Chapter 7 Troubleshooting

This chapter to be added at a later date.

Chapter 8

Replacement and Service Support

This Chapter describes the following:

Return Material Authorization (RMA)

The Wavtrace repair and return policy enables Wavtrace to quickly and efficiently repair and return quality equipment to our customers. Equipment purchased from Wavtrace can be covered under a number of warranty plans. Refer to “Wavtrace, Incorporated Limited Warranty” on page xv for specific information. Check with your Wavtrace system administrator to determine the warranty plan and coverage that was purchased for the PTM 1000 system.

The Wavtrace Technical Assistance Center (WAVTAC) has responsibility to replace or repair equipment that fails in the field depending on the coverage provided to your company in the warranty plan.

You must report all failed equipment to a WAVTAC Customer Care Service Engineer (CCSE) during normal working hours. See Support Services, page 138:

8:00 a.m. to 5:00 p.m. PST

Call:

1 (800) 793-0WAV

When a problem is reported, the CCSE assigns an RMA number to each failed equipment. Make sure you record the RMA number and keep it in a safe place. The RMA number is the key to identifying a failed equipment when it is in the repair-and-return process. Using your RMA number, you can contact WAVTAC at any time to identify the status and return date of your returned equipment.

After receiving your RMA number, ship failed equipment to:

Wavtrace, Inc.
13434 NE 16th Street, Suite 140
Bellevue, WA. 98005

Attention: WAVTAC Service Department

RMA # _____

Specific fees for these services depend upon the coverage provided for the returned equipment in the warranty. The specific turnaround time for repairs varies depending upon the overall time required for shipment and the condition of the returned equipment.

After the equipment reaches Wavtrace, Wavtrace will ship back a new or reconditioned replacement product to the latest field revision within 10 business days. Shipping arrangements are made using the most direct and economical means possible.

To facilitate the RMA process, you must provide the following information about the failed equipment:

- Name and telephone number of caller
- Warranty status (in or out of warranty)
- Serial number
- Details of the failure
- Hardware and software revisions for advanced replacement

Note The RMA number must be marked on the outside of the shipping container.

Note All charges for shipping equipment to a Wavtrace facility are the responsibility of the customer. Wavtrace is responsible for shipping costs when returning equipment to the field.

Important

All out-of-warranty work is performed based on a maximum-not-to-exceed repair quote. All out-of-warranty repairs carry a 30-day factory warranty.

Support Services

The Wavtrace Technical Assistance Center (WAVTAC) is a dedicated, 24-hour-a-day, seven-day-a-week service organization whose purpose is to provide superior technical support to Wavtrace products. WAVTAC is supported by a staff of professional Customer Care Service Engineers (CCSEs). Each CCSE is factory-trained and certified to address your technical requirements promptly, thereby reducing the cycle time for fault isolation and resolution.

The following support services are offered:

- Toll-free, round-the-clock service support for all OEM hardware, software, and system integration and configuration problems.
- Internet access to log and track problems reported into the Wavtrace customer care service database.
- Onsite callout services for parts, installation and repair on a per-incident, time and materials basis.
- Remote diagnosis and fault analysis, and priority escalation.
- Next-day business delivery of all Advanced Replacement Parts (ARPs).
- Remote support for all major hardware and software upgrades, including mandatory field installation factory upgrades.
- FAX Flash or E-mail notification for all hardware and software updates and future release schedules.
- Internet access for software updates and release notes.
- Internet access for all hardware, software and systems level documents.
- Internet access to order spare parts.

Advanced Replacement Parts (ARPs)

Wavtrace provides Advanced Replacement Parts (ARPs) for all OEM-warranted products. ARPs are shipped prepaid overnight express, provided that Wavtrace receives the request prior to 2:30 p.m. PST. Wavtrace customers are responsible for returning defective or failed parts to Wavtrace within five working days. Otherwise, the customer is charged for the ARP at the current list price.

Telephony Support

Wavtrace customers can rely on the Wavtrace CCSE to pinpoint problems and answer technical questions, assisted by a sophisticated call-tracking database, a clear escalation process and a fully-staffed problem replication lab.

Problem Reporting and Diagnosis

When problems are reported, Wavtrace records customer information and pertinent data related to the problem being reported. This database helps Wavtrace to:

- Monitor potential system problems.
- Identify customers with repeat problems.
- Respond proactively when reacting to customer problems.

The database also allows Wavtrace to statistically track failure types in the field. This statistical information helps Wavtrace improve our products and ensures that your system remains functional and reliable.

All phone calls to WAVTAC receive immediate and direct attention. Wavtrace attendants are instructed to inquire immediately about the severity of the problem.

Urgent Problems

If your problem is urgent or involves an after-hours emergency, please call our 24-hour number:

1 (800) 793-0WAV

Wavtrace is committed to respond to phone calls as follows:

- During normal business hours, 8:00 a.m. to 5:00 p.m. Pacific Standard Time (PST), you can contact a CCSE.
- Outside of normal business hours, the problem is recorded by the on-duty attendant at the WAVTAC. The on-duty attendant will contact a Wavtrace CCSE, who will respond to your call within one hour.

Non-Urgent Problems

Use the following procedure for phone calls relating to non-urgent problems:

- During normal business hours, 8:00 a.m. to 5:00 p.m. Pacific Standard Time (PST), you can leave a message. A CCSE will respond to your problem within 30 minutes.
- Outside of normal business hours, the problem is recorded by the on-duty attendant at the WAVTAC. The on-duty attendant will leave a message with a CCSE, who will respond within the first four hours of the next business day.
- You can also submit a non-urgent case via our e-mail message center:

WAVTAC@wavtech.com

- We will respond to problems submitted by e-mail within the first four hours of the next business day.

Software Updates and Software Delivery

To provide full support to customers, Wavtrace requires that all of the customer's systems are running with a CPU software release within two versions of the most recent software release. Customers using older software releases will be asked to purchase an upgrade of their system.

One annual maintenance fee covers all major and minor software releases throughout the year. To help in the development of a network upgrade plan, Wavtrace provides regular mailings that include detailed feature/function and bug fix information, and a future release schedule.

Once the decision has been made to install an upgrade, Wavtrace can download the software electronically. Wavtrace customers automatically have access to the most current versions of Wavtrace software, thus protecting your initial investment.

In addition, if you do not have the current version of software at the start of your service contract, Wavtrace sends you the current software version for your hardware platform at no charge.

Wavtrace on the Internet

With Wavtrace on the Internet, customer support and technical information can be provided online. From the Wavtrace home page, you can review service product descriptions, up-to-date technical information, software libraries, troubleshooting tools and technical tips. The Wavtrace home page also gives our customers access to our FAX and FTP servers.

Ordering Information

To purchase Wavtrace support services, please contact your Wavtrace reseller or Wavtrace account manager.

For more information about Strategic Network Solutions, please contact Wavtrace.

Appendix A Specifications

Hub Specifications

Table 33: **Hub Unit,S General**

Certifications/Qualifications	FCC Part 15, Class A UL 1950 /CSA 22.2 No. 950
Recommended Coax Cable Type	RG-8
Maximum Cable Length	1000’
# of Cables between ODM, IDM	2, 4, 6, or 8
Connector Type	N-type
Recommended Mounting Tower	Standard 4” diameter PTP Tower
Availability (per link)	Design goal: 99.98% (Bellcore TR-TSY-000499)
MTTR (per link)	Electronic assembly indoor FRUs replaced in 15 minutes, not including logistic downtime. Outdoor FRU’s replaced in 1 hour.
Net payload efficiency	
4 QAM	1.25 bits/s/Hz
16 QAM	2.50 bits/s/Hz
64 QAM	3.75 bits/s/Hz

Table 34: **Hub Outdoor Unit (ODU)**

Operational Temp Range	–40°C to +60° C
Tx Power 64 QAM	+10dBm
Tx Power 4 QAM	+16dBm
Tx Power Control Range	50dB
Rx AGC Range	70dB
Rx 10-6 BER Threshold 64 QAM	–74dBm
Rx 10-6 BER Threshold 4 QAM	–85dBm
Antenna Beamwidth Azimuth	30° high gain
Polarization	Horizontal and vertical options
Antenna Gain narrow beam (3° vert)	25, 22.7dB
Antenna Gain wide beam (20° vert)	18, 15.7dB
Antenna Elevation Adjust Range	35°
Sidelobes	20dB minimum
Operating Frequency Range	38.6GHz to 40.0GHz
Intermediate Frequency Tx	2.45GHz
Intermediate Frequency Rx	2.45GHz
Voltage Supply	–48Vdc
Power Consumption	18W per TRA
Weight (TRA)	8lbs per TRA
Weight (Empty Frame)	30lbs
Weight (Fully-loaded Frame)	140lbs
Dimensions	20” (h) x 48” (w) x 20” (d)
Storage & Transportation Temperature Range	–40°C to +70°C (Bellcore GR-63-CORE)
Operating Humidity	Non condensing Relative Humidity of 90% @ 40°C (Bellcore GR-63-CORE)
Storage Humidity	95% Relative Humidity @ 40°C (Bellcore GR-63-CORE)
Wind-loading	112 mph Operational.
Electrostatic Discharge	IEC 1000-4-2, Level 2/4

Table 34: **Hub Outdoor Unit (ODU)**

Radiated Electromagnetic Field	IEC 1000-4-3, Level 2
Electric Fast Transient/Burst	IEC 1000-4-4, Level 2/3
Electrical Surge	IEC 1000-4-5, Level 1/3
Solar Loading	Bellcore GR-487-CORE, paragraph 3.25
Enclosure	IP55
Altitude	Operational up to 13,123’ per Bellcore G-63- CORE, paragraph 4.1.3

Table 35: **Hub ODU Mechanical Specifications**

TRA	
TRA dimension (including mount)	5” wide, 10” deep, 10” tall
Azimuth adjustment range	±35°
Mounting screws	(2) #1/4-20 screws
Antennas azimuth coverage	15° or 30°
Antenna Elevation Coverage	3° or 20°
Cable assemblies	4’ ODB to TRA cable
Ports	(1) N-type connector
	(1) DB-9 connector
Weight (TRX, including mount)	8.5lbs
Hub ODF	
Frame dimensions	22” wide, 12” deep, 5” tall
Mounting bracket dimensions	13” wide, 3” deep, 13” tall
Additional hardware (included)	(2) Mounting U bolts
	Turnbuckle (7°Azimuth adjustment)
Weight	(1) Grounding cable
	24.5lbs

Table 35: **Hub ODU Mechanical Specifications**

Hub ODB	
ODB dimensions	17.5” wide, 18.4” tall, 5” deep
Mounting screws	(4) #1/4-20 screws
Ports	(10) N-type connector
Weight	18lbs
Hub ODU	
Weight (fully loaded: an ODF, ODB, and 6 TRXs)	93.5lbs
Spacing between ODFs on one mast	31"

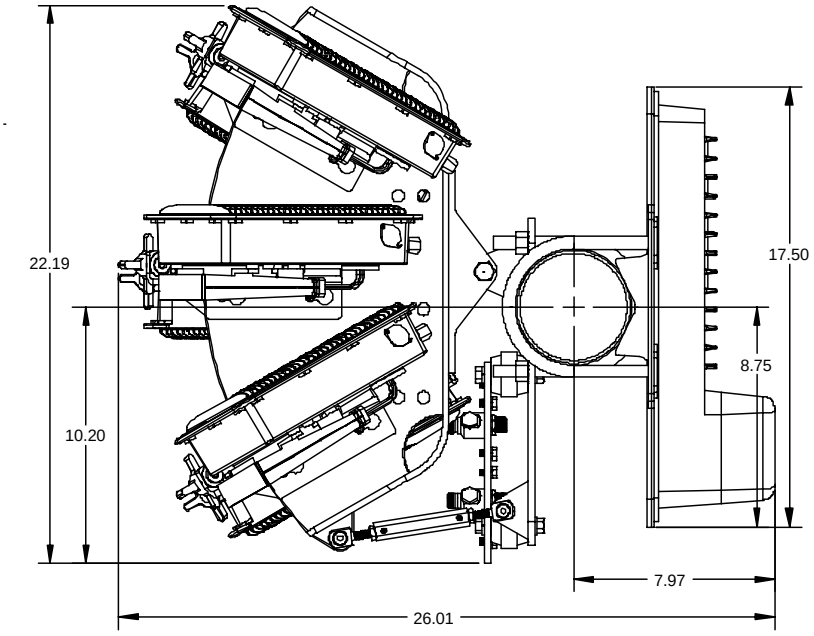

Figure 39 *Hub ODU Width and Depth*

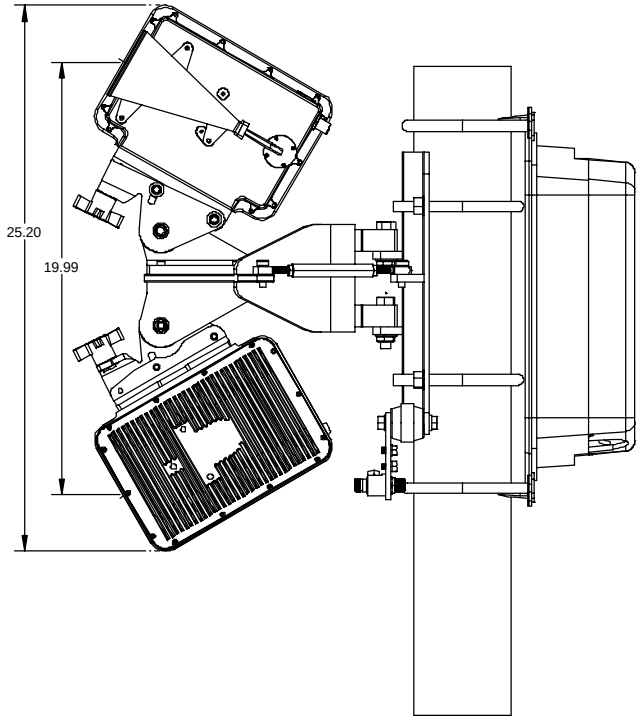

Figure 40 *Hub ODU Maximum height*

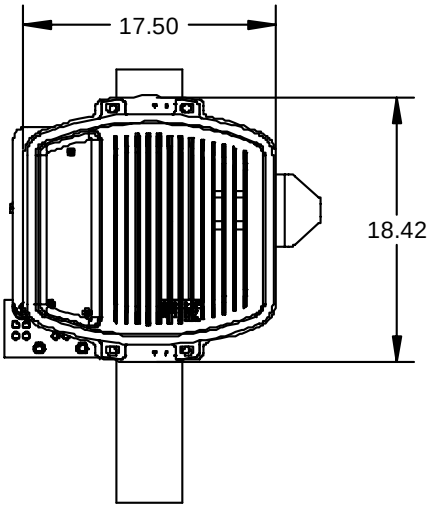

Figure 41 *Hub ODB Height and Width*

Table 36: **Hub Indoor Unit IDU**

Operational Temperature Range	+5°C to +40°C (Operational) –5°C to +50°C (Short Term)
Storage & Transportation Temperature Range	–40° C to +70° C (Bellcore GR-63-CORE)
Operating Humidity	Non condensing Relative Humidity of 90% @ 40°C (Bellcore GR-63-CORE)
Storage Humidity	95% Relative Humidity @ 40°C (Bellcore GR-63-CORE)
Electrostatic Discharge	IEC 1000-4-2, Level 2/4
Radiated Electromagnetic Field	IEC 1000-4-3, Level 2
Electric Fast Transient/Burst	IEC 1000-4-4, Level 2/3
Electrical Surge	IEC 1000-4-5, Level 1/3
Altitude	Operational up to 13,123’ per Bellcore G-63-CORE, paragraph 4.1.3
Input IF Frequency	480MHz
Modem Signaling Rate	7.5Mbaud, 45Mbps 64 QAM
Network Interface	1 to 12 x DS-1
Power Consumption	400W
Voltage Supply	120Vac or –48Vdc
Weight: Model 10	300lbs
Dimensions: Model 10	12” (d) x 19” (w) x 40” (h)

Table 37: **Hub IDU Mechanical Specifications**

Hub	
Rack Required	19’’
Rack Height	10.5” (6U)
Ports (in rear)	(8) N-type connectors (1) DB-25
Weight (fully loaded: Fan Assembly Plenum, Power Distribution Plenum, all card slots filled).	54lbs
Fan Assembly Plenum	
Rack Required	19”
Rack Height	3.5” (2U)
Weight	9.5lbs
Power Distribution Plenum	
Rack Required	19”
Rack Height	3.5” (2U)
Weight	4.5lbs
MCA PCA Ports	None
IFD PCA Ports	None
IMP PCA Ports	(1) DB-9 (1) RJ48
PCI PCA Fuses	GMT 3.5A , 15A bus

Table 38: **Hub Optical Interface**

Fiber Type	1310 SMF
Connector Type	FC (SC, ST, DF supported in the future)
Line Rate	155.52mbps
Central Wavelength	1260 to 1350nm
Spectral Width	7.7nm
Optical Power	–14dBm
Receiver Type	PIN
Receiver Level Minimum	–33dBm
Receiver Level Maximum	–9dBm
System Gain	18dBm

Remote Specifications

Table 39: **Remote Unit General**

RF Link to Antenna	N-type coax connector, panel mount
Customer Network Connection	Maximum three I/O modules
Diagnostic Port 1	RS-232 DB-9 Male
Diag	RJ45 10Base-T
Power Usage (IDU/TRA/ Total)	58W / 22W / 80W
Power Supply	90-250 Vac 50-60Hz
Power Usage	100W
Power Connector	IEC standard three prong.
Cooling Method	Forced air, fans

Table 40: **Electrical Specifications**

Embedded CPU	Motorola 68EN36025 Mhz, Ethernet qualified part
DRAM Memory	2x8 MB4, banks of 2 MB
Flash RAM	1 MB to 8 MB, Up to four 2 MB flash parts
EEPROM	8K X 8, Serial EEPROM used for configuration memory

Table 41: **Environmental Specifications**

Remote Oudoor Unit:	
Operating Temperature	–30° C to +55°C
Storage Temperature	–40°C to +80°C
Ice/Snow Loading	2” of ice with no loss of alignment after the ice melts.
Wind Loading	Antenna mounted on skyscraper roof top. 112 mph (operational), with no degradation of service. 157 mph gust, with no loss of alignment after the wind subsides.
Humidity	Withstands driving rain. maximum non-condensing relative humidity of 95% at 55°C.
Remote IDU:	
Operating Temperature	+5°C to +40°C (operational) –5°C to +50°C (short term)

Table 41: **Environmental Specifications**

Storage Temperature	40°C to +70°C (Bellcore GR-63-CORE)
Humidity	Non condensing relative humidity of 90% @ 40°C (Bellcore GR-63-CORE)
Indoor and Outdoor	
Temperature/Humidity	The PTM 1000 system shall survive storage and shipping temperatures of –40×C to 80×C. The PTM 1000 system shall survive storage and shipping non-condensing relative humidity of 95% at 80° C.
Altitude	The PTM 1000 system survives shipping at altitudes of 10,000 ft at 40°C.
Radiated and Conducted Emissions	The PTM 1000 system complies with the applicable sections of Part 15, Part 21, and Part 101 of FCC regulations.
Vibrations	The PTM 1000 system shall operate with vibrations of up to .91g at 5–500Hz (IEC 68-2-6/34). The PTM 1000 system shall survive vibrations of 2.4 g from 5–500Hz.
Mechanical Shock	The IDU shall remaining operating at peak acceleration on three axis of 10g (IEC 68-2-27/29). The IDU shall survive at peak acceleration on three axis of 40g.
Flammability	The PTM 1000 system shall comply with UL 94V-1 and UL 94-0 for printed circuit boards and external housing materials, respectively.
MTTR: IDU/ODU	15 min / 1hr.

Table 42: **Network Interface Modules**

Module Types		**Connection**	
Network option 1	Quad DSX-1	1 to 4 DSX-1	DSX-1 is the short haul is spec. 1 to 655’
Network option 2	Ethernet	10Base-T	Provides Ethernet LAN bridge to the hub
Network option 3	OC3c	Fiberoptic	Interface to high speed CPE

Table 43: **Remote Indoor Unit**

Size/Envelope	17 x 14 x 2.75 (1.5U) inches
Weight	10.5lbs.
Boards	1. MCA 2. Backplane 3. Motherboard 4-6. 1 to 3 I/O modules
Input Power	120Vac
Back Panel Connectors/Ports	(1) N-type (1) DB-9 male, serial port RJ48, 10Base-T Ethernet
Front Panel Connectors/Ports **(number of ports depends on which I/O modules are used)**	(0 to 3) RJ48 10Base-T (0 to 12) RJ45 DS-1 ports (0 to 3) DB9 serial ports
LEDs on Main Unit	2 Green, 1 Red
LEDs on Modules	12 LEDs total, 3 per port 1 Green, 1 Yellow, 1 Red
Quad DS-1 Module	
Ethernet Module	1 Green

Table 44: **Remote Outdoor Unit**

Size/Envelope	14 x 19 x 13 inches
Weight	11Lbs
Beam Width	15 degree cone
Azimuth Range	±90 degree
Elevation Range	±45 degree
Connectors/Ports	N-type 1 DB-9, for diagnostics only
LED	1 Green

Appendix B Terms and Acronyms

Term or Acronym	Definition
1U	A measurement of standard rack height equivalent to 1.75”, defined in EIA 310-D.
10Base-T	A 10Mbps twisted pair Ethernet connection. See Ethernet.
AIS	Data signal inserted into the DS1 channel when the transmission has errors.
ANT	Antenna.
Bandwidth	The maximum amount of data that can flow across a network segment. Bandwidth is generally measured in Kbps, Mbps or Gbps.
Bandwidth on Demand	The ability to size bandwidth availability with the instantaneous requirement. This is particularly important in dealing efficiently with bursty data traffic.
BER	Bit Error Rate. The ratio of received bits that contain errors.
BMC	Burst Mode Controller. Controls the burst transmission of data over the wireless airlink.
BPV	Bipolar Violation. This term is associated with T-1 line coding. A bipolar violation occurs when logical 1s do not alternate polarity in the T-1 transmission.
Broadband	A transmission facility with a capacity or bandwidth capable of carrying many voice transmissions, video and data. Normally the term broadband is associated with connections of T-1 (1.5 Mbps) rates and higher.

Term or Acronym	Definition
CAP	Competitive Access Provider. A company that bypasses local telephone companies by providing a direct link between the switching office and its customers. Bypassing local carriers may reduce costs for long distance users or result in faster data services.
CCCH	Coax Command Channel. A physical and data layer interface between the IDU and TRA. Allows the IDU to keep tabs on the TRA and program different broadcast/receive RF channels.
CLEC	Competitive Local Exchange Carrier. A company that competes with an incumbent local telephone company by providing its own networks and switching.
CPE	Customer's Premise Equipment. Reference to end user data decoding and receiving equipment, such as a PBX or network router.
DAC	Digital-to-analog convertor.
DDS	Direct Digital Synthesis. Uses a lookup table, a known clock and DAC to generate signals digitally.
DS1	See T-1.
DS3	Digital Signal Level 3. Refers to transmission speed of 44.736 Mbps, 28 T-1s, 28 DS1s, 672 standard voice channels.
EIRP	Effective Isotropic Radiated Power. The arithmetic product of the power supplied to an antenna and its gain.
Ethernet	The most commonly used LAN protocol, typically operating at 10 Mbps (10 BaseT). Newer iterations of Ethernet transmit at speeds of 100Mbps (100Base-T) and approximately 1Gbps.
ERP	Effective Radiated Power. The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction.
FDMA	Frequency Division Multiple Access. The method of radio transmission that allows multiple users to access a frequency band without interference.
FE	Millimeter Wave Front End. Signal transmitter and detector.

Term or Acronym	Definition
FRU	Field Replaceable Unit. An assembly or module capable of being field replaced.
Gbps	One billion bits per second.
GHz	Gigahertz. One GHz is equal to 10^9 Hz.
HDLC	High-Level Data Link Control. HDLC is a protocol used for synchronous data transmission.
Hz	Hertz. A unit of frequency defined as one cycle per second.
I/F	Intermediate Frequency. In superheterodyne receiving systems, the frequency to which all selected signals are converted for additional amplification, filtering and eventual direction.
IFD	Indoor I/F and Power Distribution PCA. An assembly that connects up to 8 TRAs to the coaxial cable between the indoor and outdoor units (FRU).
IMP	Hub Indoor Unit Management Processor PCA. An assembly for the main or master control for the IDM (FRU).
Indoor Unit Controller	MCA microprocessor that controls its corresponding outdoor transceiver controller, burst mode controllers, and I/O card controllers.
IP3	Third order intercept point.
IP	Internet Protocol. Protocol developed across various dissimilar computers across a network such as the Internet.
LNA	Low Noise Amplifier.
Kbps	One thousand bits per second.
LAN	Local Area Network. A group of two or more computers connected together for the purposes of sharing data and peripherals.
LEC	Local Exchange Carrier. A company providing local telephone services over existing networks, including the Regional Bell Operating Companies and a variety of independent telephone companies. When discussing a competitive local environment, the LEC is typically the incumbent while the CLEC is the competitive entrant.

Term or Acronym	Definition
LMCS	Local Multipoint Communication Systems. Characterized as wireless broadband distribution systems, operating in a cellular fashion, providing an array of video, data and telephone services directly to residential and business subscribers. These broadband local distribution networks will act as local communications common carriers and to carry basic and advanced communications, multimedia and broadcasting services.
LMDS	Local Multipoint Distribution Systems. The United States version of LMCS.
Mbps	One million bits per second.
MCA	Modem Control Assembly PCA. Indoor subsystem consisting of RF modem, burst mode controller coax modem and controller microprocessor.
MHz	Megahertz. One MHz is equal to 10^6 Hz.
MIB	Management Information Base. A directory listing the logical names of all information resources residing in a network and pertinent to the network's management. Within the Internet MIB employed for SNMP based management, Abstract Syntax Notation One is used to describe network management variables. These variables, which include such information as error counts or on/off status of a devise, are assigned a place on a tree data structure.
MIC	Microwave Integrated Circuit. A designation for a multiplex interfacing between two DSIs and one DSIC circuit.
Microwave	A very short radio wavelength whose frequency is higher than 300MHz (approximately 300MHz to 100GHz).
MMDS	Microwave Multipoint Distribution Services. Systems with wide geographical coverage, operating at low microwave frequencies. Most MMDS systems that are implemented use the 2.5 to 2.69GHz band.
MMIC	Microwave Monolithic Integrated Circuit. A replacement for silicon chips required for microwave solutions at frequencies above 25GHz.

Term or Acronym	Definition
Modulation	The process of varying some characteristic of the electrical carrier wave as the information to be transmitted on that carrier wave varies. Three types of modulation are commonly used for communications: amplitude modulation, frequency modulation and phase modulation.
Narrowband	Generally refers to delivery channels capable of carrying sub T-1 speeds, that is, less than 1.5Mbps.
NET	Interface card to Sonet OC-3 155.52Mbps network interface which provides one or two bi-directional interface ports to a SONET network.
NF	Noise Figure. The ratio (in dB) between the signal-to-noise ratio applied to the input of the microwave component and the signal-to-noise ratio measured at its output. NF is an indication of the amount of noise added to a signal by the component during normal operation. Lower noise figures mean less degradation and better performance.
NTSC	National Television Standards Committee. The Electronic Industries Association that prepared the standard of specifications for North America approved by the Federal Communications Commission in 1953 for commercial broadcasting.
OAM and P	Operations, Administration and Maintenance Procedures.
OC3	A designated SONET standard differentiating transmission line speed and bandwidth capacity, equal to 155 Mbps.
Outdoor Transceiver Controller	Microprocessor that controls the transceiver configuration and transceiver alarms.
PBX	Private Branch Exchange. Telephone switching equipment for private premises such as office buildings.
PCA	Printed Circuit Assembly. Printed circuit board.
PCS	Personal Communications Services. Refers to wireless communications services, similar to cellular telephone service but operating in a different set of frequencies. Outside of North America, PCS is referred to as personal communications networks or PCN.

Term or Acronym	Definition
PSTN	Public Switched Telephone Network. Worldwide voice telephone network accessible to all those with telephones.
QAM	Quadrature Amplitude Modulation. A high density modulation scheme used for the transmission of data.
RF	Radio Frequency. Refers to a frequency band which is higher than the audio frequencies, but below the infrared frequencies.
RSSI	Receive Signal Strength Indicator. Indicator used to measure signal level at a receiver input terminal.
Rx	Receive, receiver.
SMP	Subscriber Management Processor that controls the I/F link and provides the main or master control of the Subscriber IDU.
SMCA	Subscriber MCA. See MCA.
SNMP	Simple Network Management Protocol. A standard network protocol for use over telecommunications networks such as ATM and IP.
STM1	The international equivalent of OC-3.
SONET	Synchronous Optical Network. A set of international standards that has been broadly adopted for all digital fiber optical transmissions in North America.
Switch	A network device that establishes connections or paths to be used for the transmission of voice, video and data between end points in a network. Switching is a process of connecting circuits to form a transmission path between users. Switches allow local telecommunications service providers to connect calls directly to their destinations, while providing advanced features and recording connection information for billing purposes.
T-1	The Telco Industry term for a communication protocol (serial interface) that operates at 1.544 Mbps and is the basis of the carrier telecommunications infrastructure. T-1 is a full duplex, synchronous interface that delivers 193 bits (192 payload + 1 framing bit) ecery 125us. A T-1 (also called a DS1) is typically comprised of 24 voice or data (64Kbps) channels that are provided to an end user.

Term or Acronym	Definition
TCP	Transmission Control Protocol. Advanced Research Projects Agency of the United States Department of Defence net-deployed transport layer protocol. Corresponds to OSI layers 4 and 5, transport and session. TCP is a transport layer, connection oriented, end-to-end protocol.
TDD	Time Division Duplex. A method of alternating between transmitting and receiving.
TDM	Time Division Multiplexing. A device which derives multiple channels on a single transmission facility by connecting bitstreams one at a time at regular intervals.
TDMA	Time Division Multiple Access. A method of modulation and signal transmission that sends digital information sequentially in bursts at different instants or slots of time. Communicating devices at different geographical locations share a broadcast channel by means of a technique that allocates different time slots to different users.
TRA	Transmit/Receive Assembly: The transceiver assembly and horn antenna that connects with coax to the Hub IFD (FRU).
Tributaries	I/O ports that connect the user data to the Phoenix system. Tributaries can be DS1, Ethernet 10Base-T, Fractional DS3, etc.
Tx	Transmitter, transmit.
WAN	Wide Area Network. Uses common carrier-provided lines that cover an extended geographical area. Contrasted with a LAN. This network uses links provided by local telephone companies and usually connects disperse sites.
WLL	Wireless local loop. A replacement for POTS, that is, low bandwidth telephony, over a wireless channel, with generally no broadband data capacity; many frequency bands are possible.