dBm.
User ACM Highest Mode	This is the maximum modulation mode the radio can use when ACM is enabled. The valid range is dependant on the region, license and Tx Max Power. This control is only visible for certain regions when Radio License Modulation Selection is set to 'Adaptive'.
User ACM Lowest Mod Mode	This is the minimum modulation mode the radio can use when ACM is enabled. The valid range is dependant on the region, license and Tx Max Power. This control is only visible for certain regions when Radio License Modulation Selection is set to 'Adaptive'.
Encryption Algorithm	This is set in Configuring AES encryption on page 6-32.
Encryption Key	This is set in Configuring AES encryption on page 6-32.
Automatic Transmitter Power Control	Enable or disable this control. Use of ATPC is mandatory in some regions.

Comparing actual to predicted performance

For at least one hour of operation after alignment is complete, the link should be monitored to check that it is achieving predicted levels of performance.

To check performance, select menu option **Statistics**. The System Statistics and Counters page is displayed ([Figure 7-13](#)). Monitor the following attributes:

- Link Loss
- Transmit Data Rate
- Receive Data Rate
- **Receive Power:** To maintain error free communication, ensure that the average operational receive power, using ATPC if enabled, does not exceed -35 dBm. If the receive power exceeds -35 dBm, enable ATPC if currently disabled. Alternatively, reduce the maximum transmit power at the other end of the link to reduce the receive power to the normal operating level. If absolutely necessary the receive power level can be reduced by adding a fixed waveguide attenuator, which requires a remote mount antenna.

PTP LINKPlanner provides the prediction in the form of an installation report.

NOTE

In a protected link, the tolerances in the ODUs may result in the Receive Power delta between the primary and secondary units at same end of the link being different from the delta predicted by the network designer. Configurations using a single antenna may have up to ± 5 dB additional delta when compared with the design value. Where separate antennas are used, the tolerances may increase if either path incurs any Excess Path Loss.

For more information, refer to [Checking system statistics and counters](#) on page 7-40.

Task 13: Connecting link to the network

Perform this task to connect to the network and set the system clock.

This task consists of the following procedures:

- [Completing and testing network connections](#) on page 6-70
- [Setting the real-time clock](#) on page 6-71

Completing and testing network connections

To complete and test the network connections, proceed as follows:

1	Disconnect the local PC from the CMU management port at each CMU.
2	Connect the CMUs to the network equipment using the cables that were prepared in Preparing the network connections (unprotected) on page 5-80 or Preparing the network connections (protected) on page 5-84.
3	Check that each of the CMUs is reachable from the network management system by opening the web interface to the management agents, or by requesting ICMP echo response packets using the Ping application. The network management system will normally be geographically remote from the site, so it may be necessary to request that this action is completed by co-workers at the management centre. Alternatively, it may be possible to use remote login to the management system.
	<p> NOTE</p> <p>For testing the remote end of a link with in-band management, the wireless link may need to be operational first.</p>
4	Check that the data network operates correctly across the wireless link. This may be by requesting ICMP echo response packets between hosts in the connected network segments, or by some more structured use of network testing tools.
5	For a protected link, initiate a protection switch at one end of the link (as described in Forcing protection switches on page 7-31) and check that the data network operates correctly across the wireless link (as described in the previous step).
	Initiate a switch back to the primary unit.
	Repeat for the other end of the link.

Setting the real-time clock

The clock supplies accurate date and time information to the CMU. It can be set to run with or without a connection to a network time server (SNTP):

- In the absence of an SNTP server connection, the clock can be set to run manually. The clock is battery backed and will continue to operate for several days after the CMU is switched off.
- If an SNTP server connection is available, the clock can be set to synchronize with the server time at regular intervals.

Setting the real-time clock manually

To set the CMU clock to keep time without connecting to a networked time server, proceed as follows:

1	From the left hand menu, select Remote Management . The Remote Management page is displayed (Figure 6-20).
2	In the Clock section of the page, set the SNTP State attribute to Disabled . The manual clock attributes are displayed (Figure 6-42).
3	Review and update the manual clock attributes (Table 6-15).
4	Select Submit Updated Configuration .

Figure 6-42 Clock section of Remote Management page (SNTP disabled)

Clock	
SNTP State	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled
Set Time	10 : 33 : 55
Set Date	2009 Sep 7
Time Zone	GMT 00.00
Daylight Saving	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled

Table 6-15 Manual clock attributes

Attribute	Meaning
SNTP State	'Disabled' means that the CMU will keep time without connecting to a networked time server.
Set Time	Set hours, minutes and seconds.
Set Date	Set year, month and day.
Time Zone	Set the time zone offset from Greenwich Mean Time (GMT).
Daylight Saving	'Disabled' means that daylight saving adjustments will not be applied to the time. 'Enabled' means that daylight saving adjustments will be applied to the time, according to local rules.

Setting the real-time clock to synchronize using SNTP

To set the CMU clock to obtain accurate date and time updates from a networked time server, proceed as follows:

- 1 From the left hand menu, select **Remote Management**. The Remote Management page is displayed (Figure 6-20).
- 2 In the Clock section of the page, set the SNTP State attribute to **Enabled**. The SNTP clock attributes are displayed (Figure 6-43).
- 3 Review and update the SNTP clock attributes (Table 6-16).
- 4 Select **Submit Updated Configuration**.

Figure 6-43 Clock section of Remote Management page (SNTP enabled)

Clock	
SNTP State	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled
SNTP Server IP Address	0 . 0 . 0 . 0
SNTP Server Port Number	123
SNTP Poll Interval	3600 Seconds
SNTP Sync	No Sync
System Clock	07-Sep-2009 10:22:16
Time Zone	GMT 00:00
Daylight Saving	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled

Table 6-16 SNTP clock attributes

Attribute	Meaning
SNTP State	'Enabled' means that the CMU will obtain accurate date and time updates from a networked time server.
SNTP Server IP Address	Enter the IP address of the networked SNTP server.
SNTP Server Port Number	Enter the port number of the networked SNTP server. By convention the default value for the port number is 123.
SNTP Poll Interval	Enter the period at which the SNTP client polls the server for time correction updates (default 1 hour). If an SNTP poll fails, the client will automatically perform three retries before waiting for the user defined poll period.
SNTP Sync	This shows the current status of SNTP synchronization. If 'No Sync' is displayed, then review the SNTP Server IP Address and Port Number. A change of state may generate an SNMP trap or SMTP email alert.
System Clock	This displays the local time, allowing for the Time Zone and Daylight Saving settings.
Time Zone	Set the time zone offset from Greenwich Mean Time (GMT).
Daylight Saving	'Disabled' means that daylight saving adjustments will not be applied to the time. 'Enabled' means that daylight saving adjustments will be applied to the time, according to local rules.

Chapter 7 Operation

This chapter describes how to operate a PTP 800 link.

The following topics are described in this chapter:

- [Web-based management](#) on page 7-2
- [Managing alarms and events](#) on page 7-13
- [Disabling and enabling the wireless interface](#) on page 7-25
- [Managing wireless link protection](#) on page 7-28
- [Managing security](#) on page 7-35
- [Managing performance](#) on page 7-40
- [Rebooting the unit](#) on page 7-49
- [Using recovery mode](#) on page 7-50
- [Restoring the operational configuration](#) on page 7-57

Web-based management

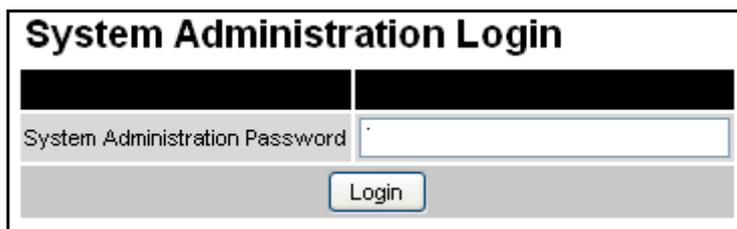
This section describes the layout and the main menu options of the PTP 800 web-based management interface.

Accessing the web interface

The web interface is best viewed using a screen resolution of at least 1024 x 768 pixels. The web pages have been tested with Internet Explorer 7, Internet Explorer 8, Firefox 3 and Firefox 3.5. Other browsers have not been tested.

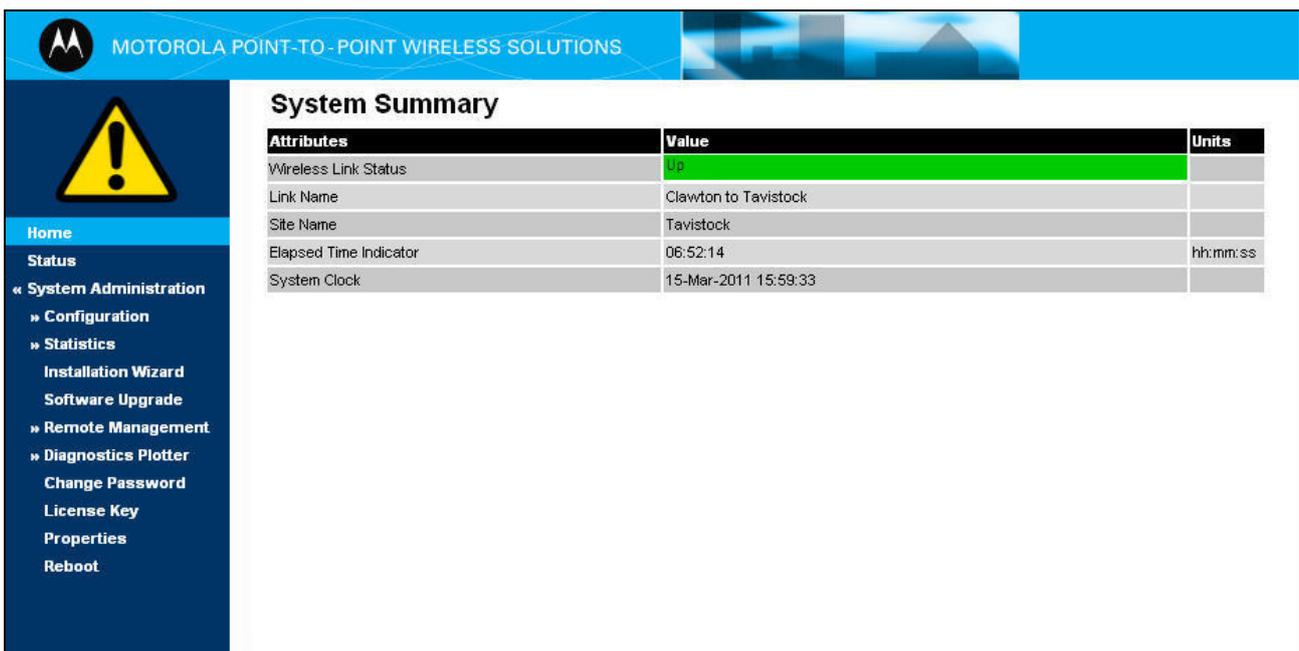
To access the web interface, type the IP address of the unit into the browser address bar and press ENTER. If the Login page (Figure 7-1) is displayed, enter Password (if set) and select **Login**.

Figure 7-1 System Administration Login page



The web interface consists of the title bar at the top, the menu bar on the left, and the web page (for the selected menu option) on the right (Figure 7-2).

Figure 7-2 Web interface



 **CAUTION**

To maintain security, users must explicitly log out of the web interface at the end of a session.

 **CAUTION**

The System Administration menu options are not password protected until a password has been set. For more information, see [Task 7: Setting passwords](#) on page 6-34.

 **NOTE**

If there is no user activity for a set period of time, the system administrator is automatically logged off. To change the automatic logout time period, or to disable automatic logout, see [Changing the log-out timer](#) on page 7-39.

Menu navigation bar

All web pages contain the menu navigation bar on the left hand side (Figure 7-3). The menu is used to navigate to other web pages. The currently selected option is always highlighted with a light blue background.

Figure 7-3 System Administration menu (with all submenus opened)



 **NOTE**

The menu option **Protected Links** is only available if 1+1 protection has been configured; see [Configuring protected links](#) on page 6-43.

Using the menu options

Table 7-1 lists the procedures that may be performed from each menu option. Many of these procedures are part of the initial configuration and alignment process described in [Chapter 6 Configuration and alignment](#).

Table 7-1 Procedures performed from each menu option

Menu option	Procedures
Home	Viewing the system summary on page 7-6
Status	Viewing the system status on page 7-8
System Administration	Logging into the web interface on page 6-6
Configuration	Configuring AES encryption on page 6-32 Reviewing system configuration attributes on page 6-67 Disabling wireless transmission on page 7-25 Enabling wireless transmission on page 7-27 Disabling AES encryption on page 7-35 Changing AES encryption keys on page 7-36
LAN Configuration	Configuring the IP interface and management mode on page 6-9
SFP Configuration	This option is only available when an SFP module is fitted. It displays information about the SFP module. There is no associated procedure.
Bridge Configuration	Configuring QoS on page 6-19
Save And Restore	Saving the system configuration on page 6-25 Restoring the configuration file on page 7-57
Protection	Task 9: Configuring protection interface on page 6-42
Protected Link	Managing wireless link protection on page 7-28
Statistics	Comparing actual to predicted performance on page 6-69 Checking system statistics and counters on page 7-40 Resetting system statistics and counters on page 7-45
Detailed Counters	
Installation Wizard	Task 10: Configuring wireless interface on page 6-47 Task 11: Aligning antennas on page 6-59
Software Upgrade	Upgrading to a new software version on page 6-28

Menu option	Procedures
Remote Management	Configuring generation of SNMP notifications on page 6-36 Configuring generation of email messages on page 6-39 Setting the real-time clock on page 6-71
Diagnostic Alarms	Configuring generation of diagnostics alarms on page 6-40
Diagnostic Plotter	Using the diagnostics plotter on page 7-45 Changing the diagnostics refresh period on page 7-48
CSV Download	Downloading diagnostic data on page 7-47
Change Password	Changing password on page 6-34
License Key	Checking licensed capabilities on page 6-21 Entering a new license key on page 6-23
Properties	Protecting access to the summary and status pages on page 6-35 Changing the log-out timer on page 7-39
Reboot	Rebooting or reviewing reboot reasons on page 7-49

Viewing the system summary

To display the System Summary page, select menu option **Home**.

The System Summary page ([Figure 7-4](#)) contains a high level summary of the status of the wireless link and associated equipment.

Figure 7-4 System Summary page

Attributes	Value	Units
Wireless Link Status	Up	
Link Name	Clawton to Tavistock	
Site Name	Tavistock	
Elapsed Time Indicator	06:52:14	hh:mm:ss
System Clock	15-Mar-2011 15:59:33	

The System Summary page displays any uncleared system alarms below the System Clock attribute. Whenever system alarms are outstanding, a yellow warning triangle is displayed on the navigation bar. For more information, refer to [Managing alarms on page 7-13](#).

 **NOTE**

Password protection can be extended to cover the System Summary page. For more information, see [Protecting access to the summary and status pages](#) on page 6-35.

The attributes of the System Summary page are described in [Table 7-2](#).

Table 7-2 System Summary attributes

Attribute	Meaning
Wireless Link Status	<p>Current status of the wireless link.</p> <p>A green background with status text 'Up' means that the point-to-point link is established.</p> <p>A red background with suitable status text (for example 'Searching') indicates that the link is not established.</p>
Link Name	The name of the PTP link, as set in the Installation wizard. The Link Name must be the same at both sites, as it is used to establish a connection with the other site.
Site Name	The name given to the site by the system administrator and set by the Installation wizard.
Elapsed Time Indicator	<p>The time (hh:mm:ss) that has elapsed since the last system reboot.</p> <p>The system can reboot for several reasons, for example, commanded reboot from the system reboot webpage, or a power cycle of the equipment.</p>
System Clock	The CMU clock presented as local time, allowing for zone and daylight saving.
Status attributes	Status attributes may be displayed in the System Summary page to indicate abnormal states.

Viewing the system status

To display the System Status page, select menu option **Status**.

The System Status page (Figure 7-5) gives the user a detailed view of the operation of the PTP 800 from both the wireless and network perspectives.

The contents of the System Status page depend upon the configuration of the PTP 800. For example, for in-band management of an unprotected unit, no status information is shown for the unused Management Port. For an unprotected link, no status information is shown relating to protection.

 **NOTE**

Password protection can be extended to cover the System Status page. For more information, see [Protecting access to the summary and status pages](#) on page 6-35.

Figure 7-5 System Status page (unprotected link)

System Status			System Status		
Attributes	Value	Units	Attributes	Value	Units
Link			Wireless		
Link Name	Bolinas Ridge to Mount Tamalpais		Wireless Link Status	Up	
Site Name	Bolinas Ridge		Maximum Transmit Power	15.0	dBm
Remote MAC Address	00:04:56:30:00:c7		Remote Maximum Transmit Power	15.0	dBm
Remote IP Address	10.10.10.51		Channel Bandwidth	40	MHz
ODU			Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
ODU Status	OK		Receive Power	-49.0, -49.0, -49.0, -49.0	dBm
Transmitter Status	Transmitting		Vector Error	-35.9, -36.3, -36.5, -36.3	dB
ODU Type	23GHz TR1008 Hi 23002-23338MHz		Link Loss	134.4, 134.4, 134.4, 134.4	dB
ODU Serial	R35094182		Transmit Link Capacity	236	Mbps
ODU Version Bank 1	105/200509		Receive Link Capacity	236	Mbps
Modem			Transmit Capacity Limit	Unlimited	
MAC Address	00:04:56:30:00:bf		Transmit Capacity Limit Detail	Running At Unlimited Capacity	
Software Version	PTP800-B266+ wdog		Transmit Modulation Mode	256QAM 0.80	
Hardware Version	05.00		Receive Modulation Mode	256QAM 0.80	
Elapsed Time Indicator	00:31:03		Transmit Modulation Selection Det	Acquiring Link	
Ethernet					
Data Port Link Status	Copper Link Up				
Data Port Speed And Duplex	1000 Mbps Full Duplex				
Management Port Link Status	Copper Link Up				
Management Port Speed And Duplex	100 Mbps Full Duplex				
Automatic page refresh period in seconds	<input type="text" value="60"/>	Seconds	<input type="button" value="Update Page Refresh Period"/> <input type="button" value="Reset form"/>		

 **NOTE**

Transmit power, receive power, vector error and link loss are presented as an array of four elements. These elements represent the maximum, mean, minimum and latest values respectively. The maximum, mean and minimum are calculated over a running one hour period.

Status page for protected links

For a 1+1 protection scheme, the IP addresses of the neighboring PTP 800 and the two remote PTP 800s are displayed on the System Status page (Figure 7-6). If the IP address is shown then this is an active link to the GUI of the other PTP 800 and clicking it transfers access to the GUI of the other PTP 800. The full status of the protection is shown by the Protected Link screen, [Managing wireless link protection](#) on page 7-28.

Figure 7-6 System Status page (protected link)

System Status			System Status		
Attributes	Value	Units	Attributes	Value	Units
Link			Wireless		
Link Name	A1 to B3		Wireless Link Status	Up	
Site Name	B3_Primary		Maximum Transmit Power	7.5	dBm
Remote Primary IP Address	172.22.9.11		Remote Maximum Transmit Power	7.5	dBm
Remote Secondary IP Address	172.22.9.13		Channel Separation	55	MHz
Remote Primary MAC Address	00:04:56:30:06:28		Transmit Power	7.5, 7.5, 7.5, 7.5	dBm
Remote Secondary MAC Address	00:04:56:30:07:60		Receive Power	-49.1, -49.4, -50.9, -50.1	dBm
Protection			Vector Error	-34.0, -34.1, -34.3, -34.1	dB
Protection State	Active		Link Loss	126.8, 125.3, 125.0, 126.0	dB
Primary Secondary Mode	Primary		Transmit Link Capacity	364.92	Mbps
Remote Primary Secondary Mode	Primary		Receive Link Capacity	364.92	Mbps
Neighbor IP Address	172.22.9.12		Transmit Capacity Limit	Unlimited	
Neighbor MAC Address	00:04:56:30:07:66		Transmit Capacity Limit Detail	Running At Unlimited Capacity	
Protection Switch Cause	No Previous Protection Switch		Transmit Modulation Mode	256QAM 0.91	
ODU			Receive Modulation Mode	256QAM 0.91	
ODU Status	OK		Transmit Modulation Selection Detail	Installation ACM Highest	
Transmitter Status	Transmitting		Ethernet		
ODU Type	ODU-A 18GHz TR1010 Hi 18940-19240MHz		Data Port Status	Copper Link Up	
ODU Serial	218KVV1034		Data Port Speed And Duplex	1000 Mbps Full Duplex	
ODU Version Bank 1	106/121209		Management Port Status	Copper Link Up	
Modem			Management Port Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:30:06:27				
Software Version	PTP800-B672+ wdog				
Hardware Version	05.03				
Elapsed Time Indicator	1 Day 00:40:49	hh:mm:ss			

Status attributes

The System Status page contains a number of status attributes. These are highlighted in green for normal operation, or in red to indicate abnormal operation. The following attributes are defined:

- ODU Status (Table 7-3).
- Transmitter Status (Table 7-4).
- Data Port Status (Table 7-5).
- Management Port Status (Table 7-6).
- Wireless Link Status (Table 7-7).
- Transmit Modulation Selection Detail Status (Table 7-8).
- Protection State (Table 7-9).

Table 7-3 ODU Status attribute values

Value	Meaning
OK	The ODU is ready for use.
ODU Fault	The ODU has raised alarms, but the CMU makes its best effort to carry on.
Incompatible License	The configured radio license is not compatible with this ODU. The ODU remains muted.
In Reset	The ODU is booting. This state is transient during CMU boot or after firmware download.
Download In Progress	New ODU firmware is being downloaded. Percentage completion is shown here.
Incompatible Firmware Version	The ODU firmware is too old. If possible, download will begin.
Incompatible Device	The connected device is an ODU, but it is not a Motorola branded product.
IF Card Attached	The connected device is an IF card, not an ODU.
No Response	No response can be detected from the ODU. It is probably not connected.
Power Supply Fault	The power supply to the ODU is at fault (short circuited).
Power Supply Disabled	The power supply to the ODU is disabled. It can only be enabled by Motorola.

Table 7-4 Transmitter Status attribute values

Value	Meaning
Transmitting	Normal transmission is in progress.
Inactive	The ODU is mute because it is in the inactive mode.
Muted - By User	The user has disabled transmission using the Configuration Page.
Muted - Configuration Error	The transmission is enabled but the radio license is not compatible.
Muted - ODU Fault	Transmission is enabled but an ODU fault is preventing transmission.

Table 7-5 Data Port Status attribute values

Value	Meaning
Down	The data port is not in operation.
Copper Link Up	The copper data port is operating normally.
Fiber Link Up	The fiber data port is operating normally.

Table 7-6 Management Port Status attribute values

Value	Meaning
Down	The management port is not in operation.
Copper Link Up	The copper management port is operating normally.

Table 7-7 Wireless Link Status attribute values

Value	Meaning
Up	The point-to-point link is established
Searching	A red background with status text "searching" indicates that the link is not established and no signal has yet been detected from the PTP 800 at the other end of the link. This is a valid status value; if the link remains in this state it implies that the remote PTP 800 has not been detected.

Value	Meaning
Other values	A red background with status text (registering, acquiring, initialising) indicates that the link is not yet established. These are normal stages in the establishment of an operational link. If the link remains in any state for a long period of time it implies a problem with the PTP 800.

Table 7-8 Transmit Modulation Selection Detail attribute values

Value	Meaning
Acquiring Link	The wireless link is not established.
Fixed	The Transmit Modulation Selection is set to 'Fixed'.
Installation ACM Highest	This is the highest transmit modulation that can be used for the installation settings.
Installation ACM Lowest	This is the lowest transmit modulation that can be used for the installation settings.
User ACM Highest	The transmit modulation is the highest configured by the user.
User ACM Lowest	The transmit modulation is the lowest configured by the user.
Limited by wireless channel conditions	The transmit modulation is limited by the wireless conditions.

Table 7-9 Protection State attribute values

Value	Meaning
Active	This unit is active, that is, it is providing the wireless transmission path on a protected link.
Inactive	This unit is inactive, that is, it is not providing the wireless transmission path on a protected link.

Managing alarms and events

This section describes how to manage PTP 800 system alarms and events.

This section contains the following procedures:

- [Managing alarms](#) on page 7-13.
- [Managing email alerts](#) on page 7-18
- [Managing SNMP traps](#) on page 7-19.

Managing alarms

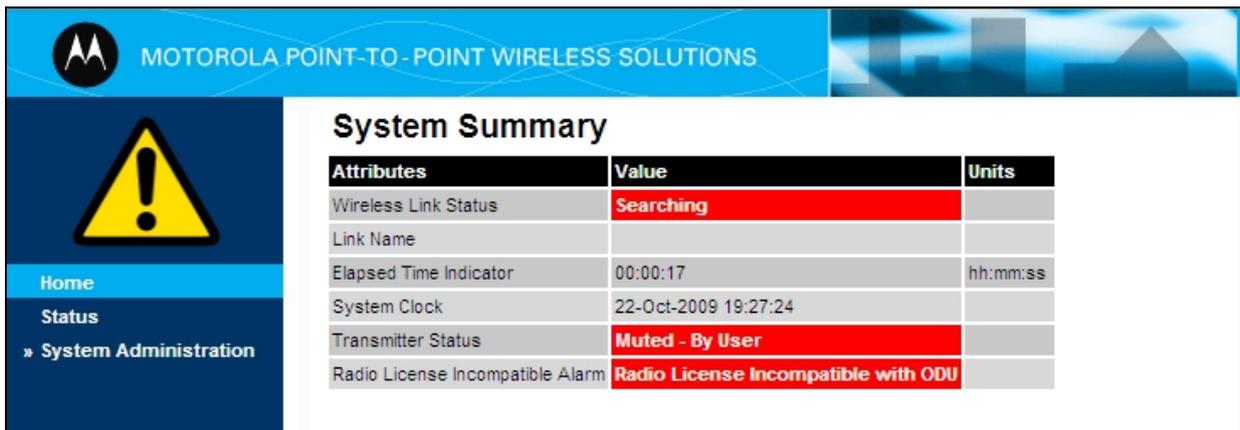
Whenever system alarms are outstanding, a yellow warning triangle is displayed on the navigation bar. The warning triangle is visible from all web pages. Click the warning triangle (or menu option **Home**) to return to the System Summary page and view the alarms. If the warning triangle disappears when it is clicked, it indicates that the outstanding alarms have been cleared.

The alarm configuration procedure is described in [Task 8: Configuring alarms and messages](#) on page 6-36.

The example in [Figure 7-7](#) shows the warning triangle in the navigation bar and the 'Channel A' alarm displayed in the System Summary page. The alarms are defined in [Table 7-10](#).

A change of state in most alarms generates an SNMP trap or an SMTP email alert.

Figure 7-7 Alarm warning triangle



System Summary

Attributes	Value	Units
Wireless Link Status	Searching	
Link Name		
Elapsed Time Indicator	00:00:17	hh:mm:ss
System Clock	22-Oct-2009 19:27:24	
Transmitter Status	Muted - By User	
Radio License Incompatible Alarm	Radio License Incompatible with ODU	

Table 7-10 System alarms

Alarm	Definition	Likely cause
Alignment mode	The CMU is in alignment mode.	This should only occur during installation or maintenance when the wireless link is being aligned.
Unit Out Of Calibration	The unit is out of calibration and must be returned to the factory using the RMA process for re-calibration.	Check the calibration status and arrange for recalibration of the unit.
Encryption Enabled Mismatch	Encryption has been enabled on one end of the wireless link but not the other.	This is probably due to a configuration error in defining use of encryption over the wireless link. See Configuring encryption in an operational protected link on page 6-31.
Data port disabled warning	The fiber and copper data port has been disabled by means of the SNMP MIB.	The Ethernet data port has been disabled remotely by a management system. The physical port continues to remain operational but no data is transmitted.

Alarm	Definition	Likely cause
Data port fiber status	A change in status at the fiber data port.	<p>There are three possible causes:</p> <ol style="list-style-type: none"> 1) The fiber interface has been installed but disabled (because the license key does not include fiber support). 2) The interface could not be established even though a fiber carrier was detected. This could be due to a broken TX fiber, or because the interface is disabled at the other end of the fiber link. 3) The interface could not be established and no fiber carrier is detected.
Data port configuration mismatch	The Ethernet configuration of the data port is not compatible with the connected network equipment.	This is probably due to a configuration error such as an auto-negotiation or forced configuration mismatch.
SNTP Synchronization Failed	SNTP has been enabled but the unit is unable to synchronize with the specified SNTP server.	<p>If SNTP Sync fails then check the server settings or disable SNTP and set the time locally.</p> <p>See Setting the real-time clock on page 6-71.</p>
Management port disabled warning	The management port has been disabled by means of the SNMP MIB.	<p>The management Ethernet port has been disabled remotely by a management system.</p> <p>The physical port continues to operate but no data is transmitted over it.</p>

Alarm	Definition	Likely cause
Management port configuration mismatch	The Ethernet configuration of the management port is not compatible with the connected network equipment.	<p>This is probably due to a configuration error such as an auto-negotiation or forced configuration mismatch.</p> <p>See Configuring the IP interface and management mode on page 6-9.</p>
ODU Status	The status of the ODU.	<p>A state of 'ok' indicates that the ODU is fully operational, although it may not be transmitting.</p> <p>Other ODU Status values indicate the nature of an ODU fault.</p> <p>See Table 7-3 for values and their meanings.</p>
Wireless link status	The status of the end-to-end wireless link.	See Table 7-7 for values and their meanings.
Data port status	The status of the data port, either fiber or copper link.	See Table 7-5 for values and their meanings.
Management port status	The status of the management port if out-of-band management is being used.	See Table 7-6 for values and their meanings.
Link name mismatch	The link names at each end of the wireless link do not match.	<p>The link name is configured differently at each end of the wireless link.</p> <p>This may be because of:</p> <p>A configuration error in defining the link name at one of the PTP 800s, see Step 1: Configuring equipment parameters on page 6-48;</p> <p>This unit is aligned to the wrong link partner.</p>

Alarm	Definition	Likely cause
FCC capacity check	The Transmit Capacity Limit of the unit (lower of license key and negotiated Ethernet speed at remote end) is below the appropriate level required by FCC Part 101.141.	This is probably due to a configuration error or the wrong license being applied to one of the CMUs.
Wireless Receives Signal Status	The Wireless Receive Signal Status indicates if the receiver is able to demodulate the transmit signal from the remote end of the link. If it cannot a protection switch may occur in a system configured for 1+1 Hot Standby.	This may be due to hardware problems: the ODU, the antenna or CMU see the diagnostic procedures under Installing the link on page 8-9. It may also be due to incorrect configuration or adverse weather conditions.
Licensed Transmit Capacity Status	In a 1+1 Hot Standby configuration, this indicates that the Licensed Transmit Capacity is below that of its neighbor.	This is probably due to a configuration error or the wrong license being applied to one of the CMUs.
Data Port Ethernet Speed Status	In a 1+1 Hot Standby configuration, this indicates if the Ethernet Speed of the Data Port is below that of its neighbor.	This is probably due to a configuration error.
Management Port Ethernet Speed Status	In a 1+1 Hot Standby configuration, this indicates if the Ethernet Speed of the Management Port is below that of its neighbor.	This is probably due to a configuration error.

Alarm	Definition	Likely cause
Protection Availability Status	This indicates whether the current configuration is capable of supporting protection.	<p>If a unit is not protected or not protecting, check the configuration of both units and check for additional alarms.</p> <p>Check that the protection interface is correctly installed.</p> <p>Check whether fault protection switching is enabled.</p> <p>See Testing protection switchover on page 8-12.</p>
Protection Configuration Status	<p>This indicates whether the configuration will support protection.</p> <p>When this indicates 'Not Protecting...', then additional status values are displayed that indicate which attributes are inconsistent between the two CMUs at a protected end.</p>	See Check the configuration of the active and inactive units on page 8-13 for further details of which attributes should be configured to the same values in both CMUs.
Protection Interface Status	This reports whether the neighbor CMU is successfully responding, physically disconnected or whether it is physically connected but not responding (perhaps because it is powered down).	This may indicate that the other unit is faulty, not available or the protection interface is not installed, not working or disconnected.

Managing email alerts

The management agent can be configured to generate alerts by electronic mail when certain events occur. The email message configuration procedure is described in [Task 8: Configuring alarms and messages](#) on page 6-36. The alerts mirror the SNMP traps defined in [Table 7-11](#).

Managing SNMP traps

The PTP 800 supports SNMP v2 remote management and provides a comprehensive range of alarms. [Table 7-11](#) lists the SNMP traps that the PTP 800 supports, their significance and possible causes.

The SNMP configuration procedure is described in [Task 8: Configuring alarms and messages](#) on page 6-36. The traps may be disabled totally or individual traps disabled.

NOTE

These traps mirror the system status and alarm information displayed on the System Summary and System Status pages.

Table 7-11 SNMP traps supported by PTP 800

SNMP Trap name	Description	Cause and action
MIB2 traps		
coldStart	A coldStart trap signifies that the SNMPv2 entity, acting in an agent role, is reinitializing itself and that its configuration may have been altered.	The CMU has rebooted. See Rebooting or reviewing reboot reasons on page 7-49.
linkDown	A linkDown trap signifies that the SNMP entity, acting in an agent role, has detected that the Operational Status for one of its communication links is about to enter the down state from some other state.	The link has gone down. This may be due to: Problems with the PTP 800. Problems on the link itself Failure of a device at the other end of the link.
linkUp	A linkUp trap signifies that the SNMP entity, acting in an agent role, has detected that the Operational Status for one of its communication links left the down state and transitioned into some other state – normally up.	The link is now available for service.

SNMP Trap name	Description	Cause and action
protectionStateTrap	<p>In a 1+1 Hot Standby configuration, this indicates a change of protection with one unit becoming active and one inactive.</p> <p>This indicates the new Protection State of a CMU / ODU to the Active or Inactive state.</p>	Check for alarms from the newly inactive unit.
Diagnostic alarms		
alignmentModeTrap	<p>Indicates if the unit is undergoing alignment.</p> <p>A change of state during operation may generate an SNMP trap and/or SMTP email alert.</p>	This should only occur during installation or maintenance when the wireless link is being aligned.
linkNameMismatchTrap	Signaling was received with the wrong Link Name.	<p>The link name is configured differently at each end of the wireless link.</p> <p>This may be because of:</p> <p>A configuration error in defining the link name at one of the PTP 800s. See Configuring encryption in an operational protected link on page 6-31.</p> <p>This unit is aligned to the wrong link partner.</p>
unitOutOfCalibrationTrap	The unit is out of calibration.	Check the calibration status and arrange for re-calibration of the unit.
encryptionEnabledMismatchTrap	Encryption has been enabled on one end of the wireless link but not the other.	Configuration error in defining use of encryption over the wireless link.

SNMP Trap name	Description	Cause and action
sNTPSyncTrap	The PTP 800 has failed to synchronize its time with the SNTP server.	If SNTP Sync fails then check the server settings in the Remote Management page, or disable SNTP and set the time locally. See Setting the real-time clock on page 6-71.
wirelessLinkStatusTrap	The status of the wireless link has changed.	<p>This shows the status that the wireless link has entered.</p> <p>If the link remains in the state 'registering' or 'searching' it is unable to detect the PTP 800 at the other end of the link.</p> <p>This may be due to the unit at the other end of the link not being operational, being incorrectly configured/aligned or due to adverse weather conditions.</p>
dataPortConfigurationMismatchTrap	The detection of Ethernet fragments (runt packets) on the data Ethernet port when the link is in full duplex operation.	This is probably due to a configuration error such as an auto-negotiation or forced configuration mismatch.
dataPortDisabledWarningTrap	The Administrative Status of the data Ethernet interface has been set to disabled.	<p>The Ethernet data port has been disabled remotely by a management system.</p> <p>The physical port continues to remain operational but no data is transmitted.</p>

SNMP Trap name	Description	Cause and action
dataPortFiberStatusTrap	<p>A problem has been detected with the fiber interface on the data Ethernet port.</p> <p>The attribute dataPotrtFiberStatus identifies which problem has been detected.</p>	<p>There are three possible causes:</p> <p>1) The fiber interface has been installed but disabled (because the license key does not include fiber support).</p> <p>2) The interface could not be established even though a fiber carrier was detected. This could be due to a broken TX fiber, or because the interface is disabled at the other end of the fiber link.</p> <p>3) The interface could not be established and no fiber carrier is detected.</p>
managementPortConfigurationMismatchTrap	<p>The detection of Ethernet fragments (runt packets) on the data Ethernet port when the link is in full duplex operation.</p>	<p>This is probably due to a configuration error such as an auto-negotiation or forced configuration mismatch.</p>
managementPortDisabledWarningTrap	<p>The Administrative Status of the out-of-band management Ethernet interface has disabled Ethernet traffic.</p>	<p>The management Ethernet port has been disabled remotely by a management system.</p> <p>Note that the physical port continues to operate but no data is transmitted over it.</p>
oDUStatusTrap	<p>A change of status of the ODU has occurred.</p>	<p>The ODU Status indicates the nature of the ODU fault.</p> <p>A state of 'ok' indicates that the ODU is fully operational, although may not be transmitting.</p>
dataPortStatusTrap	<p>A change of state for the data port has occurred.</p>	<p>The data port status has changed – most significantly to up or down</p>

SNMP Trap name	Description	Cause and action
managementPortStatusTrap	<p>Change of status of the out-of-band management Ethernet link.</p> <p>This may indicate a status of “down” or “copper link up”.</p>	<p>This may be due to failure of the link or equipment at the either end of the link.</p> <p>Note that a failure trap may not be received if no route is available.</p>
protectionAvailabilityStatusTrap	In a 1+1 Hot Standby configuration, this indicates that protection is available.	<p>If this trap is generated when a unit is not protected or not protecting, check the configuration of both units and check for alarms on the inactive unit.</p> <p>Check whether fault protection switching is enabled.</p>
configurationProtectionStatusTrap	In a 1+1 Hot Standby configuration, this indicates whether or not the configuration will support protection.	In a protected configuration check the configuration of both units.
wirelessReceiveSignalStatusTrap	<p>The Wireless Receive Signal Status indicates if the receiver is able to demodulate the transmit signal from the remote end of the link.</p> <p>If it cannot demodulate the signal, a protection switch may occur in a system configured for 1+1 Hot Standby.</p>	<p>This may be due to hardware problems: the ODU, antenna or CMU.</p> <p>It may also be due to incorrect configuration or adverse weather conditions.</p>
licensedTransmitCapacityStatusTrap	In a 1+1 Hot Standby configuration, this indicates that the Licensed Transmit Capacity is below that of its neighbor.	This is probably due to a configuration error or the wrong license being applied to one of the CMUs.
dataPortEthernetSpeedStatusTrap	In a 1+1 Hot Standby configuration this indicates that the Ethernet Speed of the Data Port is below that of its neighbor.	This is probably due to a configuration error.

SNMP Trap name	Description	Cause and action
managementPortEthernetSpeedStatusTrap	<p>In a 1+1 Hot Standby configuration, this indicates that attribute indicates that the Ethernet Speed of the Management Port is below that of its neighbor.</p>	<p>This is probably due to a configuration error.</p>
protectionInterfaceStatusTrap	<p>In a 1+1 Hot Standby configuration, information is shared between neighbor CMUs over the Protection Interface.</p> <p>This reports whether the neighbor CMU is successfully responding, physically disconnected or whether it is physically connected but not responding, for example powered down.</p>	<p>This may indicate that the other unit is faulty, not available or the protection interface is not installed, not working or disconnected.</p>

Disabling and enabling the wireless interface

This section describes how to disable wireless transmission (prevent antenna radiation) and enable wireless transmission (allow antenna radiation).

Disabling wireless transmission

Perform this procedure to prevent the antenna from radiating. This is necessary when maintenance work is needed near the antenna.

To disable wireless transmission, select menu option **Configuration**. The System Configuration page is displayed. Select **Mute Transmitter** (Figure 7-8). The Transmitter attribute value changes to 'Muted'.

NOTE

Wireless transmission can also be disabled from the Protection Configuration page (Figure 6-22), for both protected and unprotected links.

CAUTION

In a 1+1 protected interface, disable protection switchover before disabling wireless transmission (see [Enabling and disabling fault protection](#) on page 7-33). Otherwise, a switchover to the inactive unit may occur when the wireless interface is muted. Re-enable protection switchover when wireless transmission is re-enabled.

Figure 7-8 System Configuration page

System Configuration

This page controls the day to day configuration of the PTP wireless unit.

Attributes	Value	Units
Transmitter	Enabled	
<input type="button" value="Mute Transmitter"/>		

Attributes	Value	Units
Link		
Link Name	Test of AM Installation Wizard	
Site Name	<input type="text" value="Cool wall"/>	
Antenna		
Antenna Gain	38.0	dBi
RF Feeder Loss	0.0	dB
IF Cable		
IF Cable Length	0	m
Modem		
Short Power Cycle For Recovery	Disabled	
Radio License		
Radio License Identifier		
Radio License Band	18 GHz	
Radio License Region	ETSI	
Radio License Channel Separation	7 MHz	
Radio License Max EIRP	90.0	dBm
Radio License Tx Freq	18192.500	MHz
Radio License Rx Freq	19202.500	MHz
Radio License Modulation Selection	Adaptive Modulation	
Radio License Ref. Modulation	128QAM 0.76	
Wireless		
Maximum Transmit Power (Max 17.0, Min 7.0)	<input type="text" value="17.0"/>	dBm
EIRP	55.0	dBm
User ACM Highest Mod Mode	<Please re-select the Maximum Mod Mode> <input type="button" value="v"/>	
User ACM Lowest Mod Mode	64QAM 0.82 <input type="button" value="v"/>	
Encryption Algorithm	<input checked="" type="radio"/> None <input type="radio"/> AES 128-bit (Rijndael)	
Encryption Key	<input type="text"/>	
Automatic Transmitter Power Control	Enabled	
<input type="button" value="Submit Updated System Configuration"/> <input type="button" value="Reset Form"/>		

Enabling wireless transmission

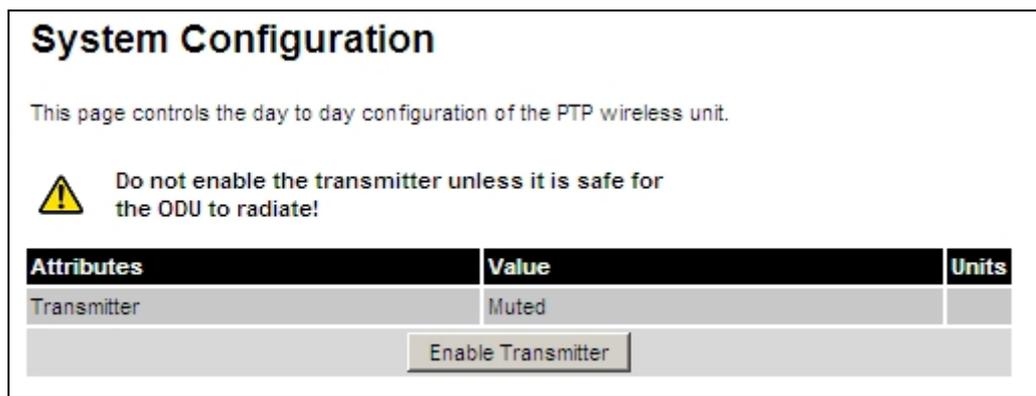
Perform this procedure to permit the antenna to radiate. This is necessary to restart the link when maintenance work is complete.

To enable wireless transmission, select menu option **Configuration**. The System Configuration page is displayed (Figure 7-9). Select **Enable Transmitter**. The Transmitter attribute value changes to 'Enabled'.

NOTE

Wireless transmission can also be enabled from the Protection Configuration page (Figure 6-22), for both protected and unprotected links.

Figure 7-9 System Configuration page (partial view) when transmitter is muted



Managing wireless link protection

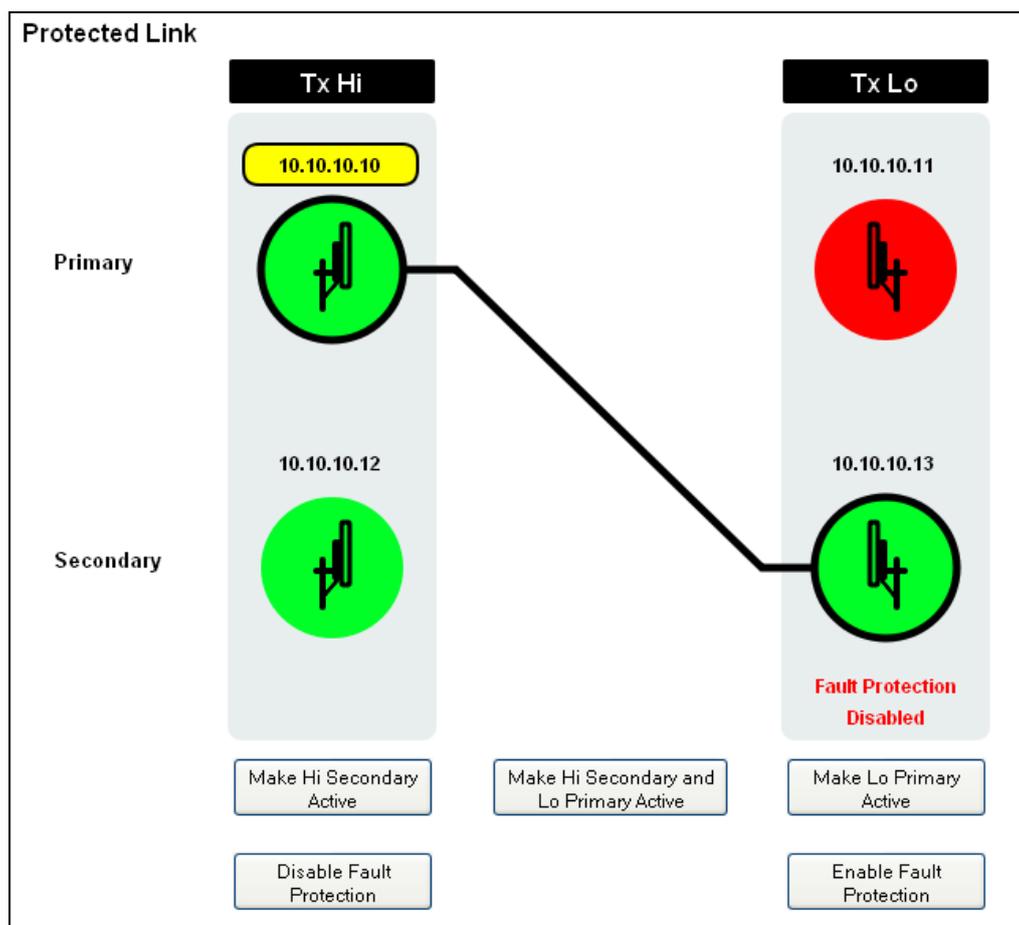
This section describes the features of the Protected Link page. These are:

- A graphical view of the current protection state of a wireless link and the individual PTP 800 units.
- An indication of any alarm conditions detected by the PTP 800s.
- Access to the management GUI of the PTP 800 units in the protection scheme.
- The ability to force protection switches and inhibit protection switching.

Viewing the status of a protected link

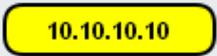
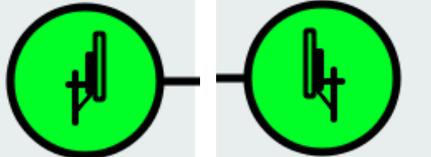
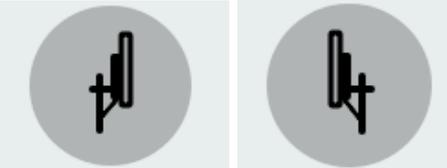
To view the status of a protected link, select menu option **Configuration, Protected Link** (this option is only available when link protection is enabled). The Protected Link page (Figure 7-10) is displayed.

Figure 7-10 Protected Link page



This page shows the same view of the link from the web interface of any of the four units. The positions of the units on the page are determined by their Tx Hi/Lo and Primary/Secondary mode settings. The symbols, text and their meanings are shown in [Table 7-12](#).

Table 7-12 Protected Link page symbols and text

Symbols or text	Meaning
	Units at this end of the link transmit on the higher frequency sub-band (always shown on the left).
	Units at this end of the link transmit on the lower frequency sub-band (always shown on the right).
Primary	These units are configured to be active until a protection switch occurs.
Secondary	These units are configured to be inactive until a protection switch occurs.
	IP address of the unit that currently provides the management interface.
	IP address of a unit that currently does not provide the management interface.
	These units are active (Tx Hi and Tx Lo). The black line represents the link between active units.
	These units are inactive (Tx Hi and Tx Lo).
	These units are faulty, or fault protection has been disabled (Tx Hi and Tx Lo). Roll the mouse over this icon to see the alarm condition.
	These units cannot be reached. The status is unknown (Tx Hi and Tx Lo).

Symbols or text	Meaning
 The icon consists of a light blue rounded rectangle containing the text 'Fault Protection' in red and 'Disabled' in black below it.	Protection switching has been disabled at this link end (the inactive unit is shown in red).

Using the Protected Link page

Viewing system status

To view the System Status page for an active, inactive or faulty unit, click on the icon. See [Viewing the system status](#) on page 7-8.

Viewing alarms and faults

If the alarm warning triangle is displayed on the menu bar, click on it to view the outstanding alarm list for the unit that currently provides the management interface. See [Viewing the system summary](#) on page 7-6 and [Managing alarms](#) on page 7-13.

Rolling the cursor over a red icon causes a list of protection faults for that unit to be displayed.

Viewing the status of mismatched neighbors

Certain configuration attributes must be the same on neighbors in order for an inactive unit to protect an active unit. If the inactive unit does not match, it will be shown in red on the Protected Link page and the reason will be 'Configuration not protecting'. To determine which attribute is not matched, select the Home page of the misconfigured unit.

If the inactive unit is not protecting the active unit for any reason (for example, it is misconfigured or has a fault) a summary attribute called `protectionAvailabilityStatus` will be displayed on the Home page of both the active and inactive unit. On the active unit it will have the value of 'Not Protected'. On the inactive unit it will have the value of 'Not Protecting'.

Forcing protection switches

Protection switches may be forced for a variety of reasons, for example:

- During maintenance operations.
- During software or hardware upgrades.
- To investigate error conditions that have not resulted in a protection switch.
- To confirm that the inactive unit remains fully functional.

CAUTION

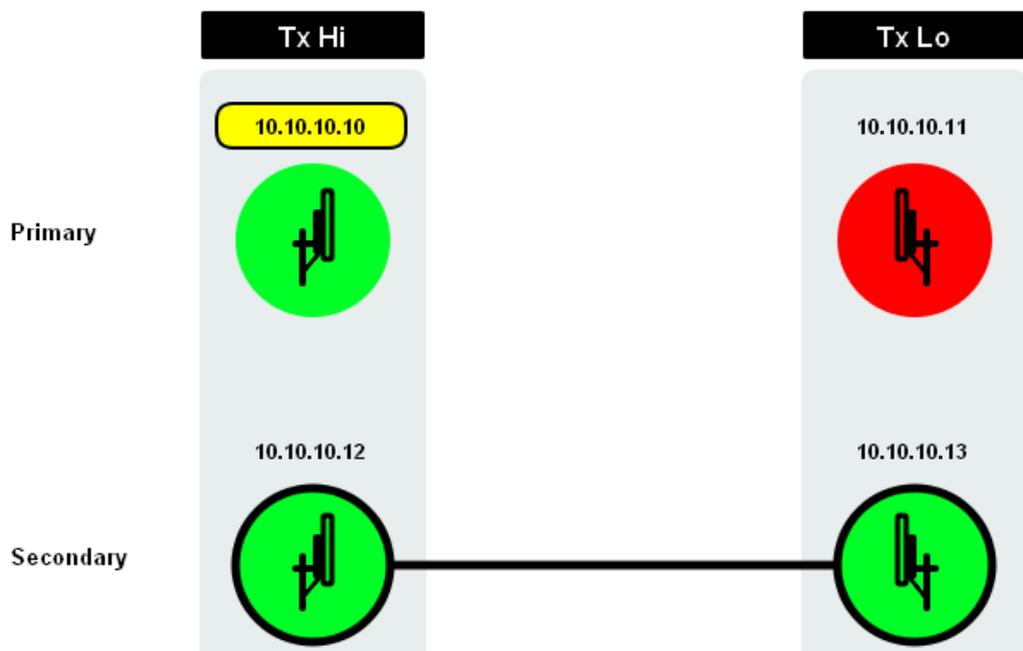
To avoid loss of service, force protection switches only if link planning indicates that the unit(s) are capable of operating a satisfactory link.

After a protection switch has been initiated, if work is to be carried out on the newly inactive unit, ensure that fault protection is temporarily disabled until the activity is completed.

To force protection switches, click on the buttons on the Protected Link page. The text in the buttons varies depending upon which units are active and which are inactive. Assuming that the initial status is Primary to Primary ([Figure 7-10](#)), the buttons and their functions are as follows:

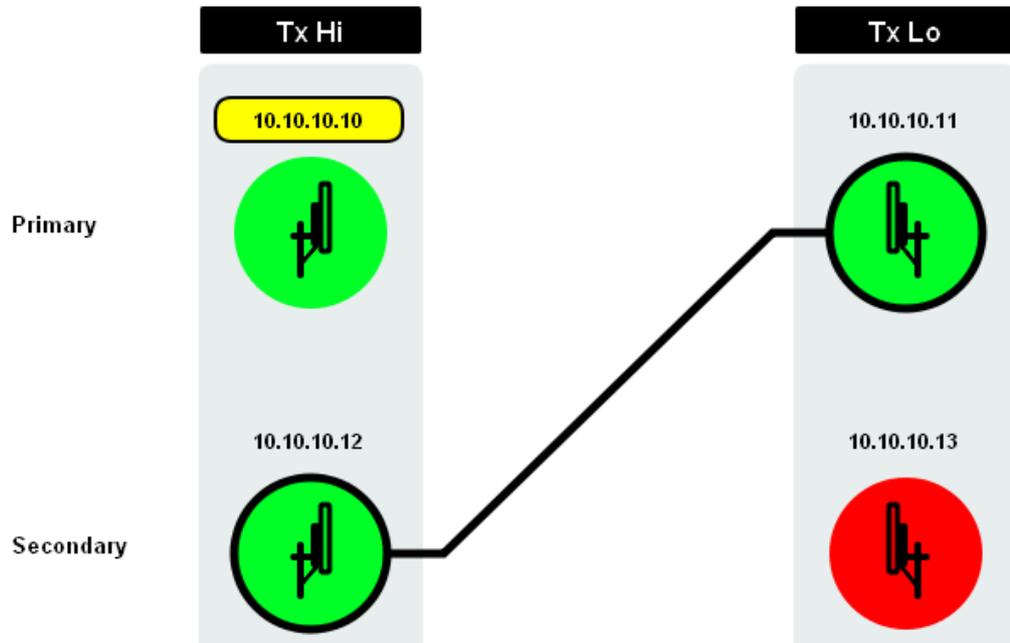
Make Hi Secondary
Active

This changes the [Figure 7-10](#) configuration to:



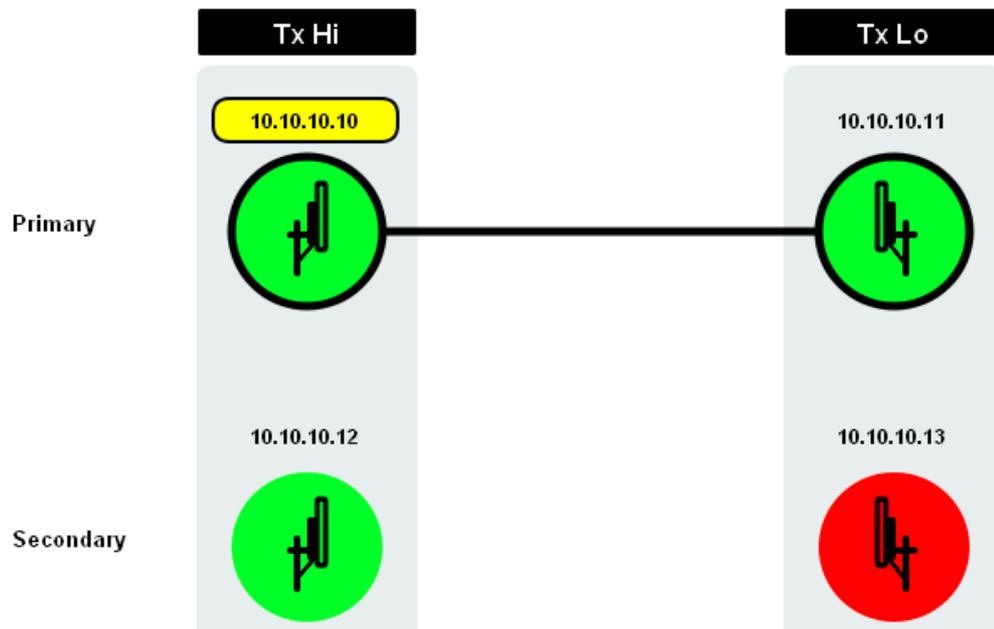
Make Hi Secondary and Lo Primary Active

This changes the [Figure 7-10](#) configuration to:



Make Lo Primary Active

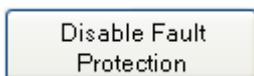
This changes the [Figure 7-10](#) configuration to:



Enabling and disabling fault protection

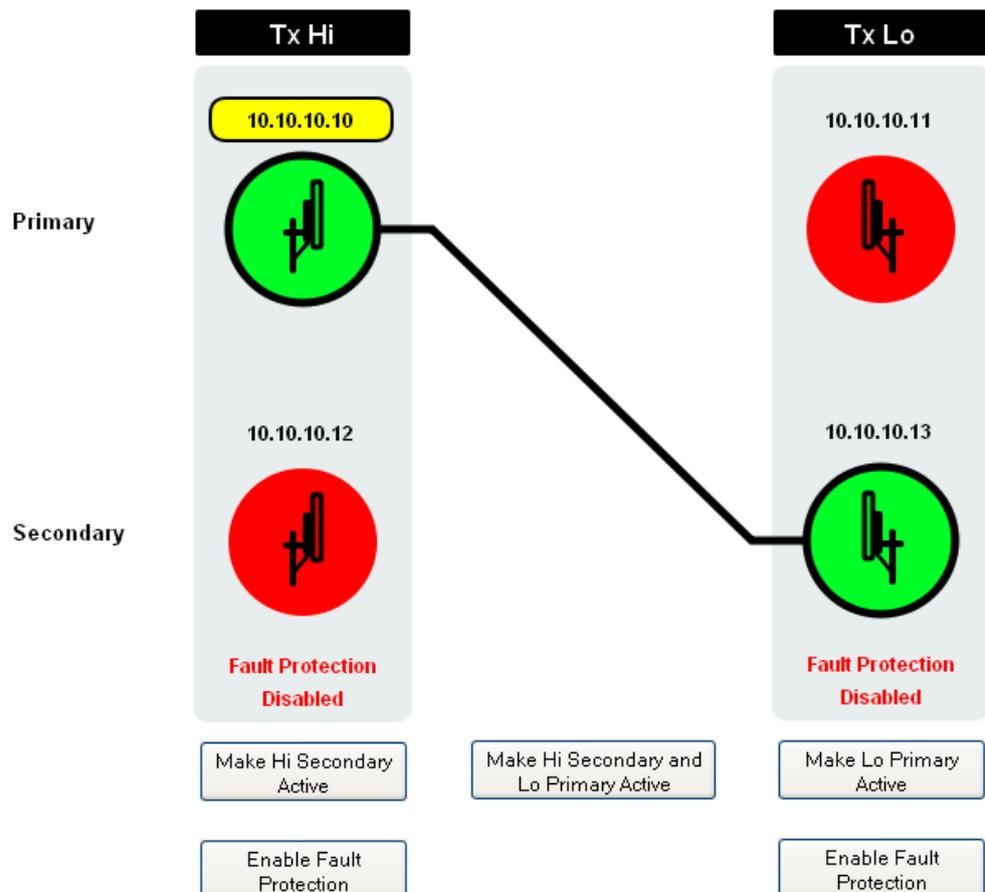
The Protected Link page can be used to enable or disable fault protection switching during the operation of the link. When switching is disabled, a fault will not cause a protection switch, but the user may still manually switch. This feature is intended to be used during maintenance actions where the user does not wish faults to change which CMU/ODU is active.

Enable and disable fault protection using the buttons on the Protected Link page. The text in the buttons varies depending upon which units are active and which are inactive. For the example in [Figure 7-10](#), the buttons and their functions are as follows:



Effect of this button: the Tx Hi inactive unit icon changes color to red, the 'Fault Protection Disabled' message is displayed and the button text changes to 'Enable Fault Protection'. This changes the [Figure 7-10](#) configuration to:

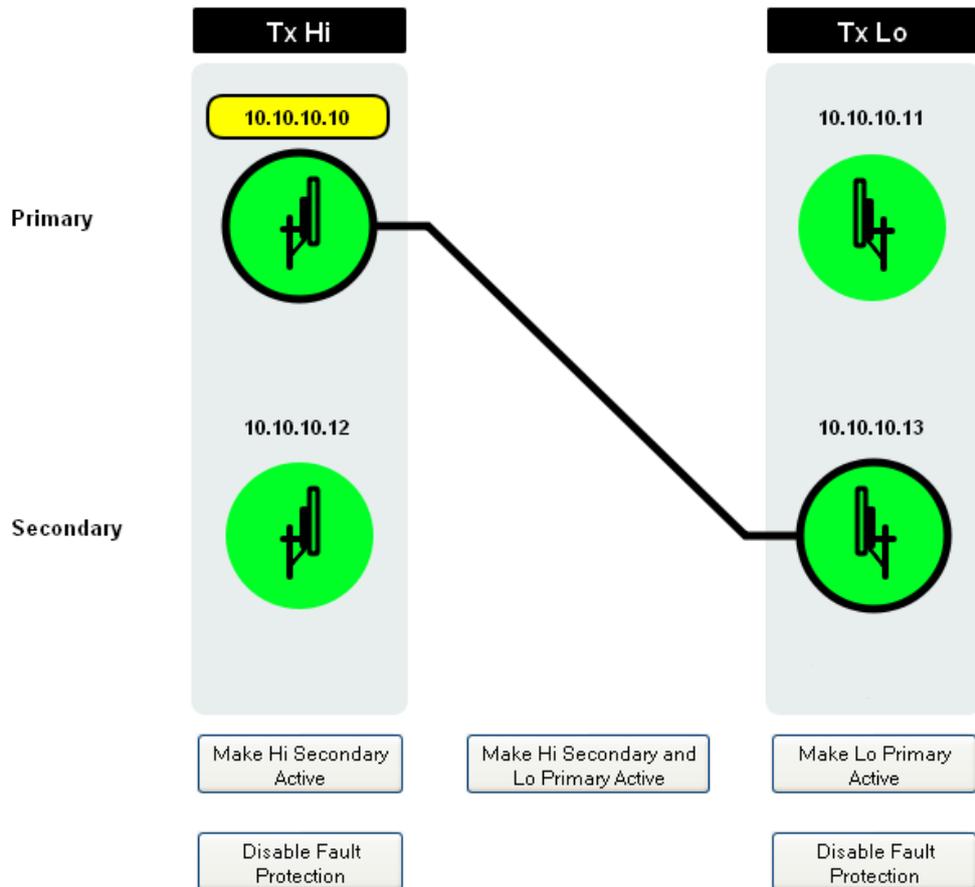
Protected Link





Effect of this button: the Tx Lo inactive unit icon changes color to green, the 'Fault Protection Disabled' message is removed and the button text changes to 'Disable Fault Protection'. This changes the [Figure 7-10](#) configuration to:

Protected Link



NOTE

Protection switching can also be enabled or disabled from the Protection Configuration page, as described in [Task 9: Configuring protection interface](#) on page 6-42.

Managing security

Disabling AES encryption

Perform this task to disable the encryption of data transmitted over the PTP 800 bridge. For more information on AES encryption, see [Security](#) on page 1-49

This procedure must be repeated at both ends of the link.

NOTE

If AES encryption is disabled at one end of the link, it must also be disabled at the other end of the link, otherwise the link will not work.

Unprotected link

To disable AES encryption for an unprotected link, proceed as follows:

1	Select menu option Configuration . The System Configuration page is displayed (Figure 7-8).
2	Set the Encryption Algorithm attribute to 'None'.
3	Select Submit Updated System Configuration . The Configuration Change Reboot dialog is displayed.
4	Select Reboot Wireless Unit . The Reboot Confirmation dialog is displayed.
5	Select OK . The reboot progress message is displayed. On completion, the unit restarts with AES encryption disabled.

Protected link

To disable AES encryption for a 1+1 protected link, proceed as follows:

1	If link planning indicates that the inactive units are not able to operate a link of satisfactory quality, force a protection switch at one end of the wireless link.
2	Disable fault protection switching for all PTP 800 units, as described in Enabling and disabling fault protection on page 7-33.
3	Disable AES Encryption for both inactive PTP 800 units as defined above for unprotected links.
4	Force a simultaneous protection switch at both ends of the wireless link, as described in Forcing protection switches on page 7-31. Check that the link is operating correctly without encryption.

5	Disable AES Encryption for both newly inactive PTP 800 units as defined in the above procedure for unprotected links.
6	Force a simultaneous protection switch at both ends of the wireless link, as described in Forcing protection switches on page 7-31. Check that the link is operating correctly without encryption.
7	If a protection switch was forced at one end of the link (Step 1) force a protection switch at the other end of the link so that the link is operated by the two primary units.
8	Re-enable protection switching for all PTP 800 units, as described in Enabling and disabling fault protection on page 7-33.

Changing AES encryption keys

Perform this task to update the encryption key used for data transmitted over the PTP 800 bridge. For more information on AES encryption, see [Security](#) on page 1-49

This procedure must be repeated at both ends of the link.

NOTE

If the AES encryption key is changed at one end of the link, it must also be changed to the same value at the other end of the link, otherwise the link will not work.

Unprotected link

To change the AES encryption key for an unprotected link, proceed as follows:

1	From the left hand menu, select Configuration . The System Configuration page is displayed (Figure 7-8).
2	If the encryption attributes are not displayed, or if the Encryption Key attribute is set to 'None', see Configuring AES encryption on page 6-32.
3	Update the Encryption Key attribute.
4	Select Submit Updated System Configuration . The Configuration Change Reboot dialog is displayed.
5	Select Reboot Wireless Unit . The Reboot Confirmation dialog is displayed.
6	Select OK . The reboot progress message is displayed. On completion, the unit restarts with AES encryption enabled, using the new key.

Protected link

This procedure must be performed for all units. When upgrading each pair of units, then either the web interface can be opened simultaneously for each CMU, or the remote system can be configured and then the local system configured.

NOTE

Before changing encryption keys, check that no alarms are outstanding for the units to be upgraded. See [Managing alarms](#) on page 7-13.

It is expected that this procedure will normally take place from an initial status of Primary to Primary, especially for an asymmetric coupler or for a protected antenna when the inactive unit has a lower capacity.

To change the AES encryption key for a 1+1 protected link, proceed as follows:

1	Disable local and remote protection switching, as described in Enabling and disabling fault protection on page 7-33.
2	Force a protection switch at the local end of the wireless link, as described in Forcing protection switches on page 7-31, so that the link is operating between a primary and a secondary unit.
3	Change AES Encryption keys for both inactive PTP 800 units, as defined in Unprotected link on page 7-36.
	<div style="background-color: #ffff00; padding: 2px;"> CAUTION</div> <p>If an incorrect encryption key is entered at the remote end, then it may be necessary to go to the remote end to correct the encryption key.</p>
4	Force a simultaneous protection switch at both ends of the wireless link, as described in Forcing protection switches on page 7-31. Check that the link is operating correctly using the new encryption key.
5	Change AES Encryption keys for both newly inactive PTP 800 units, as defined in Unprotected link on page 7-36.
6	Check the System Status page for encryption alarms (Figure 7-11). If any are displayed, investigate and correct the encryption configuration.
7	Force a simultaneous protection switch at both ends of the wireless link, as described in Forcing protection switches on page 7-31. Check that the link is operating correctly using the new encryption keys.
8	Force a protection switch at the local end of the link, so that the link is running Primary to Primary, and check that the link is operating correctly. This confirms that the new encryption key is the same for all four units.
9	Re-enable local and remote protection switching, as described in Enabling and disabling fault protection on page 7-33.

Figure 7-11 Encryption key mismatch

System Summary

Attributes	Value	Units
Wireless Link Status	Up	
Link Name	A1 to B3	
Site Name	B3_Secondary	
Elapsed Time Indicator	00:05:04	hh:mm:ss
System Clock	18-Mar-2011 09:36:05	
Protection Availability Status	Not Protecting	
Encryption Key Neighbor Compatibility	Mismatch	

Encryption Key Neighbor Compatibility ✖

In a 1+1 Hot Standby configuration, neighboring CMUs must be configured with the same value of Encryption Key. The Encryption Key Neighbor Compatibility attribute indicates when this is not the case.

Changing the log-out timer

Perform this task to change the automatic logout time period.

The automatic logout time period is the amount of time without user activity that is allowed to elapse before the system administrator is logged off.

To change the log-out timer, proceed as follows:

1	From the left hand menu, select Properties . The Web Page Properties page is displayed (Figure 7-12).
2	Set the Auto Logout Timer attribute to the number of minutes that should elapse before automatic logout occurs. If automatic logout is not wanted, set Auto Logout Timer to zero. This means that the system administrator will remain logged on, with or without user activity.
3	Select Apply Properties .

Figure 7-12 Web Page Properties page

Webpage Properties		
Properties		
Attributes	Value	Units
Web Properties	<input checked="" type="checkbox"/> Disable FrontPage login	
	<input type="checkbox"/> Disable HTTP NO-CACHE META data	
Auto Logout Timer	<input type="text" value="60"/>	Minutes
Distance Units	<input checked="" type="radio"/> Metric <input type="radio"/> Imperial	
Use Long Integer Comma Formatting	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Popup Help	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
<input type="button" value="Apply Properties"/> <input type="button" value="Reset Form"/>		

Managing performance

Checking system statistics and counters

Perform this task to check system statistics and counters.

1	From the left hand menu, select Statistics . The System Statistics and Counters page is displayed (Figure 7-13).
2	Review the statistics and counters (Table 7-13).

NOTE

To enable or disable the display of commas in long integers (for example 1,234,567), select **Properties** from the menu and update the Use Long Integer Comma Formatting attribute.

NOTE

Transmit power, receive power, vector error and link loss are presented as an array of four elements. These elements represent the maximum, mean, minimum and latest values respectively. The maximum, mean and minimum are calculated over a running one hour period.

NOTE

The frame counter attributes each contain a number in parentheses; this shows the number of frames received since the last page refresh.

Figure 7-13 System Statistics and Counters page

System Statistics and Counters

Attributes	Value	Units
System Statistics		
Transmit Power	-60.0, -60.0, -60.0, -60.0	dBm
Receive Power	-90.0, -90.0, -90.0, -90.0	dBm
Vector Error	-2.1, -10.4, -20.2, -18.4	dB
Link Loss	0.0, 0.0, 0.0, 0.0	dB
Transmit Data Rate	0.0, 0.0, 0.0, 0.0	Mbps
Receive Data Rate	0.0, 0.0, 0.0, 0.0	Mbps
Aggregate Data Rate	0.0, 0.0, 0.0, 0.0	Mbps
Statistics Measurement Period	01:00:00	hh:mm:ss
<input type="button" value="Reset System Statistics"/>		
Data Port Counters		
Ethernet Data Tx Frames	0 (+0)	
Ethernet Data Rx Frames	0 (+0)	
Management Port Counters		
Ethernet Management Tx Frames	7,180 (+509)	
Ethernet Management Rx Frames	1,773,015 (+3,154)	
Management Agent Counters		
Frames To Management Agent	268,879 (+653)	
Frames From Management Agent	7,213 (+540)	
Wireless Port Counters		
Wireless Data Tx Frames	0 (+0)	
Wireless Data Rx Frames	0 (+0)	
Wireless Management Tx Frames	0 (+0)	
Wireless Management Rx Frames	0 (+0)	
Byte Error Ratio	0	
Code Word Error Ratio	9.730e-1	
Wireless Link Availability	0.0000	%
Counter Measurement Period	3 Days 22:14:56	hh:mm:ss
<input type="button" value="Reset System Counters"/>		
Elapsed Time Indicator		
Elapsed Time Indicator	3 Days 22:14:56	hh:mm:ss
Statistics Page Refresh Period	<input style="width: 50px;" type="text" value="3600"/>	Seconds
<input type="button" value="Submit Page Refresh Period"/>		

Table 7-13 System Statistics and Counters attributes

Attribute	Meaning
System Statistics	
Transmit Power	The maximum, mean, minimum and latest measurements of Transmit Power.
Receive Power	The maximum, mean, minimum and latest measurements of Receive Power.
Vector Error	<p>The maximum, mean, minimum and latest measurements of Vector Error.</p> <p>Normalized Mean Square Vector Error is a measure of quality for the received signal after all corrections made by the demodulator. The value is generally in the range from -3 dB to -35 dB. A more negative number indicates a higher quality signal.</p>
Link Loss	<p>The maximum, mean, minimum and latest measurements of Link Loss.</p> <p>Link Loss is a measurement of the loss in signal level as the radio wave propagates between the antennas installed at each end of the link. It is determined by measurement of the receive level, the transmit power of the remote end and the antenna gains and feeder losses at each end of the link.</p> <p>The Link Loss is therefore only accurate if the correct antenna gains and feeder losses have been configured at both ends of the link.</p> <p>Link Loss (dB) = Remote Transmit Power (dBm) - Remote Feeder Loss (dB) + Remote Antenna Gain (dBi) + Local Antenna Gain (dBi) - Local Feeder Loss (dB) - Local Receive Power (dBm).</p>
Transmit Data Rate	The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means..
Receive Data Rate	The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means.

Attribute	Meaning
Aggregate Data Rate	The sum of the data rate in the directions expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means.
Statistics Measurement Period	The time over which the system statistics were collected.
Data Port Counters	
Ethernet Data Tx Frames	Count of Ethernet frames transmitted at the data port.
Ethernet Data Rx Frames	Count of Ethernet frames received at the data port.
Management Port Counters	
Ethernet Management Tx Frames	Count of Ethernet frames transmitted at the management port.
Ethernet Management Rx Frames	Count of valid Ethernet frames received at the management port.
Management Agent Counters	
Frames To Management Agent	Count of Ethernet frames processed by the management agent.
Frames From Management Agent	Count of Ethernet frames generated by the management agent.
Wireless Port Counters	
Wireless Data Tx Frames	Count of Ethernet frames transmitted at the data channel of the wireless port.
Wireless Data Rx Frames	Count of Ethernet frames received at the data channel of the wireless port.
Wireless Management Tx Frames	Count of Ethernet frames transmitted at the management channel of the wireless port.
Wireless Management Rx Frames	Count of Ethernet frames received at the management channel of the wireless port.
Byte Error Ratio	Byte error ratio calculated since the last reset of the system counters.

Attribute	Meaning
Code Word Error Ratio	<p>Code Word Error Ratio provides an indication of wireless link performance in the direction towards the unit where the attribute is being monitored.</p> <p>Data transmitted over the wireless link is organized into blocks called Code Words. The size of the code word is fixed for a given configuration of bandwidth. The transmitter applies Forward Error Correction (FEC) to each Code Word and this allows the receiver to correct certain Code Words which have been received in error. If the receiver cannot correct a Code Word, it will be counted as a Code Word Error. This may occur if the link fades below the sensitivity threshold of the minimum modulation.</p> <p>The Code Word Error Ratio is the ratio of Code Words Errors to the total number of Code Words received, calculated since the last reset of the system counters.</p>
Wireless Link Availability	Link availability calculated since the last reset of the system counters.
Protection (Detailed counters)	
Active Elapsed Time	This is the time that the CMU/ODU has been in the active role of a 1+1 Hot Standby configuration since the last statistics reset.
Active Available Time	This is the time which the Wireless link status has been up whilst the CMU/ODU has been in the Active role of a 1+1 Hot Standby configuration. The reported time is since the last statistics reset.
Active Byte Count	This reports the number of bytes received over the wireless interface whilst the CMU/ODU is in the Active role of a 1+1 Hot Standby configuration. This count is since the last statistics reset.
Active Byte Error Count	This reports the number of byte errors which have been detected over the wireless interface whilst the CMU/ODU is in the Active role of a 1+1 Hot Standby configuration. This count is since the last statistics reset.
Other attributes	
Elapsed Time Indicator	Time elapsed since the last system reboot.
Statistics Page Refresh Period	Automatic page refresh period in seconds.

Resetting system statistics and counters

To reset system statistics and counters, proceed as follows:

1	From the left hand menu, select Statistics . The System Statistics and Counters page is displayed (Figure 7-13).
2	To reset the System Statistics attributes, select Reset System Statistics .
3	To reset the Counters attributes, select Reset System Counters .

Using the diagnostics plotter

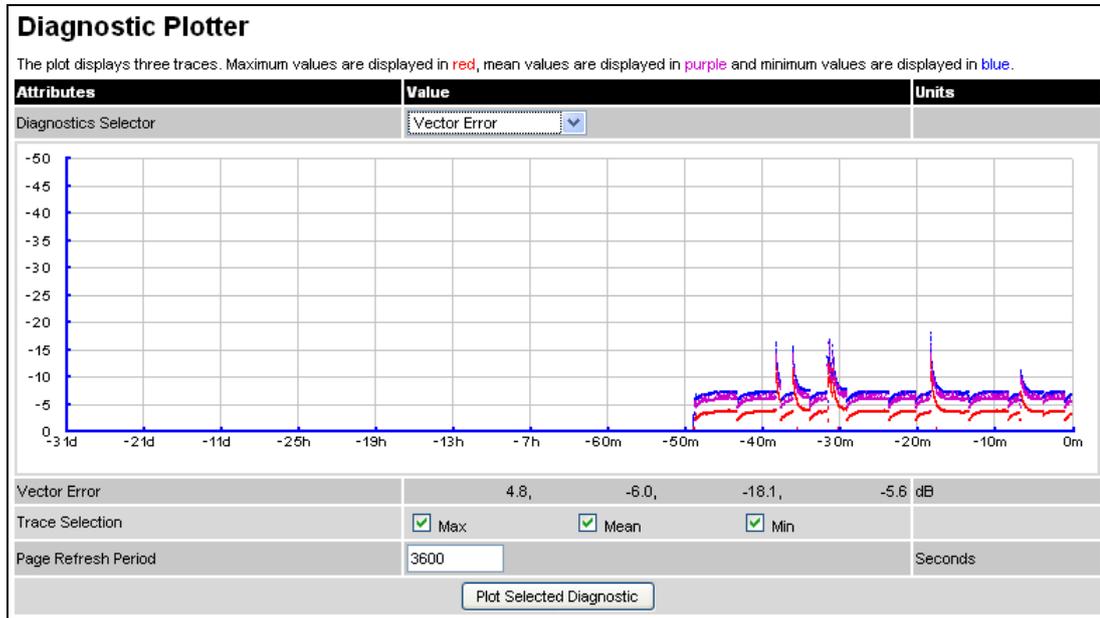
The diagnostics plotter can trace the following statistics (refer to [Table 7-13](#) for definitions):

- Vector Error
- Rx Power
- Tx Power
- Link Loss
- Rx Data Rate
- Tx Data Rate
- Aggregate Data Rate
- Protection State: In a 1+1 Hot Standby configuration, only one CMU / ODU at a given end of the link is Active at any one time, the neighbor CMU / ODU being Inactive. The Protection State indicates whether a CMU / ODU is in the Active or Inactive state.
- Remote Primary Secondary Mode: This indicates the Primary /Secondary Mode of the active unit at the remote end of the wireless link.

To plot diagnostics, proceed as follows:

1	Select menu option Diagnostics Plotter . The Diagnostics Plotter page is displayed (Figure 7-14).
2	Use the Diagnostics Selector drop-down list to select a diagnostic type to plot.
3	Use the Trace Selection to select traces of the maximum, mean or minimum values of the diagnostic type. Maximum values are displayed in red , mean values are displayed in purple and minimum values are displayed in blue .
4	Select Plot Selected Diagnostic . The trace is displayed in the graph.

Figure 7-14 Diagnostics Plotter page



Downloading diagnostic data

Perform this task to download snapshots of the system diagnostics to a CSV file.

The CSV file contains at most 5784 entries, recorded over a 32 day period:

- 3600 entries recorded in the last hour.
- 1440 entries recorded in the previous 24 hours.
- 744 entries recorded in the previous 31 days.

The following statistics can be downloaded (refer to [Table 7-13](#) for definitions):

- Vector Error
- Rx Power
- Tx Power
- Link Loss
- Rx Data Rate
- Tx Data Rate
- Aggregate Data Rate
- Protection State
- Remote Primary Secondary Mode

To download diagnostics data, proceed as follows:

1	Select menu option CSV Download . The Generate Downloadable Diagnostics page is displayed (Figure 7-15).
2	Use the Diagnostics Selector drop-down list to select a diagnostic type to download.
3	Select Generate Diagnostics . The Generate Downloadable Diagnostics page is redisplayed with the name of the generated CSV file.
4	Click on the CSV file name and select Save File. Save the CSV file to the hard drive of the local computer.
5	Open the CSV file in MS Excel and use it to generate statistical reports and diagrams.

Figure 7-15 Generate Downloadable Diagnostics page

Attributes	Value
Diagnostics Selector	Vector Error ▼

Generate Diagnostics

Changing the diagnostics refresh period

Perform this task to change the frequency with which the Diagnostics Plotter page is refreshed.

The default refresh period is 3600 seconds (1 hour). If a much shorter refresh period is selected, for example 60 seconds, it is possible to monitor the performance of an operational PTP 800 link in real time.

To change the diagnostics refresh period, proceed as follows:

- | | |
|----------|--|
| 1 | Select menu option Diagnostics Plotter . The Diagnostics Plotter page is displayed (Figure 7-14). |
| 2 | Enter the required refresh frequency in the Page Refresh Period attribute. |

Maintaining the system

Once installed, a PTP 800 link should require little or no maintenance.

Yearly maintenance

Recommended yearly physical maintenance:

- Check cables for corrosion, chafing etc.
- Check waterproofing
- Check ground points for corrosion, tightness etc.

Monthly maintenance

Recommended monthly radio maintenance:

- Read Link Loss and compare against last reading.
- Read ByteER and compare against last reading.

Protected link maintenance

For a 1+1 protected link, consider a controlled switchover to the inactive unit (once every three months), to confirm that it is fully functional.

NOTE

This can cause a short interruption to traffic and should be scheduled accordingly to minimize the effects.

Rebooting the unit

Rebooting or reviewing reboot reasons

Perform this task either to reboot the CMU or to view a list of previous reboot reasons.

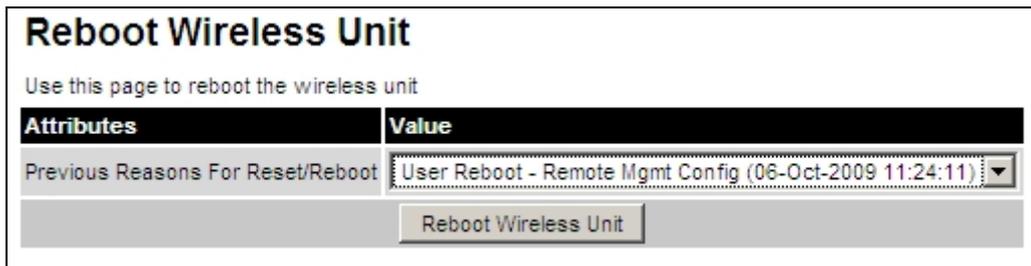
To reboot the CMU, proceed as follows:

- 1 From the left hand menu, select **Reboot**. The Reboot Wireless Unit page is displayed (Figure 7-16).
- 2 Select **Reboot Wireless Unit**. The Reboot Confirmation dialog is displayed.
- 3 Select **OK**. The reboot progress message is displayed. On completion, the unit restarts.

NOTE

View the list of past reboot reasons in the Previous Reasons For Reset/Reboot field. This is as a drop down selection box, where the latest reason for reboot is located at the top of the list.

Figure 7-16 Reboot Wireless Unit page



Attributes	Value
Previous Reasons For Reset/Reboot	User Reboot - Remote Mgmt Config (06-Oct-2009 11:24:11)

Reboot Wireless Unit

Using recovery mode

This section describes how the CMU enters recovery mode and how to recover the CMU.

For a general description of the recovery mode, see [Recovery mode](#) on page 1-48.

NOTE

When the CMU is in recovery mode, it cannot be recovered via a remote network connection. It can only be recovered from a PC that is directly connected to the Management port using the default IP address 169.254.1.1.

Entering recovery mode

When the CMU status indicator ([Table 1-2](#)) blinks red, the CMU has entered recovery mode automatically.

The CMU may enter recovery mode automatically in the following circumstances:

- When a checksum error occurs for the main application software image.
- When the Short Power Cycle for Recovery attribute is enabled ([Table 6-11](#)), the CMU is power cycled and the “off” period is between one and five seconds.

To enter recovery mode manually, proceed as follows:

1	Power off the CMU.
2	Press the CMU front panel Recovery button (Figure 1-2).
3	Keep the Recovery button pressed while powering on the CMU. Keep the Recovery button pressed for at least 20 seconds after powering on.
4	When the CMU status indicator (Table 1-2) blinks red, the CMU is in recovery mode.

Selecting recovery option

Perform this task to select the option for recovering the CMU when it is in recovery mode.

Before starting this task, check that the CMU is in recovery mode. When the CMU status indicator ([Table 1-2](#)) blinks red, the CMU is in recovery mode.

To select the CMU recovery option, proceed as follows:

1	Start the web browser.
2	Type IP address 169.254.1.1 into the address bar and press ENTER. The Recovery Mode Warning page is displayed (Figure 7-17).
3	Click anywhere on the Recovery Mode Warning page. The Recovery Options page is displayed (Figure 7-18).
4	Select the required recovery option and perform the recovery task (Table 7-14).

Figure 7-17 Recovery Mode Warning page



Figure 7-18 Recovery Options page

Motorola PTP 800 Series Recovery Options

Software Upgrade:

Configuration Management

Management Mode After Reset IP :: Out-of-Band Local In-Band

Software Version:: Recovery-01-02

Recovery Reason:: Short Power Cycle

MAC Address:: 00:04:56:30:00:bf

Table 7-14 Recovery options

Option	Recovery task
Upgrade Software Image	Upgrading software image on page 7-53.
Management Mode After Reset IP	This option selects the management mode that will be configured following reset of the IP and Ethernet configuration, or following erasure of all configuration data.
Reset IP & Ethernet Configuration back to factory defaults	Resetting IP and Ethernet configuration to factory defaults on page 7-54.
Erase Configuration	Erasing configuration on page 7-55.
Zeroize Critical Security Parameters	Zeroizing security parameters on page 7-56.
Reboot	This option is used to reboot the CMU after resetting configuration or parameters, as described in the above recovery tasks.

Upgrading software image

Perform this task when the CMU is in recovery mode. The purpose of this task is to replace a corrupt or unwanted software image. Before starting this task, check that the Recovery Options page is displayed (Figure 7-18).

To upgrade the software image in recovery mode, proceed as follows:

1	Select Browse . Navigate to the folder containing the required software image (PTP 800-nn-mm.dld2) and select Open .
2	If software corruption is suspected, select the software image that was installed when the CMU went into recovery mode. If an incorrect image has been loaded, select the correct software image.
3	Select Upgrade Software Image . The Software Upgrade Confirmation page is displayed (Figure 7-19).
4	Select Program Software Image into Non-Volatile Memory . The Progress Tracker page is displayed. On completion, the Software Upgrade Complete page is displayed (Figure 7-20).
5	Select Reboot Wireless Unit . The Reboot Confirmation dialog is displayed.
6	Select OK . The reboot progress message is displayed. On completion, the CMU restarts with the new software installed.

Figure 7-19 Recovery Software Upgrade confirmation page

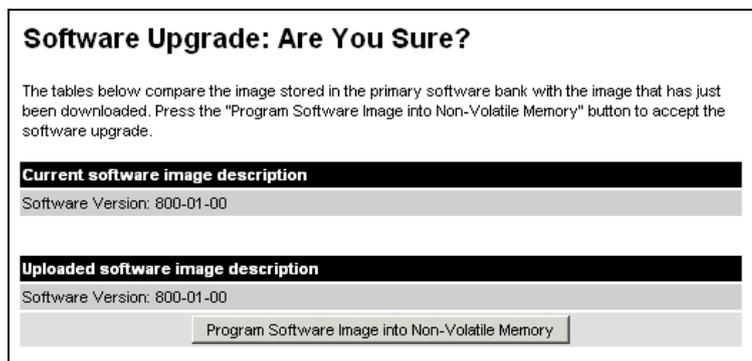


Figure 7-20 Recovery Software Upgrade complete page



Resetting IP and Ethernet configuration to factory defaults

Perform this task when the CMU is in recovery mode. The purpose of this task is to reset IP and Ethernet configuration back to factory defaults.

Before starting this task, check that the Recovery Options page is displayed (Figure 7-18).

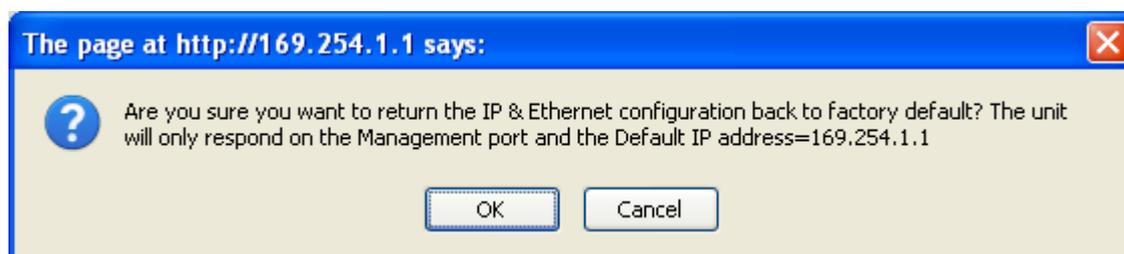
To reset IP and Ethernet configuration parameters, proceed as follows:

1	Select Reset IP & Ethernet Configuration back to factory defaults . The Reset Configuration dialog is displayed (Figure 7-21).
2	Select OK . The Recovery Options page is redisplayed with a message indicating that the configuration has been reset.
3	Select Reboot . The Reboot Confirmation dialog is displayed.
4	Select OK . The reboot progress message is displayed. On completion, the CMU restarts.
5	To restore the IP and Ethernet configuration to meet the operator's requirements, see Task 2: Configuring IP and Ethernet interfaces on page 6-7.

NOTE

When the CMU is rebooted after selecting the recovery option **Reset IP & Ethernet Configuration back to factory defaults**, the IP address remains at its default setting of 169.254.1.1 and the CMU can only be accessed via a direct network connection from the PC to the management port.

Figure 7-21 Reset Configuration dialog



Erasing configuration

Perform this task when the CMU is in recovery mode. The purpose of this task is to erase all changes that have been made to the configuration of the CMU and return it to its factory settings. This includes all changes made to the wireless, IP, Ethernet, license key, security, fault and performance parameters.

Before starting this task, check that the Recovery Options page is displayed (Figure 7-18).

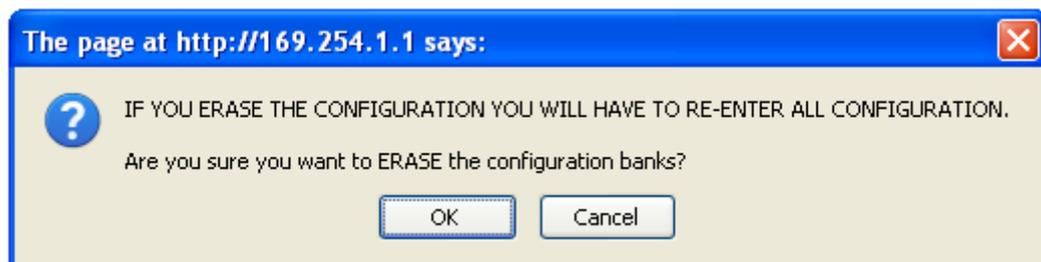
To erase the entire configuration of the CMU, proceed as follows:

1	Select Erase Configuration . The Erase Configuration dialog is displayed (Figure 7-22).
2	Select OK . The Recovery Options page is redisplayed with a message indicating that the configuration has been erased.
3	Select Reboot . The Reboot Confirmation dialog is displayed.
4	Select OK . The reboot progress message is displayed. On completion, the CMU restarts.
5	Reconfigure the PTP 800 to meet the operator's requirements.

NOTE

When the CMU is rebooted after selecting the recovery option **Erase Configuration**, the IP address remains at its default setting of 169.254.1.1 and the CMU can only be accessed via a direct network connection from the PC to the management port.

Figure 7-22 Erase Configuration dialog



Zeroizing security parameters

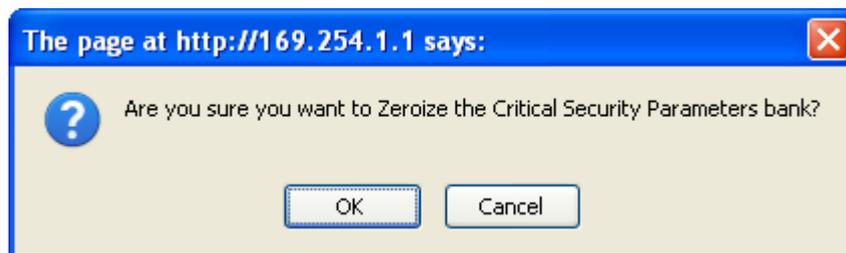
Perform this task when the CMU is in recovery mode. The purpose of this task is to zeroize the critical security parameters of the CMU.

Before starting this task, check that the Recovery Options page is displayed ([Figure 7-18](#)).

To erase the critical security parameters of the CMU, proceed as follows:

1	Select Zeroize Critical Security Parameters . The Zeroize Security Parameters dialog is displayed (Figure 7-23).
2	Select OK . The Recovery Options page is redisplayed with a message indicating that the security parameters have been zeroized.
3	Select Reboot . The Reboot Confirmation dialog is displayed.
4	Select OK . The reboot progress message is displayed. On completion, the CMU restarts.

Figure 7-23 Zeroize Security Parameters dialog



Downgrading PTP 800 software

To downgrade to an older version of PTP 800 software:

- Carefully record the existing configuration of the link
- Delete all configuration data as described in [Erasing configuration](#) on page 7-55
- Load the older software image as described in [Upgrading software image](#) on page 7-53.
- Re-install using the Installation Wizard and Configuration pages.

Restoring the operational configuration

Restoring the configuration file

Perform this task to restore the operational configuration of the unit.

The save and restore feature allows the system administrator to save and restore the operational configuration of the units. Motorola recommends that the configuration should be saved immediately after a successful link installation and immediately before a software upgrade. In the unlikely event that a unit has to be replaced in the field, the replacement unit can be reconfigured by restoring the saved configuration file.

Before starting this task, ensure that:

- The configuration file of the old (faulty) unit has been saved.
- The new (replacement) unit has been installed.
- The license key of the old unit has been entered in the new unit.

To restore the configuration file, proceed as follows:

1	Select menu option Configuration, Save And Restore . The Save & Restore Configuration page is displayed (Figure 6-12).
2	Select Browse and navigate to the PC folder containing the saved configuration file (.cfg).
3	Select Restore Configuration File and Reboot .
4	Select OK to confirm the restore. The configuration file is uploaded and used to reconfigure the new unit to the same state as the old unit. On completion, the unit reboots.

Chapter 8 Troubleshooting

.....

This chapter provides instructions for identifying and correcting faults in a PTP 800 link.

The following topics are described in this chapter:

- [Connecting to the web management interface](#) on page 8-2
- [Installing the link](#) on page 8-9
- [Testing protection switchover](#) on page 8-12

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Connecting to the web management interface

Perform this task if any problems are encountered when connecting to the PTP 800 web interface.

Check the CMU power indicator

The CMU power indicator shows the presence of the DC supply within the CMU. Check the state of the CMU power indicator and take action as described in [Table 8-1](#).

Table 8-1 CMU power indicator checks

CMU power indicator state	Likely cause and action
Green steady	Continue at Check the CMU status indicator on page 8-3.
Off	The DC supply may be absent or the CMU may be faulty. Continue at Check the DC supply to the CMU on page 8-2.

Check the DC supply to the CMU

Check the DC supply at the CMU using a suitable voltmeter and take action as described in [Table 8-2](#).

Table 8-2 DC supply checks when CMU power indicator is off

DC supply state	Likely cause and action
Absent or less than -40.5 V	Check the AC supply, power converters, wiring, circuit breakers and fuses as appropriate.
Reversed polarity	The CMU has been damaged. Return the CMU to Motorola for repair.
Correct polarity and within the range -40.5 V to -60 V.	The CMU has an internal power supply fault. Return the CMU to Motorola for repair.

Check the CMU status indicator

The CMU status indicator shows if the CMU has a hardware fault, is booting, is operating in recovery or is operating in normal mode. Additionally, in normal mode it indicates if the wireless link is up or down.

Check the state of the CMU status indicator and take action as described in [Table 8-3](#).

Table 8-3 CMU status indicator checks

CMU status indicator state	Likely cause and action
Green steady, green slow blink	<p>The CMU is operating in normal (not recovery) mode.</p> <p>If the CMU has not yet been attached to a network, or if network is designed for out-of-band management, continue at Check the Management port Ethernet connection on page 8-4.</p> <p>If the network is designed for in-band management and the copper port is in use, continue at Check the copper Data port Ethernet connection on page 8-5.</p> <p>If the network is designed for in-band management and the fiber port is in use, continue at Check the fiber Data port Ethernet connection on page 8-6.</p>
Yellow steady	<p>The CMU is booting. If the status indicator remains yellow steady for longer than 60 seconds, then continue at Using recovery mode on page 7-50, selecting the option to reload application software.</p>
Red steady	<p>The CMU is out of service. Continue at CMU out of service on page 8-3.</p>
Red slow blink	<p>The CMU is operating in recovery mode. Continue at Using recovery mode on page 7-50.</p>
Off	<p>If the CMU power indicator is illuminated and the status indicator is off, then the CMU has an internal power supply fault. Return the CMU to Motorola for repair.</p>

CMU out of service

The out of service condition is shown by red steady illumination of the CMU status indicator. Continue at [Using recovery mode](#) on page 7-50, selecting the option to reload application software.

Check the Management port Ethernet connection

Check the state of the Management port indicators and take action as described in [Table 8-4](#).

Table 8-4 Management port indicator checks

Management port indicator state	Likely cause and action
Yellow steady	The Ethernet link is up but is not carrying traffic. Continue at Check IP network connection on page 8-7.
Yellow flash	The Ethernet link is up and is carrying traffic. Continue at Check IP network connection on page 8-7.
Off	The Ethernet link is down. Continue at Management port indicator is off on page 8-4.

Management port indicator is off

If the Management port indicator is off, it means that the Ethernet link is down.

If the CMU Management port is connected to a management network, check the following:

- The associated network equipment (workstation, PC, router, switch etc.) is powered up and operating correctly.
- The Ethernet port in the associated equipment is enabled.
- The Ethernet cable between the CMU and the network equipment is connected and is not damaged. If possible, substitute a known good Ethernet cable.
- The Ethernet ports have compatible auto negotiation and duplex settings as described in [Configuring the IP interface and management mode](#) on page 6-9.

If the CMU Management port is connected directly to a PC, check the following:

- The Ethernet port in the PC is enabled.
- The Ethernet cable between the CMU and the PC is connected and is not damaged. If possible, substitute a known good Ethernet cable.
- The Ethernet ports have compatible auto negotiation and duplex settings as described in [Configuring the IP interface and management mode](#) on page 6-9.

If these steps fail to resolve the problem, continue at [Using recovery mode](#) on page 7-50, selecting the option to reset IP and Ethernet configuration.

Check the copper Data port Ethernet connection

Check the state of the copper Data port indicators and take action as described in [Table 8-5](#).

Table 8-5 Copper Data port indicator checks

Copper Data port indicator state	Likely cause and action
Yellow steady, green steady	The Ethernet link is up but is not carrying traffic. Continue at Check IP network connection on page 8-7.
Yellow flash, green flash	The Ethernet link is up and is carrying traffic. Continue at Check IP network connection on page 8-7.
Off	The Ethernet link is down. Continue at Copper Data port indicator is off on page 8-5.

Copper Data port indicator is off

If the Copper Data port indicator is off, it means that the Ethernet link is down.

If the CMU copper data port is connected to a network, check the following:

- The associated network equipment (workstation, PC, router, switch etc.) is powered up and operating correctly.
- The Ethernet port in the associated equipment is enabled.
- The Ethernet cable between the CMU and the network equipment is connected and is not damaged. If possible, substitute a known good Ethernet cable.
- The Ethernet ports have compatible auto negotiation and duplex settings as described in [Configuring the IP interface and management mode](#) on page 6-9.

If the CMU Data port is connected directly to a PC, check the following:

- The Ethernet port in the PC is enabled.
- The Ethernet cable between the CMU and the PC is connected and is not damaged. If possible, substitute a known good Ethernet cable.
- The Ethernet ports have compatible auto negotiation and duplex settings as described in [Configuring the IP interface and management mode](#) on page 6-9.

If these steps fail to resolve the problem, continue at [Using recovery mode](#) on page 7-50, selecting the option to reset IP and Ethernet configuration.

Check the fiber Data port Ethernet connection

Check the state of the fiber Data port indicator and take action as described in [Table 8-6](#).

Table 8-6 Fiber Data port indicator checks

Fiber Data port indicator state	Likely cause and action
Green steady	The Ethernet link is up but is not carrying traffic. Continue at Check IP network connection on page 8-7.
Green flash	The Ethernet link is up and is carrying traffic. Continue at Check IP network connection on page 8-7.
Off	The Ethernet link is down. Continue at Fiber Data port indicator is off on page 8-6.

Fiber Data port indicator is off

If the Fiber Data port indicator is off, it means that the Ethernet link is down. Check the following:

- The fiber adaptor is correctly inserted at the CMU.
- The fiber cable is correctly connected to the adaptor.
- The associated network equipment (router, switch etc.) is powered up and operating correctly.
- The fiber port in the associated equipment is enabled.
- The fiber cable between the CMU and the network equipment is connected and is not damaged. If possible, substitute a known good fiber cable.

If these steps fail to resolve the problem, continue at [Entering recovery mode](#) on page 7-50, selecting the option to reset IP and Ethernet configuration

Check IP network connection

If the Management port indicators are illuminated (for a network using out-of-band management) or the Data port indicators are illuminated (for a network using in-band management) but the IP address of the CMU is unknown, continue at [Entering recovery mode](#) on page 7-50, selecting the option to reset IP and Ethernet configuration.

If the IP address of the CMU is known, send a sequence of ICMP Echo Request packets to the CMU management agent using the Ping program at the command line interface of the management PC or workstation.

If the CMU responds then the command line will appear similar to this:

```
C: \pi ng 169. 254. 1. 1
Pi ngi ng 169. 254. 1. 1 wi th 32 bytes of data:
Repl y from 169. 254. 1. 1: bytes=32 ti me=1ms TTL=64
Repl y from 169. 254. 1. 1: bytes=32 ti me<1ms TTL=64
Repl y from 169. 254. 1. 1: bytes=32 ti me<1ms TTL=64
Repl y from 169. 254. 1. 1: bytes=32 ti me<1ms TTL=64
Pi ng stati sti cs for 169. 254. 1. 1:
  Packets: Sent = 4, Recei ved = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli -seconds:
    Mini mum = 0ms, Maxi mum = 1 ms, Average = 0ms
```

If the CMU fails to respond then the command line will appear similar to this:

```
C: \pi ng 169. 254. 1. 1
Pi ngi ng 169. 254. 1. 1 wi th 32 bytes of data:
Reque st ti med out.
Pi ng stati sti cs for 169. 254. 1. 1:
  Packets: Sent = 4, Recei ved = 0, Lost = 4 (100% loss),
```

Check the Ping response and take action as described in [Table 8-7](#).

Table 8-7 Ping response checks

Ping response	Likely cause and action
Reply	The IP network is providing connectivity between the PC and CMU. Continue at Check browser settings on page 8-8.
Request timed out	<p>There is no IP connectivity. Check network configuration including IP addresses, gateway address, subnet masks, VLAN membership in network equipment between the PC and the CMU. Check if the PC can reach other equipment in the same network.</p> <p>If these steps fail to resolve the problem, continue at Entering recovery mode on page 7-50, selecting the option to reset IP and Ethernet configuration.</p>

Check browser settings

If there is IP connectivity between the CMU and the management PC or workstation, but web-pages cannot be displayed, check that browser settings are appropriate for the PTP 800 web interface.

Installing the link

Perform this task if any problems are experienced with a newly installed (or operational) wireless link.

Connect to the web management interface

See [Connecting to the web management interface](#) on page 8-2.

Check ODU status

ODU status is indicated by the ODU Status attribute in the Status screen of the web interface.

Check the ODU Status attribute and take action as described in [Table 8-8](#).

Table 8-8 ODU status checks

ODU Status attribute	Likely cause and action
OK	The ODU is available for use. Continue at Transmitter status on page 8-10.
Download In Progress	The CMU is downloading updated firmware to the ODU. Wait for the download to complete.
No Response	The ODU is not responding to management messages from the CMU. Check connections and continue at Testing the installation on page 5-63.
Power Supply Fault	The CMU cannot power the ODU. Check connections and continue at Testing the installation on page 5-63.
ODU Fault	The ODU is reporting a fault condition.
Incompatible Device Incompatible Firmware Version	The ODU firmware is not compatible with the CMU. Replace the ODU.

Transmitter status

Transmitter status is indicated by the Transmitter Status attribute in the Status Screen of the web interface and in Step 6: Antenna Alignment of the Installation Wizard.

The transmitter is muted by default. The transmitter is enabled automatically during installation in Step 6: Antenna Alignment of the Installation Wizard. The transmitter may additionally be enabled or muted using the Configuration page of the web interface.

Go to the Status page, or use the Installation Wizard and navigate to Step 6: Antenna Alignment. Check the Transmitter Status attribute and take action as described in [Table 8-9](#).

Table 8-9 Transmitter Status checks

Transmitter Status attribute	Action
Transmitting	Continue at Antenna alignment on page 8-10.
Muted – By User	The Antenna Alignment step of the Install Wizard has not been completed successfully, or the transmitter has been muted using the Mute Transmitter button on the Configuration Page. Restart the Installation Wizard.
Muted – ODU Configuring	Transmission is disabled while the ODU configuration is changing. This status will normally exist for no more than a few seconds.
Muted – ODU Fault	There is a fault in the ODU. Use the Home page to review the ODU alarms.
Muted – Configuration Error	The ODU is not compatible with the configured radio license. Restart the Installation Wizard.
Muted - Due to standby	The CMU is the inactive unit of a 1+1 protected end.

Antenna alignment

Repeat the Antenna Alignment procedure as described [Step 6: Aligning antennas](#) on page 6-61.

Check the receive power from the RSSI connector of the ODU, or from the Receive Power attribute in Step 6: Antenna Alignment.

If the receive power level is very small or cannot be measured, continue at [Check transmit and receive frequencies](#) on page 8-11.

If the receive power is close to the predicted power for the link then continue at [Check link status](#) on page 8-11.

Check transmit and receive frequencies

Check that the transmit frequency at the near end of the link is exactly equal to the receive frequency at the remote end of the link.

Check that the receive frequency at the near end of the link is exactly equal to the transmit frequency at the remote end of the link.

If this fails to resolve the problem, continue at [Check waveguide and antennas](#)

Check waveguide and antennas

Check the antennas, waveguides, RMKs and couplers for defects and incorrect assembly.

If this fails to resolve the problem replace the near end ODU and, if necessary, replace the remote ODU.

Check link status

Link status is indicated by the Link Status attribute on the System status page of the web interface.

If the receive signal power is close to the predicted value, check the Link Status attribute and take action as described in [Table 8-10](#).

Table 8-10 Link Status checks

Link Status attribute	Action
Searching	Check that the same channel bandwidth is configured for both ends of the link
Acquiring Registering	Check the System Summary for a Link Name mismatch alarm. If present, correct Link Name so that it is identical at both ends of the link.

Testing protection switchover

Perform this task if any problems are experienced with protection switchovers in a newly installed (or operational) protected link.

Check protection interface status

Check Protected Interface Status in the System Summary page as described in [Table 8-11](#).

In a 1+1 Hot Standby configuration, information is shared between neighbor CMUs over the protection interface. The Protection Interface Status attribute reports whether the neighbor CMU is successfully responding, physically disconnected or whether it is physically connected but not responding, for example powered down.

Table 8-11 Protected Interface Status values and actions

Value	Meaning	Action
OK	The CMU has detected that the neighboring CMU is responding.	Check that protection switching is enabled, the status of the wireless link and consider forcing a protection switchover.
Neighbor not connected	The neighbor CMU is not physically present.	Check that the protection interface is correctly connected.
Neighbor not responding	The neighbor CMU is not responding	Check the status of the second CMU.

Check that Protection Switching is enabled

Check the Protected Link page as described in [Managing wireless link protection](#) on page 7-28.

If protection switching is disabled for this end of the wireless link, re-enable it, see [Enabling and disabling fault protection](#) on page 7-33.

If the Protection Link screen indicates that there are alarms for this unit then follow the trouble shooting guide for the alarms indicated.

Check the status of the wireless interface

Check the status of the wireless interface, see [Check link status](#) on page 8-11.

NOTE

If the wireless link quality has been affected by adverse weather it is likely that the secondary unit will not be able to provide a service either, particularly if an asymmetric coupler has been used or the secondary unit is providing antenna protection with a less powerful antenna.

Check the physical Link Protection cable

Check the physical link protection cable is connected as described in [Preparing the network connections](#) (protected) on page 5-84.

Force a Protection Switchover

Consider manually initiating a protection switchover as described in [Forcing protection switches](#) on page 7-31, provided the link planning indicates that the units have the capability of operating a link of satisfactory quality.

This particularly applies where asymmetric couplers have been used, or a secondary antenna of lower power.

Check the configuration of the active and inactive units

Check that the active and inactive units have a compatible configuration.

They must be configured to have:

- The same link parameters;
- The same radio licence parameters;
- The same radio parameters;
- The same encryption parameters;
- The same management and protection options;
- The same data connectivity parameters

They must be configured to have:

- Different IP addresses;
- Different primary/secondary attributes.

Glossary

Term	Definition
ACM	Adaptive Coding and Modulation
AES	Advanced Encryption Standard
ATPC	Automatic Transmitter Power Control
CEPT	European Conference of Postal and Telecommunications Administrations
CIR	Committed Information Rate
CMU	Compact Modem Unit
EAPS	Ethernet Automatic Protection Switching
EIRP	Equivalent Isotropic Radiated Power
EMC	Electromagnetic compatibility
EMD	Electromagnetic discharge
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FEC	Forward Error Correction
GARP	Generic Attribute Registration Protocol
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
IC	Industry Canada
ICMP	Internet Control Message Protocol
ID	Identity
IEEE	Institute of Electrical and Electronic Engineers
IF	Intermediate Frequency
IP	Internet Protocol
ITU	International Telecommunications Union
LAN	Local Area Network

Term	Definition
LDPC	Low Density Parity Check
LOS	Line-of-Sight (clear line-of-sight, and Fresnel zone is clear)
LPU	Lightning Protection Unit
LTE	3GPP Long Term Evolution
MAC	Medium Access Control Layer
MIB	Management Information Base
MRP	Multiple Registration Protocol
ODU	Outdoor Unit
PC	IBM Compatible Personal Computer
PING	ICMP Echo Request
PTP	Point-to-Point
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RMK	Remote Mount Kit
RF	Radio Frequency
RSL	Receive Signal Level
RSSI	Received Signal Strength Indication
SELV	Safety Extra Low Voltage
SFP	Small Form-factor Pluggable
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
STP	Spanning Tree Protocol
TCP	Transmission Control Protocol
URL	Universal Resource Location
USA	United States of America
UV	Ultraviolet
VLAN	Virtual Local Area Network