

FTTx

For Installers and Technicians



Appendix A

FTTx Glossary



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Glossary of Terms

µm

A micron; a millionth of a meter. Common unit of measurement for fiber optic diameters.

4K HDTV

Enhanced HDTV with a resolution of 3,840 pixels and 2,160 lines, four times the resolution of standard HDTV.

8K HDTV

Currently the highest level of HDTV standards used by the broadcast and Pro-A/V industries. 8K HDTV has a resolution of 7,680 pixels and 4,320 lines.

Absorption

Caused by impurities introduced during the manufacturing process, absorption creates loss in a fiber by turning light energy into heat. The amount of absorption is determined by the wavelength and depends upon the composition of the glass or plastic. Absorption and scattering are the two causes of intrinsic attenuation in an optical fiber.

Acceptance test

A test to confirm that an optical cable or link meets established performance specifications.

Active device

An active device is a device that requires electrical power. One type is those that convert signals between electrical and optical formats such as lasers, LEDs, and photodiodes. Active devices also can manipulate light, such as optical amplifiers and modulators.

Active Ethernet

A technique, defined in IEEE 802.3ah, that uses Ethernet as the main transmission method over fiber optics. Active Ethernet is a point-to-point system can use either one fiber (bidirectionally at 1490 nm downstream and 1310 nm upstream) or two fibers (one Tx and one Rx) at 1310 nm. Most active Ethernet systems use SFP modules.

Active optical cable (AOC)

A fiber optic cable that has been preterminated with an external electrical endface, thereby removing the termination process. The electrical endfaces can be manufactured with most module formats. The most common module formats are the SFP and HDMI interfaces, but DVI, VGA, SFP+, and QSFP+ interfaces also can be provided.

Adapter

A mechanical device that transitions the transmitter or receiver of an optical loss test set (OLTS) to the fiber optic cable assembly.

Add/drop multiplexer (ADM)

A mid-span electronic element that provides optoelectric/electro-optic conversion to add, drop, or multiplex photonic signals.

Aerial

A type of installation in which the cable is connected to poles or towers by means of clamps or other attachment hardware.

Aerial cables

Cables that are designed to handle environmental concerns such as wind and ice loading, pollution, UV radiation, thermal cycling, stress, and aging in aerial placements. There are several variations of aerial cables including OPGW and ADSS.

Air blown fiber (ABF)

An installation technique developed by British Telecom where micro ducts or “pipe cables” are installed, and then optical fibers or fiber bundles are blown into the cable with spans reaching 10,000 feet.

All-dielectric self-supporting (ADSS)

A self-supporting loose tube cable structure without any metallic elements. Specified by the IEEE P-1222 standard, ADSS cable is designed for a variety of short and long span lengths between poles and to withstand typical weather loads on those spans.

Allowable path loss (APL)

The difference, in dBm, between a transmitter’s outputs (minimum or maximum) and the receiver’s sensitivities (maximum or overload). Subtracting the minimum APL from the maximum APL equals the differential optical path loss in dB.

American National Standards Institute (ANSI)

The official American standards body through which standards are published and various other standards committees are accredited.

Amplitude modulation (AM)

An analog transmission method, used by the CATV industry, in which information carried by an electronic signal causes the height of the sine wave (amplitude) to vary. Principle forms include QDM, QAM, SSB, and VSB.

Analog

A data format using continuous physical variables such as voltage amplitude (AM) or frequency (FM) variations that are analogous to the original signal.



Angled physical contact (APC)

A ferrule endface at 8° that minimizes Fresnel reflections when in contact with another APC termination. APC polishes normally have a component reflectance value of 60-70 dB. They are most often used in analog, DWDM, and FTTx installations.

Aramid yarn

A woven strength member incorporated into fiber optic cable assemblies for protection and mechanical bonding.

Architecture

In networks, it is how the components are connected to and operate with one another. The term “network architecture” focuses on how fiber optic system elements communicate including functional organization (services) and configuration (topology and communications). Network architectures are usually designed as to their protocols. B-PON, G-PON, EPON, GEAPON, SONET, ATM, Ethernet, etc., are examples of network architectures.

Armored cable

Cable with metallic sheathing or rods placed under or between cable jackets to prevent rodents from damaging the internal cable elements.

As-builts

Drawings that provide accurate depictions of cable running lines, pedestal locations, electronic sites, manholes, marker posts, etc., to aid with the management of cable assets and allow the facilities to be located, protected, maintained, and modified.

Asynchronous

A transmission method that sends one character at a time without waiting for a response that the previous character sent was received.

Asynchronous transfer mode (ATM)

A high-speed call-based transmission scheme that provides bandwidth on demand for multimedia (voice, video, or data).

Asynchronous transfer mode PON (APON)

See *broadband PON*.

Asynchronous transmission

A transmission method with no clocking signal in which each character of information is individually synchronized through start and stop elements that notify the receiver of incoming data without regard for timing of the previous character. Also see *synchronous transmission*.

Attenuation

The loss of optical power, whether caused intrinsically (absorption, scattering, microbends, etc.), or extrinsically by components (connectors, splices, splitters, etc). Expressed as dB or dB/km (with fiber).

Attenuator

A component that incorporates a specific amount of loss into an operational optical network. Attenuators also provide a safety margin in planned networks to allow for electronics degradation over time, or physical changes to the optical component portion of the network. Attenuators come in two styles, fixed and variable. Variable optical attenuators are used for testing systems for dynamic range and quality of signal testing.

Avalanche photodiode (APD)

A photodiode that takes advantage of avalanche multiplication of photocurrent to convert one photon to multiple electrons.

Backbone

The cabling used to connect entrance facilities, cross-connects, telecommunications closets, and equipment rooms. The backbone may consist of either interbuilding and/or intrabuilding cabling.

Backreflection

The loosely-used term covers optical return loss (ORL) for spans, reflectance for components, and Fresnel reflectance.

Backscattering

See *Rayleigh scattering*.

Band

A range of optical spectrum allocated based on optical amplifiers. Six bands are specified: O (original), E (enhanced), S (short), C (conventional), L (long), and U (ultra). These cover the optical spectrum from 1260 nm to 1675 nm. Further, the ITU-T G.983 through G.987 have identified operational wavelength bands with the names of: 1300 nm, intermediate, basic, and enhancement bands.

Bandwidth

A measure of the maximum frequency by which light intensity can be modulated before the signal experiences 3 dB of excess attenuation. The difference between the highest and the lowest frequencies of a transmission channel or path; identifies the amount of data that can be sent through a given channel. The greater the bandwidth, the greater the information carrying capacity. Multimode fiber bandwidth is expressed in MegaHertz per kilometer (MHz-km).

Basic band

The wavelength region originally called out for B-PON, G-PON, and EPON at 1480 to 1500 nm.

Bend-insensitive fiber (BIF)

Single-mode fibers that have been modified to demonstrate reduced bend radius characteristics without attenuation changes. Specified in the ITU-T G.657 standard.

Bend loss

Increased attenuation due to macrobends (curvature of fiber) or microbends (small distortions in the fiber) coupling light energy from the fiber core to the cladding.



Bend radius

The minimum radius that fiber or cable can bend and still maintain its optical and physical qualities.

Bidirectional (Bidi)

Operating in both directions.

Bidirectional transceiver

A device that sends information in one direction and receives information from the opposite direction.

Bit

An electrical or optical pulse whose presence or absence indicates data. The capacity of the optical waveguide to transmit information without error is expressed in bits per second per unit length.

Bit error rate (BER)

A measurement of transmission accuracy. It is a ratio of bits received in error versus bits sent. Fiber optic communication systems normally have a BER value of 10^{-9} or 10^{-12} .

Bit error rate tester (BERT)

Test equipment that measures the bit error rate of digital transmission systems.

Bit rate

A unit of measure for digital transmission speeds expressed in bit per second (b/s).

Breakout kit

A kit that provides a breakout cable structure for non breakout structures (with one fiber per tube).

Broadband

A bundle of services over a wide range of wavelengths or frequencies, exchanged over various types of media, between the service provider and the customer.

Broadband PON (B-PON)

The first FTTx standard issued as ITU-T G.983, the B-PON standard was designed for the bidirectional transmission of ATM cells over G.652 single-mode fiber at a distance of 20 kilometers using wavelength independent couplers (splitters) with split rates of up to 1:32. Originally defined by the FSAN S652 document.

Brownfield

A type of FTTx network installation that makes upgrades or additions to existing legacy copper or coax installations.

Buffer tube

Buffer tubes accommodate 250-micron coated fibers in a loose tube cable configuration. They can be filled with gel, powder, threads, or tapes to resist moisture intrusion.

Buried

Cable placed by trenching, direct burial, plowing, boring, or installation into underground ducts.

Butt closure

Closure with cable ports located at one end of the closure.

Byte

One segment of digital information; usually 8, 16, or 32 bits equal to a single character. Defined with a capital "B" as opposed to "bits", which uses a lowercase "b".

Cabinet

A container that may enclose connection devices, terminations, and equipment.

Cable assembly

A fixed length of cable with connectors installed on both ends. Sometimes called a patchcord, patch cable, or jumper.

Cable jacket

The protective outer covering of wire or optical cable. Common materials include polyethylene (PE), polyurethane (PU), polyvinyl chloride (PVC) and Teflon (plenum).

Carrier-to-noise ratio (CNR)

A quantification of analog system noise. The ratio, expressed in decibels, of the level of the carrier to that of the noise in the receiver bandwidth before any nonlinear process such as amplitude limiting and detection takes place.

C-band

The C-band is the "Conventional" DWDM transmission band, occupying the 1530 to 1565 nm wavelength range, as specified in ITU-T G.692. Most erbium-doped fiber amplifiers (EDFAs) operate in the C-band. *See conventional band.*

Cell

A common term used in network protocol language to contain and transport fixed length packets (as in ATM/SONET SMDS systems) or variable length packets (as in Ethernet) of secured identification information (header) and user-processed data (payload).

Centralized topology

A PON topology where the optical splitter is located in one location in the outside plant, normally at a fiber distribution hub.

Center wavelength (CW)

The nominal value operating wavelength in a laser; thereby, the wavelength defined by a peak mode measurement where the effective optical power resides. Also, the average of the two wavelengths measured at half amplitude points of the power spectrum in lasers and LEDs.

Central office (CO)

The building in which telephone companies, etc., locate their switching equipment and terminate their circuits. Sometimes called an "exchange."



Chromatic dispersion (CD)

The variation in the velocity of light (group velocity) as a function of wavelength. It causes pulses of a modulated laser source to broaden when traveling within the fiber, up to a point where pulses overlap and bit error rate increases. CD is a limiting factor in high-speed transmission and must be properly compensated, which implies proper testing. A combination of material and waveguide dispersion.

Churn

Data scrambling and low-level protection during downstream transmission from the OLT to the ONT. Primarily used for data confidentiality.

Cladding

The low refractive index material, usually glass, that surrounds and protects the core and provides the optical refractive barrier.

Clock

In data communications, a device that generates precisely-spaced timing pulses used for synchronizing transmissions and recording elapsed times.

Closure

See *splice closure*.

Cloud computing

A representative model for individual access to a shared grouping of computer resources, including other networks, servers, applications, storage and services. These can be easily accessed and managed with little or no service provider intervention. Usually shown as a cloud on network drawings.

Coarse wavelength division multiplexing (CWDM)

Applies to greater separation of wavelengths than DWDM. In single-mode applications, CWDM defines a 20-nm separation from 1471 nm to 1611 nm. With multimode fibers, the wavelengths are 778, 800, 825, and 850 nm.

Coating

A plastic or acrylate coating, normally up to 245-250 microns, that is placed over the cladding during the manufacturing process. After this process, the fiber can be colored or upper coated to 900 microns for use in tight buffered cables.

Coexistence

When WDM is used to overlay older legacy PON systems to newer standards including ITU-T G.987 (10G-PON), ITU-T G.989 (WDM-PON), IEEE 802.3av (10GEPON), and SCTE 174 (RFoG). Legacy systems use different defined wavelength assignments.

Color code

A color system for circuit identification by use of solid colors, contrasting stripes, tracers, braids, surface markings, etc., as determined by the TIA-598 standard.

Community antenna television (CATV)

Assumed to be cable television, CATV uses fiber and coaxial media to provide voice, video, or data services.

Compression

A technique to minimize bandwidth requirements by reducing the data stream needed to convey the information.

Concatenated

Connected together in a line.

Connect rate

Homes connected divided by homes passed.

Connector

Most fiber optic connectors consist of two plugs and one adapter. Connectors can be push/pull types (SC, LC, MPO, MTP®), Bayonet (ST), or threaded (FC). Most use a 2.5-mm ferrule but small form factor types use a 1.25-mm ferrule. Other features include a key and keyway that provide critical alignment for repeatability and for strain relief internally and at the rear boot. Key specifications for all connectors include attenuation, reflectance, and repeatability.

Continuous wave (CW)

Energy is emitted from a module continuously, rather than in short pulses. CW applications require the laser to be on at all times. Constant output from an optical source that is active but not modulated by a signal.

Conventional band

Defined in ITU-T G.692 as between 1530 and 1565 nm, the C-band is used in FTTx applications for RF overlay and RFoG downstream transmission. It is the dominant wavelength in DWDM and long haul transmission systems using EDFA optical amplifiers. See *C-band*.

Cordage

Tight buffered breakout cables used to build patch cords (jumpers). Internally, the fibers are normally one or two 900-micron coated fibers. The term “zipcord” describes a two-fiber cordage to allow two separate plugs to have their own strain relief.

Core

The light guiding part of the fiber with a refractive index higher than that of the cladding.

Coupler

See *splitter*.

Coupling loss

The optical attenuation of a connection or passive device, expressed as a value in dB.

Coupling ratio

A measure of how a device distributes light from its inputs to its outputs. Expressed as either a percentage or in dB.



Customer premises equipment (CPE)

The telecommunications terminal equipment located on the customer's premises, including telephones, private branch exchanges, and data terminals.

Cutoff wavelength

The wavelength at which a particular waveguide mode ceases to be a bound mode. When transmitting lower than a single-mode fiber's cutoff wavelength, the fiber transmits multimode. For G.652 single-mode fibers the cutoff wavelength is 1260 nm. For G.655 fibers, it can range from 1260 nm to 1450 nm.

Dark fiber

An unused fiber installed for future use.

Data communications

The transmission of data from one point to another.

Data encryption

A mathematical technique that encodes data so that it is more secure during transmission or storage. The data must be decrypted for use.

dB

A decibel, a logarithmic unit describing the ratio of two powers. Used to measure attenuation, reflectance, and amplification of optical signals. The ratio of two power levels, P_1 and P_2 , expressed by $-10 \log_{10}(P_1/P_2)$.

dB/km

A logarithmic unit that describes the ratio of loss of power per kilometer distance, always referenced to a specific wavelength, e.g., 0.35 dB/km at 1310 nm. Used by fiber and cable manufacturers to define the fiber's attenuation.

dBm

Decibels relative to one milliwatt. A positive number indicates the power is above one milliwatt; a negative number indicates the power is below. This unit has become common in fiber optic communication systems because the power of light sources used with optical fibers is on the order of one milliwatt.

Dense wavelength division multiplexing (DWDM)

Specified by ITU-T G.694, DWDM is the transmission of multiple optical wavelengths over a single-mode fiber with spacings of 200 GHz (1.6 nm), 100 GHz (0.8 nm), or 50 GHz (0.4 nm). First implemented in the 1990s, it is mostly used for oceanic, long haul, and metropolitan area networks.

Detector

A device such as a photodiode or photodetector that converts optical energy into electrical energy. They can be made from silicon, germanium, gallium arsenide, indium gallium arsenide or from other semiconductors, depending on the wavelengths to detect. The positive-intrinsic-negative (PIN) and the avalanche photodiode (APD) types are used in fiber optics. PIN types can be used for analog or digital systems, while APDs with their internal amplification can only be used in digital systems.

Dielectric

An insulating (nonconducting) medium.

Differential group delay (DGD)

A delay caused by different arrival times of optical signals, which results in modal dispersion. In multimode fibers, DGD is the delay difference of the various modes. In single-mode fibers, DGD can be caused by chromatic, waveguide, and polarization mode dispersion.

Differential optical path loss (DOPL)

The difference between the maximum and minimum APL calculations. In the ITU-T G.983 and G.984, the DOPL equals 15 dB for Classes A (5-20 dB), B (10-25 dB), and C (15-30 dB) and automatically includes the optical loss for the 1:32 splitter in the PON network.

Diffraction grating

An array of fine, parallel, equally-spaced reflecting or transmitting lines that mutually enhance the effects of diffraction to concentrate the diffracted light in a few directions determined by the spacing of the lines and by the wavelength of the light.

Digital

A data format that uses discrete varying signals to contain information. Used in fiber optics as this format is easier to process and multiplex, and it is less sensitive to noise than analog transmission.

Digital signal (DS)

A hierarchy of digital signal speeds used to classify capacities of digital lines and trunks. The fundamental speed level is DS-0 (64 kb/s).

Digital subscriber line (DSL)

A generic name for a family of digital lines provided by local telephone companies to their subscribers.

Digital video

Video signals represented by discrete numerical values rather than by continuously varying signal levels as in analog video. Because of this, it is simpler to maintain the fidelity of the video information as it travels through a transmission medium.

Diplexer

A component used to provide two functions, such as multiplexing or filtering optical signals. For example, a diplexer used at an FTTx optical network terminal filters the downstream 1490-nm wavelength and multiplexes the upstream 1310-nm wavelength to or from a single fiber.

Directional coupler

A fiber optic coupler that preferentially transmits light in one direction.



Directionality

A quantification of how much light is passing in any direction, measured in dB. If a 0 dBm signal passes through a coupler with 50 dB directionality, only -50 dB (0.01 μ m) will pass in the wrong direction.

Dispersion

The cause of bandwidth limitations in fiber. In multimode systems, modal dispersion is caused by differential optical path lengths known as differential path delay. For single-mode systems, chromatic dispersion is a combination of material dispersion (caused by the line width of the laser source) and waveguide dispersion (caused by the difference in the speed of light in the core and the cladding of the fiber). Another type of dispersion is polarization mode dispersion (PMD), which is caused by random vibration, temperature variations, and bending of the fibers known as birefringence.

Dispersion-shifted fiber (DSF)

Specified by ITU-T G.653, this fiber provides low attenuation and dispersion at 1550 nm. It could not be used with DWDM as it caused four wave mixing, and has been obsolete and replaced by G.655 nonzero dispersion-shifted (NZDS) fiber.

Distributed feedback (DFB) laser

A laser that uses an internal grating to reduce the line width of the laser, and may be used for analog applications, e.g., AM/FM/DWDM.

Distributed topology

A PON topology where two or more optical splitters are located in the outside plant. The tapered bus using tap splitters is technically a distributed topology.

Distribution cable

A tight-buffered non breakout style cable mostly used for indoor installations. Jackets can be plenum, riser, or low smoke zero halogen to meet building codes. Internally, the fibers have a 900-micron coating. In the outside plant, the term "distribution cable" is used by service providers to describe the cable between the feeder (backbone) and drop cables.

Distribution network

The fiber cables network deployed from the splitter to the curb in a PON.

Distribution panel

A combination of a patch panel and splice panel.

DOCSIS

The Data-Over-Cable-Service Interface Specification that permits a cable modem termination system to be designed as either a layer 3 router or layer 2 switch. Used by the CATV industry.

Drop cable

The fiber cable that connects the subscriber to the curb box and into the network.

Duct

A small pathway, generally 4" or smaller in diameter. Smaller inner ducts or fabric mesh inner duct are installed to allow cables to be pulled through. It may be buried, installed aerially, or within a building. Common types include smoothwall, ribbed, and corrugated.

Duplex

Two; twin. Refers to the type of fiber optic cable, e.g., duplex zipcord, or duplex plug, e.g., SC, LC.

Duplex transmission

Transmission in both directions, either one at a time (half duplex) or both directions simultaneous (full duplex).

Dynamic bandwidth allocation (DBA)

A technique where transmission bandwidth in a shared architecture such as a passive optical network (PON) can be allocated on demand.

Dynamic range

For an optical instrument, defined (in dB) as the ratio of the smallest signal that can be observed at a specified wavelength separation in the presence of a strong nearly-saturating signal.

E-band

Defined by ITU-T G.692 as "extended" for wavelengths between 1360 and 1460 nm, this band includes the high OH peak in single-mode fibers. G.652D fiber is designed for transmission within this band. In FTTx systems, the term can be confused with the enhancement band, which the ITU-T G.983 and G.984 PON FTTx standards define as the wavelengths between 1550 and 1560 nm for RF overlay transmission of video signals. *See extended band.*

Electromagnetic interference (EMI)

The frequency spectrum of electromagnetic radiation that extends from subsonic frequency to X-rays. Not to be used in place of RFI.

End separation loss

The optical power loss caused by distance between the end of a fiber and a source, detector, or another fiber.

Endface

The surface area of the fiber optic ferrule where the optical fiber is centered and polished.

Enhancement band

A wavelength band (1550-1560 nm) selected for RF overlay capabilities for PON systems. These may include video services and DWDM.

Enterprise local exchange carrier (ELEC)

Management of a large number of communication lines associated with a campus-type environment, such as a university, business or theme-type parks with a centralized exchange. The ability to provide multiple services over the entire campus makes it operate like a small town or community, and thus its own exchange carrier.



Entrance facility

The entrance to a building for communications and power. It provides the transition between the outside plant and the premises. The entrance facility can connect to telecom, utility, or communication rooms or closets.

Erbium-doped fiber amplifier (EDFA)

An optical amplifier that uses active erbium-doped fiber and a pump source (laser) to boost or amplify the optical signal. Used in DWDM, CATV HFC, RF overlay and RFoG systems. Amplifies mostly in the C-band (1530 to 1565 nm).

Ethernet

A data communications protocol for premises and local access networks (IEEE 802.3). Ethernet features variable length packets that allow data to be sent with less overhead.

Ethernet PON (EPON)

Based on IEEE 802.3ah protocol for Ethernet, EPON is a network data transport using a variable length packet structure up to 1,518 bytes at data rates up to 1,000 Mb/s over single-mode fiber. The EPON format uses up to 1:32 optical splitters and can use either one fiber bidirectionally (BX) or two fibers (LX) in low medium or high power configurations.

Exclusive access

A situation in which a single retail service provider (who may or may not be the network operator) has exclusive use of the FTTH network.

Extended band

The E-band, called out in the ITU-T Series G, Sup. 39 as the spectral wavelength region for single-mode fiber between 1360 nm and 1460 nm. *See E-band.*

Extended reach

See reach extender.

Extrinsic loss

Loss caused by imperfect alignment of fibers in a connector or splice such as lateral offset, angular misalignment, end separation, and end finish.

Fabric mesh inner duct

A type of flexible inner duct used to increase capacity of ducts. It conforms to the shape of the cables placed inside, greatly reducing the space required in the conduit.

Fabry-Perot (FP) laser

A multilongitudinal mode laser diode with a semiconductor on each end to form a resonant chamber to create the lasing effect. Used in digital applications. Limited to 10 Gb/s speeds and used only for digital transmission.

Fast Ethernet

IEEE 802.3 standard operating at 100 Mb/s.

Federal Communications Commission (FCC)

A United States regulative body created in 1934 to standardize and control both transmitted communications.

Feeder cable

The main fiber optic cable coming from the central office to a splice closure near a point of demarcation, such as a fiber distribution hub. Links to distribution part of the network.

Feeder network

The fiber cables network deployed from the OLT in the central office to the first splitter in the field in a PON architecture.

Ferrule

Most often made of ceramic, but can also be steel or plastic. The fiber is bonded internally to the ferrule, which provides the alignment with the mating sleeve and opposite ferrule. Ferrule endfaces can be flat, radiused, or angled depending on the type of fiber and endface polish.

Fiber

A single optical transmission element characterized by a core, a cladding, and a coating. Two common structures, single-mode (with a step-index profile) or multimode (with a graded-index profile) are used for fiber optic communication systems. Different variations are made depending on the attenuation, bandwidth, dispersion, wavelengths, and mechanical requirements.

Fiber access terminal (FAT)

A small cabinet or pedestal with a limited amount of distribution fiber either to make a transition to drop fibers or a single splitter is placed and then drop fiber is run to the customer's interface. As an example, a low-rise MDU installation could use a FAT as its interface to the network.

Fiber amplifier

Most common are the erbium doped fiber amplifiers (EDFAs), semiconductor optical amplifiers (SOAs), and Raman amplifiers, which are used to increase signal gain without electrical conversion.

Fiber Bragg grating (FBG)

A piece of photo-refractive fiber that is exposed to high-intensity UV interference patterns, causing it to reflect a specific wavelength while being transparent to all other wavelengths. Used as a filter in WDM systems.

Fiber break locator

A low-cost OTDR that is used to locate breaks in optical fiber cables.

Fiber coating

A UV-cured material immediately surrounding the glass cladding that serves to protect the integrity of the fiber from surface damage and stresses. Normally 200 or 250 μm for outside plant cables and upjacketed to 900 μm for indoor cables.

Fiber demarcation box (FDB)

A fiber demarcation box provides a service provider with a customer disconnection point, either via a splice or connector interface. Slack cable storage and battery backup are stored here as well.



Fiber distribution hub (FDH)

A type of outside plant cabinet that houses optical splitters in passive optical systems between feeder, distribution, and drop segments. Pole, pad, or wall mounted, they provide an easy fiber management location for connecting subscribers to the service providers.

Fiber distribution unit (FDU)

Enclosures that house and organize groups of fibers.

Fiber in the loop (FITL)

An outside plant architecture deployed by telephone companies to provide broadband services to subscribers. In this architecture, SONET/SDH fiber runs from the telephone company central office to an optical networking unit. From this unit, subscribers are served in a star topology with a drop of coax, twisted pair, or composite coax/twisted pair.

Fiber nonlinearities

Types of nonlinearities include stimulated Brillouin scattering (SBS), four-wave mixing (FWM), modulation instability, self phase modulation, soliton formation, cross-phase modulation (XPM) and stimulated Raman scattering.

Fiber optic cable

A communications cable that consists of one or more optical fibers, each capable of transmitting data via modulated light waves. Loose buffered types for outside plant applications can be armored or dielectric stranded or central tube designs. Applications include aerial figure-8, ducted, direct buried, all dielectric self-supporting (ADSS), and optical power ground wire (OPGW). Indoor designs are tight buffered breakout or distribution types with cable jackets designed to meet building codes for use in plenum, riser, and low smoke zero halogen environments.

Fiber optic test procedure (FOTP)

Standardized methods for testing various fiber optic components, as specified in the TIA-455 standard.

Fiber optics

Term used to describe links used for voice, video, data, medical, sensing, and illumination applications. All use optical fibers to transmit or receive optical signals or power.

Fiber to the antenna (FTTA)

See *fiber to the cell*.

Fiber to the building/business (FTTB)

A topological reference to a network that supports multiple subscribers in a single structure, i.e., a business or a building. Multiple dwelling unit (MDU) defines residential use and multiple tenant unit (MTU) defines business units. In order to classify as FTTB, the fiber must at least: (a) enter the building; (b) terminate on an external wall of the building; (c) terminate no more than 2m from an external wall of the building; (d) enter at least one building within a cluster of buildings on the same property; (e) terminate on an external wall of one building within a cluster of

buildings on the same property; or (f) terminate no more than 2m from an external wall of one building within a cluster of buildings on the same property.

Fiber to the cell (FTTCell)

Fiber to the cell tower. Used to provide greater bandwidth and to transition to IP requirements using Ethernet.

Fiber to the curb/customer (FTTC)

Distribution of communication services by providing fiber optic links to a central point in each neighborhood and continuing to the homes by either twisted pair or coax.

Fiber to the desk (FTTD)

Transmission system using fiber optics from transmitter to desktop.

Fiber to the home (FTTH)

An access network architecture in which the final connection to the subscriber's premises is optical fiber. The fiber optic communications path is terminated on or inside the premises for the purpose of carrying communication services (voice, video, data) to a single subscriber. In order to be classified as FTTH, the access fiber must cross the subscriber's premises boundary and terminate: (a) inside the premises; (b) on an external wall of the subscriber's premises; or (c) no more than 2m from an external wall of the subscriber's premises. FTTH excludes architectures where the optical fiber terminates before reaching the premises and where the access path continues to the subscriber over a physical medium other than optical fiber, i.e., coax.

Fiber to the node (FTTN)

An access network in which fiber is used for part, but not all, of the link from the OLT to the end user. An optical-to-electrical conversion takes place at a node, which typically serves a neighborhood. The terminal network segment is usually twisted copper pair (FTTC) or coaxial cable (HFC). Most current CATV and telephony networks have FTTN architectures.

Fiber to the premises (FTTP)

Coined around the preliminary debates associated with the RBOCs and the CLECs before the FCC triennial review of the Telecommunications Act of 1996. A less generic term for fiber to the user (FTTx).

Fiber to the user (FTTx)

A more generic term than FTTP covering all types rather than one specifically.

Five nines

Any system operating 99.999% of the time.

Forward error correction (FEC)

A method to improve the performance of large-capacity optical transmission systems. System designs employing FEC can accept relatively large BER (better than 10^{-12}) in the optical transmission line before encoding.



Frequency

The number of cycles per unit of time, denoted by Hertz (Hz); 1 Hertz = 1 cycle per second.

Frequency division multiplexing (FDM)

Two or more signals combined at different frequencies so they can be transmitted as one signal.

Frequency modulation (FM)

A modulation scheme in which the message signal modulates a carrier signal so that the frequency (as opposed to the amplitude or phase) of the carrier is varied.

Fresnel reflection

Reflection of a portion of the incident light at a planar interface between connectors, mechanical splices, or two homogeneous media having different refractive indices.

Full duplex

Information can be sent in both directions simultaneously, as with a telephone.

Full Service Access Network (FSAN)

Develops PON specifications, which it forwards to the ITU to develop into standards. The FSAN S652 document is considered to be the grandfather document for the ITU G.983 B-PON standard. FSAN is working on next generation PON standards, including G.987 10G-PON and WDM-PON.

Full width half maximum (FWHM)

Used to measure the spectral width of light sources. Measure the spectral width at 3 dB (half power from peak) and at the full width of the source's power peak.

Fused biconical taper (FBT)

A splitter manufacturing process by which two fibers are positioned side-by-side, twisted together and pulled while being heated in a hydrogen flame, until their cores are close enough laterally to allow light transmission between them.

Fusion splicer

A mechanical device that optically joins optical fibers by discharging voltage between two electrodes. Variations include the single fiber and ribbon fixed V-groove types, the profile alignment splicer (PAS) and the local injection detection (LID), both of which are categorized as core alignment splicers.

G.652

Recommendation ITU-T G.652 describes the geometrical, mechanical, and transmission attributes of a single-mode optical fiber and cable that has zero-dispersion wavelength around 1310 nm. This fiber was originally optimized for use in the 1310 nm wavelength region, but can also be used in the 1550 nm region. This is the most commonly used fiber in typical FTTx networks.

G.657

ITU-T Recommendation that describes the geometrical, mechanical, and transmission attributes of fibers with strongly improved bending performance when compared to G.652 single mode fiber and cables. These fibers are increasingly used in FTTH networks, especially in the headend, cabinet, and in the last segments to and in the home and MDU.

Generic Requirements (GR) document

A broad range of Technical Specifications developed and published by Telcordia Technologies, typically with substantial input from leading industry manufacturers and service providers.

Giga (G)

A prefix meaning one billion.

Gigabit Ethernet

The IEEE 802.3z standard for high-speed Ethernet, capable of transmitting one billion bits per second. It provides increased network bandwidth and interoperability, and can be used in backbone environments to interconnect multiple lower-speed Ethernet systems.

Gigabit PON (G-PON)

Standardized in ITU-T G.984, G-PON handles data rates up to 2.5 Gb/s and split ratios up to 1:64. The standard features the G-PON encapsulation method (GEM), which allows for the transmission of Ethernet packets and ATM cells.

Gigahertz (GHz)

A unit of frequency equal to one billion Hertz.

G-PON encapsulation method (GEM)

A method of data encapsulation over the G-PON network, similar to ATM, that uses variable length frames to transport up to an encapsulated payload of 1500 bytes. Capable of sending ATM cells or Ethernet packets over the network.

Greenfield

Network deployment in an area under development. Since everything is being built for the first time, network construction can be done with few obstructions and installation can be accomplished parallel to other utilities.

Ground

An electrical connection to the earth, generally through a ground rod.

Handhole

An access opening provided in equipment or in a below-the-surface enclosure into which personnel reach, but do not enter, to work with or place cable. Also known as maintenance access handhole.



Head end

Central distribution point for a CATV system where a link is created between the HFC system and any external data networks. Video signals are received and frequency is converted to the appropriate channels, combined with locally originated signals, and then rebroadcast.

High definition television (HDTV)

Digital television with significantly more resolution than that of a good NTSC or PAL television signal. The specific resolution can vary, however it is typically about twice the resolution of standard television signals, and has a 16:9 aspect ratio.

High-density connector

Typically, connectors with multiple fibers in a small form factor housing, i.e., MPO, MTP®.

Home run

A PON architecture where the optical splitter is housed at the service provider's facility. Home runs are the easiest for handling changes, but require a fiber rich cabling system as one fiber is dedicated for each subscriber.

Homes connected

The number of premises that are connected to an FTTH network.

Homes passed

The potential number of premises to which an operator has capability to connect in a service area, but the premises may or may not be connected to the network.

Horizontal cabling

Cabling that extends between and includes the horizontal cross-connect and the telecommunications outlet.

Horizontal cross-connect (HC)

A cross-connect of horizontal cabling to other cabling, e.g., horizontal, backbone or equipment. Could be a patch panel or LAN (small) panel.

Hybrid cable

A cable with multiple types of optical fibers (e.g., multimode and single-mode). Often confused with composite cable.

Hybrid fiber coax (HFC)

A hybrid system, used by the CATV industry, that employs a fiber optic backbone and coax cables for final distribution from the node to the customer.

Incumbent local exchange carrier (ILEC)

The dominant phone carrier within a geographic area that provides local exchange service to that area.

Index matching fluid

A gel or liquid material whose index of refraction is almost equal to that of the fiber core. It is used to reduce Fresnel reflections in mechanical splices or cleave and crimp connectors.

Index of refraction (IOR)

The ratio of the speed of light in a vacuum to the speed of light in a material. When light strikes the surface of a transparent material, some light is reflected while some is bent (refracted) as it enters. The IOR is used to calibrate OTDRs for measuring fiber length.

Indium gallium arsenide (InGaAs)

The components of crystalline semiconductors used in fiber optic photodetectors.

Indoor living unit (ILU)

The customer premises within a multi-dwelling unit.

Infrared

Light wavelengths extending from 770 nm on.

Inline splice closure

Closure that has cable ports at opposite ends.

Innerduct

Usually a nonmetallic pathway that may be placed within a duct to facilitate initial and subsequent placement of multiple cables in a single duct.

Insertion loss

Total optical power loss caused by the insertion of an optical component such as a connector, splice or splitter.

Inspection scope

A microscope or digital scope that inspects ferrule and termini fiber endfaces for polishing quality, damage, or contamination.

Institute of Electrical & Electronics Engineers (IEEE)

A standards organization representing the United States on the ISO in the areas of electrical or electronic standards. Writes standards on communications including Ethernet and OPGW and ADSS cables.

Interbuilding backbone

A network that provides communications between buildings, e.g., college campus, office park, or military installation.

Interconnection

A scheme that provides for the direct connection of a cable to the other cable without a patchcord or jumper.

Interexchange carrier (IXC)

Any common carrier that provides long-distance services, i.e., Sprint or AT&T.

Intermediate band

A wavelength region allocated in the ITU-T G.983.1 for future use between 1360 nm and 1480 nm. Included guard bands for allocation by ITU.

Intermediate cross-connect (IC)

A cross-connect between first and second level backbone cabling. It can be between main (MC) and horizontal (HC). Normally would consist of a patch panel.



Intermediate distribution frame (IDF)

A metal rack located in an equipment room or closet that is designed to connect cables. It consists of components that provide the connection between interbuilding cabling and the intrabuilding cabling.

International Electrotechnical Commission (IEC)

An international standards body responsible for a wide range of recommendations and standards for telecommunications.

International Standards Organization (ISO)

An international body funded by the United Nations, that provides consistent worldwide standards. U.S. membership is provided by ANSI.

International Telecommunications Union (ITU)

The international body for communications standards. The telecommunications group within ITU is designated as ITU-T.

Internet protocol (IP)

A set of rules for how data is transmitted from place to place on the Internet. IP is a connectionless protocol in which data is broken down into small bundles known as packets. Each packet is transmitted separately, possibly along a different route than other packets from the same message.

Internet protocol address

A protocol on which the Internet is based, this software-describing standard tracks addresses for different nodes, routes outgoing messages, and recognizes incoming messages.

Internet protocol television (IPTV)

A compressed digitized video provided through packet or cell transmission (FTTH) to subscribers.

Internet service provider (ISP)

An organization whose business is connecting users to the Internet. By serving as the interface between end users and the Internet, the ISP's equipment is analogous to a CATV head end or telephony CO.

Intrabuilding backbone

A network that provides communications within a building; often referred to as the riser backbone in vertical buildings.

Intrinsic losses

Losses arising from differences in fiber tolerances.

Integrated services digital network (ISDN)

A digital network available to business or home users for transmission of voice, video, or data up to 1.5 Mb/s.

Isolator

A passive fiber optic component that either allows only unidirectional passing of light or that passes only some wavelengths of light. Used in conjunction with lasers or optical amplifiers to reduce or remove backreflections.

Jacketing

The outer jacket of a cable, which can be made from a variety of materials including but not limited to HDPE, MDPE, PVC, *et. al.*

Jitter

The variation in time of a received signal compared to the instance of its transmission or compared to a fixed time frame at the receiver. Examples of jitter sources include signal-pattern-dependent laser turn-on delay jitter, noise-induced jitter on a gating turn-on point, gating hysteresis jitter, and gating jitter that accumulates in a link between two nodes.

Jumper

See *patchcord*.

Kellems grips

Wire, aramid or synthetic mesh that is placed around the cable to be installed, intended to provide positive pulling power. Also known as pulling or mesh grips.

Kevlar™

Strands of protective aramid fiber used to provide strain relief in cable assemblies. Also used in cables as their dominant means of strain relief. Kevlar™ is a trademarked name by DuPont.

Keyed

Connectors in which the plug and adaptor are fixed in alignment to prevent rotation and physical fiber endface damage.

Kilo (k)

Numerical prefix denoting one thousand.

Kilometer (km)

Standard length of measurement for fiber optics; 1,000 meters, 3,281 feet, or 0.621 miles.

kpsi

Tensile strength measured in thousands of pounds per square inch.

Laser

Light amplification by stimulated emission of radiation; a coherent source of light with a narrow spectral width.

Laser chirp

Noise created by reflected or crosstalk optical energy entering the lasing chamber.

Laser diode

A semiconductor diode that emits light in a narrow spectrum; typically over 90% of the light output power concentrated within one angstrom.

Lashing

Attaching a cable to a supporting strand or cable using a steel or dielectric filament around both cable and messenger.



Last mile

The last mile is the local access network that extends from the CO to the end-user subscriber. Also called the local loop network, it is traditionally copper-based and suffers from the bandwidth limitations of that media.

Latency

Delay of a signal in time, which can be caused by transmission, processing, rotation, and propagation delays.

L-band

The “long” DWDM transmission band, occupying the 1565 nm to 1625 nm wavelength range. *See long band.*

LC connector

Lucent connector, a high density push/pull connector style that is common in FTTH networks.

Light

The region of the electromagnetic spectrum that can be perceived by human vision, designated by the visible spectrum and nominally covering the wavelength range of 400-770 nm. In optical communications, it includes the much broader portion of the electromagnetic spectrum that can be handled by the basic optical techniques used for the visible spectrum. This region is not clearly defined but may be considered to extend from the near-ultraviolet region of approximately 300 nm, through the visible region, and into the mid-infrared region to 30,000 nm.

Light-emitting diode (LED)

A semiconductor device that emits incoherent light formed by the P-N junction. Burrus (well) and edge-emitting diodes are used with systems operating up to 622 Mb/s over multimode fibers.

Light source

The fiber optic transmitter in an optical loss test set (OLTS) that uses one or more LEDs or lasers at specified wavelength. Lasers used in communication systems must be stabilized and operating in continuous wave or modulated at 2 kHz.

Link

An optical cable with connectors attached to a transmitter and receiver.

Local access and transport area (LATA)

The geographic area that is the domain of the local exchange carrier. Bell operating companies are generally precluded from carrying traffic across LATA boundaries; this traffic must be handed off to an interexchange carrier.

Local area network (LAN)

An interconnected system of separate stations, usually computers, in a relatively small geographical location such as an office building or campus.

Local exchange carrier (LEC)

The phone carrier providing local transmission services. Defined as either independent or regional Bell operating company (RBOC).

Local loop

The connection between a customer’s telephone or data equipment and a local exchange company or other telephone service provider.

Long band

The L-band, the spectral band allocated by the ITU-T Series G Sup. 39 as the wavelengths between 1565 nm and 1625 nm. *See L-band.*

Loose tube cable

A type of cable where the internal 250-micron fibers are loose within buffer tubes. Types include stranded, central tube, OPGW, ADSS, and microduct cable. Also known as loose buffer cable.

Loose tube gel filled (LTGF)

A loose tube cable structure with buffer tubes filled with gel to restrict moisture intrusion. Mostly replaced with “dry” techniques, it is still used in areas of extreme low temperatures.

Loss

See attenuation.

Loss budget

The tolerable difference between the light impulse where it originates and the light impulse where it arrives at the receiving end. If too much light power has been lost along the way through deficiencies in the cable or connectors, the signal cannot be read and interpreted.

Loss windows

Fiber optic transmission typically occurs at 850, 1300, 1310, 1550, and/or 1625 nm. These “windows” were selected because absorption and scattering losses were lower within them. These wavelengths require light sources and photodetectors that operate efficiently over multimode and single-mode fibers. The newer term “bands” is used to define optical windows that match up with optical amplifiers and their optimum transmission wavelengths. The history of the usage comes from the availability of sources and detectors and their operating characteristics over an optical fiber due to the absorption effects at different wavelengths.

Low-smoke zero halogen (LSZH) cable

The standard cable used in Europe in place of plenum or riser cable types. Internationally, LSZH cables are used in place of plenum and riser cable jackets. In North America, LSZH cables are used on ships and in tunnels. Also known as zero halogen cable.

Macrobending

In an optical fiber, all macroscopic deviations of the axis from a straight line; distinguished from microbending.



Main cross-connect (MC)

A cross-connect for first and second level cabling, e.g., from equipment facility connecting to all other locations (ICs and HCs). Usually would consist of a distribution or patch panel.

Main distribution frame (MDF)

A wiring arrangement that connects the telephone lines coming from outside on one side and the internal lines on the other. A main distribution frame may also carry protective devices as well as function as a central testing point.

Margin

The amount of additional loss that can be tolerated in a link.

Material dispersion

Dispersion caused by differential delay of various wavelengths of light in a waveguide material.

Material safety data sheet (MSDS)

Technical bulletin required by OSHA detailing information about the physical or health hazards of a chemical or mixture.

Mean time between failure (MTBF)

Developed by the military to estimate maintenance or replacement times for various pieces of high-end equipment, MTBF is based upon statistical evidence derived from in-use testing under extreme conditions (simulated or actual environment). Testing is performed by the manufacturer of the equipment or an independent test facility.

Mechanical splice

A fiber splice accomplished by fixtures or materials, rather than by thermal fusion. Index matching material may be applied between the two fiber ends.

Mega (M)

A prefix meaning one million.

Megabit (Mb)

One million bits.

Messenger wire

Galvanized wire ranging from 1/4" to 9/16" which is placed between poles and which standard cable types are lashed.

Metropolitan area network (MAN)

An interconnected data transmission system connecting users and LANs in a localized geographical area such as a city.

Microbending

An effect where small stresses or flaws create attenuation. Mostly an extrinsic effect caused by tie wraps and point deformations onto the fiber that allow light to escape. Intrinsic sources are flaws or defects in the core/cladding boundary created during the manufacturing process.

Microduct

Small HDPE ducts up to 16 mm in diameter that can be installed in empty or partially filled ducts to provide space for microduct fiber optic cables.

Microduct cable

Microduct cables are designed for high-density fiber counts in a small optical cable, normally between 5-16 mm. Designed for blowing into microducts.

Micron (μm)

A millionth (10^{-6}) of a meter. A common unit of measurement for fiber optic diameters.

Mid-entry

Opening a cable in the middle of a span to access the fibers. Also known as an express entry.

Mode

A light path.

Mode field diameter (MFD)

The portion of a single-mode fiber that actually transmits the light energy. Generally 20% larger than the physical core. The size of the mode field varies with wavelength.

Modulated laser

A laser module that allows users to control output power by varying a control voltage, which turns the laser on and off.

Modulation

The coding of information onto a carrier frequency. May use amplitude, frequency, phase, or time, plus many forms of on/off digital coding.

Modulator

A waveguide device used externally to the laser to electro-optically change the refractive index of the waveguide in response to an applied electric field. The phase changes induced can result in amplitude modulation of light at the output port.

Moving Pictures Experts Group (MPEG)

Various standards, established by the, that define the amount of compression, and thereby the quality, of the resultant video information file.

Multifiber push-on connector (MPO)

A high-density connector that can terminate up to 24 single-mode or 72 multimode fibers in a single termination.

Multilongitudinal mode (MLM) laser

A laser, usually Fabry-Perot, that has a measured spectral width specified by the maximum root mean square of the spectral distribution (side modes), limited to no more than 20 dB down from the peak mode.



Multimode fiber (MMF)

An optical waveguide that allows more than one mode to be guided. 50/125, 62.5/125 and 100/140 are the most common. Graded-index types are used in fiber optic communication systems. Multimode fibers are also specified by the IEC 11801 standard and classified by modal bandwidth as OM1, OM2, OM3, or OM4.

Multiple system operator (MSO)

A cable television provider.

Multiplex

A concept in which independent sources of information are combined and transmitted over a single communication channel. Electronic multiplexing includes TDM and FDM, while optical multiplexing includes wide, coarse, and dense wavelength division multiplexing.

Multiplexer (Mux)

A device which combines two or more separate signals for transmission through a single fiber. Optical multiplexer combines signals at different wavelengths. Electronic multiplexer combines TDM or FDM signals electronically before they are converted into optical form.

Multiple dwelling unit (MDU)

Apartment or condominium units within a larger building. Also known as a multifamily dwelling unit.

Multiport service terminal (MST)

An environmentally-hardened outside plant fixture that contains 4-12 ruggedized connector ports, connectors, and optical fiber cable length to span from splitter location to MST location.

Multiprotocol label switching (MPLS)

An overall data-carrying protocol that encompasses circuit-based and packet-switching services such as ATM, SONET, and Ethernet, as well as network digital formats such as VoIP and IPTV.

Multitenant data center (MTDC)

A facility that provides Internet infrastructure services, such as electrical power, fire suppression, security, cooling, and network access, usually over optical fiber. Some firms lease datacenter space to other providers or individual enterprises. Colocation data centers sell space on the basis of racks, cabinets, or cages.

Multiuser telecommunications outlet assembly (MUTOA)

Used in work areas of premises networks to allow multiple terminations.

Nanometer (nm)

One billionth of a meter, or 10^{-9} meters. Most common unit of measurement for light.

Nanosecond (ns)

One billionth of a second, expressed as 10^{-9} seconds.

National Electrical Code (NEC)

A North American code that addresses proper electrical/fiber optic systems and equipment installation to protect people and property from hazards stemming from the use of those systems in buildings and structures. Updated every three years. In Canada, refer to the Canadian Electrical Code (CEC).

National Electrical Safety Code (NESC)

This outside plant code contains basic safety provisions that cover supply, communication lines, equipment, and work practices of personnel employed by utilities.

National Television Standards Committee (NTSC)

Committee that defines specifications and methods for displaying video information on a standard television.

Network equipment building system (NEBS)

A requirement for central office equipment in the North American Public Switched Telephone Network. Originally developed by Bell Labs (now Telcordia) in the 1970s and released as a public document in 1985.

Network operations center (NOC)

The group responsible for the day-to-day care and feeding of a network. Also called a network control center (NCC).

Network topology

The cable plant that connects the operator's premises and the subscriber's premises, i.e., point-to-point, point-to-multipoint, or ring topology.

Next generation PON (NG-PON)

Defined by FSAN as NG1 and released by the ITU as the G.987 10 Gigabit PON standard.

Next generation PON2 (NG-PON2)

A 40-Gigabit passive optical network that uses time and wavelength division multiplexing (TWDM). Released as ITU-T G.989.

Node

Transmission equipment placed in the outside plant to connect multiple users to a common link that extends back to a head end, CO, or similar location.

Noise

In a cable or circuit, any extraneous signal that tends to interfere with the signal normally present in or passing through the system.

Nonzero dispersion-shifted fiber (NZDS)

Single-mode fiber designed for DWDM and optical amplifier applications. Specified in ITU-T G.655.

Numerical aperture (NA)

A measure of the angular acceptance for a fiber, approximately the sine of the half-angle of the acceptance cone. The NA of an optical fiber defines a characteristic of the fiber in terms of its acceptance of incoming light. "Light gathering ability" and "acceptance cone" are terms describing this characteristic.



O-band

The “original” transmission band, occupying the 1260 to 1360 nm wavelength range, with a center wavelength of 1310 nm. Used in FTTH standards for upstream transmission. *See original band.*

Occupational Safety & Health Administration (OSHA)

The main government agency for enforcement of safety and health law in the United States.

Open access

When multiple retail service providers may share use of infrastructure or network and compete to offer their services to end users.

Open access (duct)

The situation where multiple retail or wholesale service providers may use the infrastructure covering a substantial region by drawing or blowing their fiber cables through shared ducts, and compete to offer their services.

Open access (packet)

The situation where multiple retail service providers may use the FTTH network on an equitable base by connecting at a packet layer interface and competing to offer their services to end users.

Open access flexibility point

The concentration point, possibly located at a building or cabinet, where multiple retail or service providers may connect via their feeder cables and access Layer 1 feeder fiber connectivity to each household.

Open system interconnection (OSI)

A seven-layered framework of standards for network communication. OSI creates an open systems networking environment where different systems can share data regardless of vendor or platform.

Operational support system (OSS)

Software that furnishes tools to provide network control, monitoring and business functions.

Operations, administration and maintenance (OAM)

A group of network management functions that provide fault indications, performance information, and network diagnosis.

Optical access networking (OAN)

An access network made up of optical transmission links as opposed to copper links composed of twisted-pair or coaxial cabling.

Optical add/drop multiplexer (OADM)

A multiplexer typically used in DWDM systems to allow a wavelength to be added or dropped optically. Can be fixed (FOADM), reconfigurable (ROADM), or dynamic (DOADM).

Optical amplifier

A device that amplifies light without converting it to electrical signal. Types include the EDFA, Raman, and SOA.

Optical attenuator

A passive component that produces controlled signal loss in an optical transmission line to decrease the optical power. Available as fixed or as variable types.

Optical carrier (OC)

Usually followed by a numerical designator such as 1, 12, 192, etc. Used in SONET and ATM transmission systems to describe the optical conversion of a synchronous transport signal at a specific rate, i.e., OC-3.

Optical circulator

A multiport device that steers optical energy between specific ports. Used in conjunction with a Bragg filter to provide OADM.

Optical code division multiple access (OCDMA)

Creates a unique optical code, similar to a bar code, for each channel by selectively filtering out portions of the spectrum. This spectrally encoded light is then modulated with the data to be transmitted.

Optical distribution network (ODN)

The fibers, splitters, couplers, etc., in a passive optical network that provide the optical transmission means from the OLT to the users, and vice versa.

Optical-electrical-optical (OEO)

Specifies a network switch that receives an optical signal, and demultiplexes, switches, multiplexes and re-transmits the signal optically. Can perform 3R functions.

Optical fiber

An optical waveguide comprised of a light-carrying core and cladding, which traps light in the core. Fiber optic communication systems use either single-mode or multimode types.

Optical filter

A passive component used to modify the optical radiation that passes through it, usually by altering the spectral distribution. Employed to reject or absorb optical radiation in particular ranges of wavelength while transmitting it in other ranges. Tunable optical filters can track the signal wavelength variation over its operating wavelength range while untunable models have fixed values.

Optical isolator (OI)

A nonreciprocal device intended to suppress backward reflections along an optical fiber transmission line while having minimum insertion loss in the forward direction.

Optical line terminal (OLT)

The PON controller card or unit located at the service provider that converts incoming traffic into laser pulses and sends them down the fiber, and signals the ONTs when to send upstream traffic. The laser at the OLT is always on and is frequently a DFB laser that transmits at 1490 or 1550 nm. Several OLTs may be located in a single chassis.



Optical loss

The amount of optical power lost as light is transmitted through fiber, splices, couplers, etc. See *attenuation*.

Optical loss test set (OLTS)

A single-mode or multimode test set consisting of a light source and power meter. OLTS is used for measuring a completed fiber optic cable assembly's loss (in dB) at the connector interfaces, within the specified wavelength of the fiber optic.

Optical network terminal (ONT)

A media converter or gateway at a home or business that converts signals from light to electrical signals and contains ports to distribute signals either wirelessly or on existing home wiring.

Optical power

The amount of radiant energy per unit time, expressed linearly (watts) or logarithmically (dB).

Optical receiver

An electronic device that converts optical signals to electrical signals.

Optical return loss (ORL)

The sum of the amount of light reflected from all optical fibers and components. The fiber, connectors, or splices in an optical system can cause the reflection.

Optical signal-to-noise ratio (OSNR)

The difference between the signal being transmitted and the noise being created by an optical laser's pulse. The higher the OSNR, the better the quality of service.

Optical supervisory channel (OSC)

A channel, accessed at optical line amplifier sites, used for maintenance purposes including but not limited to remote site alarm reporting, communications necessary for fault location, and orderwire. Does not carry payload traffic.

Optical switch

A passive component possessing two or more ports that selectively transmits, redirects, or blocks optical power in an optical fiber transmission line, or that re-routes signals from one optical fiber into others. Types include MEMs, matrix, bypass, optical cross-connect, and electrical network switches.

Optical time-division multiplexing (OTDM)

Use of optical processors to multiplex, process, and demultiplex signals to achieve higher speeds. There are two fundamentally different types of OTDM, interleaved and slotted. OTDM may well be a practical necessity for generating data rates well above 40 Gb/s.

Optical time-domain reflectometer (OTDR)

A type of test equipment used to characterize a fiber via the transmission of an optical pulse. The resulting backscatter and reflections are measured as a function of time attenuation. The OTDR provides identification of defects over a length of fiber. Types include mainframe, full feature, mini, fault locators, and specialty OTDRs.

Optical-to-electrical (OE)

Shorthand notation for a point or device that converts an optical signal to an electrical signal.

Optoelectronic

Pertaining to a device that responds to optical power, emits or modifies optical radiation, or utilizes optical radiation for its internal operation.

Optomechanical switch

Bipolar switch, based on moving fibers or mirrors, that moves optical signals between fibers.

Original band

The O-band, the spectral band for single-mode, as called out in the ITU-T Series G, Sup. 39, ranging from 1260 nm to 1360 nm. See *O-band*.

OS1

G.652 single-mode fiber, as designated by IEC 11801.

OS2

G.652D single-mode fiber, as designated by IEC 11801.

Outlet

See *telecommunications outlet*.

Output power

Radiant power, expressed in watts.

Outside plant (OSP)

The portion of a communication network that exists mostly outdoors, but also between transmission sites. It includes patch panels, closures, pedestals, the media (e.g., fiber, twisted pair, coax) and the structure (aerial, underground, etc.) where the cable is installed and routed. The patch panels at each end are points of access for testing, as well as a point of separation of responsibilities for the transmission network.

Overbuild

See *brownfield*.

Packet

A data unit of variable length used in communications protocols such as Ethernet and IP. Packets allow some flexibility by allowing more data to be sent without breaking it up into pieces and then re-assembling it at the receiver, in turn reducing overhead.



Packet switching

Messages are divided into small chunks that fit easily into memory and reassembled into the original message at the destination, enabling communications channels to be used simultaneously by more than one node.

Passive

A component that requires no electrical power to operate, i.e., optical splitters, wavelength division multiplexers, filters, circulators, and optical attenuators.

Passive optical network (PON)

A point-to-multipoint system, specified by the ITU, IEEE, and SCTE, that is made up of fiber optic cabling, passive splitters and WDMs that distribute an optical signal from the service provider to homes (FTTH) or buildings (FTTB).

Patchcord

A fixed length of cable with like connectors on both ends (or, in the case of a hybrid cable, different connectors). Sometimes called a cable assembly, patch cable or jumper.

Patch panel

A wall- or rack-mounted cross-connect panel for interconnection of multiple cables or fibers.

Pathway

A facility for the placement of telecommunications cable.

Pay-per-view (PPV)

The sale of content to subscribers on a per-program basis as opposed to a subscription basis.

Penetration rate

Homes connected divided by the number of premises in a served area.

Photodetector

An electro-optic device that transforms light energy into electrical energy.

Photodiode

A semiconductor that converts light into an electrical signal, used in fiber optic receivers.

Photon

The packet or element of light exhibiting features of both particle and wave.

Physical contact (PC)

Refers to the endface polish of a ferrule. Designed to lower reflections by changing the spherical or angle at the end of a ferrule and its internal fiber. Variations include PC, super PC (SPC), ultra PC (UPC), and angled PC (APC).

Pigtail

A short length of cable that has one end terminated with a connector and the other end is spliced to existing cable and placed into a splice tray in a patch panel. Pigtails are generally manufactured for single-mode fiber with machine polished endfaces for low backreflection.

PIN diode

Positive intrinsic negative diode, a type of photodiode used to convert optical signals in a receiver.

Plain old telephone service (POTS)

Basic telephone service, dial tone without special features.

Planar lightwave circuit (PLC)

A technology that enables photons to pass through a wafer structure in much the same way they do through fiber. It has become an accepted technology for WDM systems, largely in the form of multiplexer/demultiplexer modules based on arrayed waveguide gratings.

Planar waveguide

A waveguide formed on the surface of an optically flat material where the area of propagation has a high refractive index and guides light in the same manner as optical fiber. When utilized in couplers or splitters, the waveguide is divided from a single input into multiple outputs.

Plenum

Defined in the NEC as the air handling space between walls, under structural floors, and above suspended drop ceilings, which can be used to route intrabuilding cabling. See *OFNP*.

Plug

Connector. The male side of a connection. Usually consists of three main parts: the body, ferrule and strain relief boot.

Point of presence (POP)

The physical location where a long-distance carrier terminates lines before connecting to the local exchange company, another carrier, or directly to a customer.

Point-to-multipoint (P2MP)

A star topology with optical splitters for PON systems in which an OLT is optically linked to multiple ONTs through entirely passive means. It provides branching optical fiber paths from a communication node to more than one premises such that a portion of the optical paths are shared by traffic to and from multiple premises.

Point-to-point (P2P, PtP, Pt-Pt)

A topology in which all fiber links are from one transmitter to one receiver. Branching can be done at an intermediate point via an active device located anywhere on the network, including the CO or a curb-side enclosure. It provides an uninterrupted optical fiber path from the communication switching equipment point to the a single location at the premises. For FTTx systems, it is typically used in active Ethernet.

Polarization

The orientation of the electric and magnetic field vectors of a propagating electromagnetic wave. An electromagnetic wave theory describes in detail the propagation of optical signals (light).



Polarization mode dispersion (PMD)

Typical single-mode fibers support two perpendicular polarizations of the original transmitted signal, which may travel at different speeds and arrive at different times. The average difference in arrival times of the two polarization modes, normalized with length, is referred to as PMD.

Polarized dispersion loss (PDL)

The difference in dB between the maximum and minimum values of loss (attenuation) due to variation of the polarization states of light propagating through a device. The ITU defines PDL as polarization dependent loss, the maximum variation of insertion loss due to a variation of the state of polarization (SOP) over all SOPs.

Power

The rate at which energy is absorbed, received, transmitted, transferred, etc., per unit time. Optical power is measured in dBm or watts.

Power budget

The difference (in dB) between the transmitted optical power (in dBm) and receiver sensitivity (in dBm).

Power meter

Test equipment that measures the optical power (dBm) and attenuation (dB) in a fiber optic connector, fiber optic cable, or fiber optic system.

Premises

Defined as the subscriber's home or place of business. In a multiple dwelling unit, each apartment is counted as one.

Private branch exchange (PBX)

Customer premises version of central office switch. Switches calls between phones on premises and provides a second dial tone for calls over the public network.

Protocol

A set of communications conventions that enable orderly and accurate transfer of data between stations.

Public switched telephone network (PSTN)

The traditional voice network infrastructure, including both local and long distance service, that has been in use in various parts of the world for the last century.

Pulling tension

The force that can be applied to a cable without affecting the specified characteristics for the cable, or the longitudinal force exerted on a cable during installation. Also known as pulling stress.

Pulse broadening

An increase in pulse duration resulting in optical dispersion.

Pulse code modulation (PCM)

A coding scheme for converting analog signals into a digital bit stream.

Pulse spreading

The dispersion of incoming optical signals along the length of an optical fiber.

Pulse width

A measurement of the full width half maximum (FWHM) value of a light source's peak power and spectral width at the 3 dB point. Lasers in OTDRs can change pulse width to create greater dynamic range.

Quadplexer

Commonly known as a passive WDM, this transceiver package performs four multiplexing or demultiplexing functions. Used in 10 Gigabit OLTs when coexisting with legacy PON systems.

Quality of service (QoS)

A measure of the telephone service quality provided to a subscriber.

Raceway

A metal or plastic channel designed to hold and protect cables. Types include ladder, splice, and mesh trays. Fiber raceway systems are designed specifically for fiber optic cables.

Radio frequency interference (RFI)

The disruption of signals which can be caused by high voltage and lightning.

Radio frequency over glass (RFoG)

An SCTE 174 standard released in 2010, RFoG addresses PON network transmission for the CATV industry.

Rayleigh scattering

The scattering of light into a direction generally reverse to the original one. The principle on which OTDRs operate; the scattering of light caused by index of refraction variations in the submicroscopic structure of the glass. One of the two major causes of attenuation in optical fibers.

Reach extender (RE)

The extended distance of the ODN beyond the 20-km maximum limit agreed upon by the originating standards bodies. Used by active Ethernet and XG-PON for network distances from 40 to 80 km. Also known as reach extension and extended reach. Reach extension can occur by using optical amplifiers (1R) or 3R signal regeneration.

Receive (Rx)

Refers to the detection of light from an optical source.

Receiver (RCVR)

An electronic unit that converts an optical signal to an electrical signal using an APD or PIN photodiode.

Receiver sensitivity

This tells how much optical power the photodetector must receive to achieve a specified base band performance, such as a specified bit error rate or signal-to-noise ratio. Expressed in dBm.



Receptacle

A connector adapter with an internal LED, laser or detector that connects to optical plug assemblies.

Reconfigurable OADM (ROADM)

Unlike OADMs, ROADMs can be managed via a network connection without need for a truck roll. They function as optical switches, allowing for remote service changes, and provide an express wavelength path and power monitoring.

Reflectance

The percentage of light reflected from a component, such as a connector, splice, splitter, or WDM.

Reflection

The abrupt change in direction of a light beam at an interface between two dissimilar media that returns the light beam back into the medium where it originated, i.e., a mirror.

Refraction

The bending of a beam of light in transmission between two dissimilar materials or in a graded index fiber where the refractive index is a continuous function of position.

Refractive index

The ratio of light velocity in a vacuum to its velocity in the transmitting medium.

Regional Bell operating company (RBOC)

A company formed from the forced breakup of AT&T and the Bell system.

Relative intensity noise (RIN)

Light is reflected back into a laser and amplified through the same physical mechanism that causes laser action. Caused by reflections from discontinuities in endfaces, connectors, or splices.

Remote terminal (RT)

A POTS-related switching terminal that is remotely located in a pedestal or electronics cabinet.

Repeatability

The amount of times a connector can be mated within an interface before the amount of insertion loss measured exceeds the Telcordia GR-20 standard. Detailed optical connector performance specifications may be found in Telcordia GR-326 (single fiber) and GR-1435 (multi-fiber).

Repeater/regenerator

A 3R repeater is a device inserted at intervals along a circuit that detects a weak signal, amplifies it, cleans it up, and retransmits it in optical form. A 3R regenerator is a receiver and transmitter combination used to reconstruct signals for digital transmission. Optical amplifiers are 2R regenerators.

RF overlay

RF and RF overlay are terms commonly used in the FTTx architecture to refer to the analog video signal added, usually via a WDM to the optical network within a certain wavelength band or region.

Ribbon cable and fiber

A cable that has internal optical fiber ribbons. Up to 24 fibers (250 μm) are spaced evenly, sandwiched between two layers of matrix. Normally there are up to 12 fibers per ribbon.

Ribbon splice

A fusion or mechanical splice that aligns and fuses or mechanically bonds two ribbon fibers together. Ribbon splices require special stripping and cleaving tools.

Rights of way (ROW)

Legal right of passage over land owned by another.

Ring topology

A communications topology in which each station is logically arrayed in a ring and passes information to the next station in order. It provides a sequence of optical fiber paths in a closed loop that connects a series of communication nodes.

Rise time

The time required for the leading edge of a pulse to rise from 10% to 90% of its amplitude; the time required for a component to produce such a result.

Riser cable

Cable installed in vertical runs and penetrating more than one floor or cables installed in vertical runs in a shaft. Rated by the NEC/CEC for resisting flame spread and smoke generation.

Roll-off

An OTDR trace of a fiber that gradually rolls off due to nonreflective breaks.

Router

Highly intelligent devices that connect networks, typically supporting multiple protocols.

S-band

The "short" DWDM transmission band, which occupies the 1460-1530 nm wavelength range.

SC connector

Subscriber connector, a push/pull connector style that is common in FTTH networks. It is available in simplex, duplex, hybrid, or hardened styles.

Service loop

(a) Allowing for "slack" in a splice tray, closure, or vault to accommodate future needs. (b) When a device is terminated to the wire in the communications outlet, a fair amount of "slack" should be left on the wire and wound in the box to accommodate future trimming when devices are changed out.



Serving area (SA)

An area defined by 32 optical network terminals (ONTs).

Signal-to-noise ratio (SNR)

The ratio of the power of the signal versus the power of the background noise, usually measured in decibels. Describes the quality of an electronic transmission system.

Silicon detector

A semiconductor that used absorbed photon energy to stimulate carriers from one energy level to a higher one. The change in charge across the junction is monitored as a current in the external photodiode circuit. Silicon photodetectors are commonly used in multimode systems operating at 850 nm.

Simple/signalling network management protocol (SNMP)

Network management architecture initially designed for the Internet but easily applied or extended to any network type.

Simplex

Operation of a communications channel in one direction only with no capability of reversing.

Simplex cable

A tight buffered breakout cable with only one fiber.

Single-longitudinal mode (SLM) laser

A laser, usually distributed feedback (DFB) type, where the spectral width is the width at the 20 dB down points divided by 6.07.

Single-mode

A step-index waveguide in which only one mode will propagate above the cutoff wavelength.

Single-mode fiber (SMF)

The most common types are those specified by the ITU as G.652 (standard SMF), G.652D (low water peak SMF), G.657 (bend-insensitive SMF), and G.655 nonzero dispersion shifted (NZDS). The ITU-T G.652 and G.652D fibers are also specified by the IEC 11801 standard as OS1 and OS2 fibers.

Sleeve

A mating device of either split or solid construction, commonly made of ceramic or bronze, that is used to align two ferrules within an adapter.

Small form factor (SFF)

A connector that offers higher density, lower connector costs, easier termination, and better optical performance.

Source

Usually an LED or laser used to convert an electrical information-carrying signal into a corresponding optical signal for transmission by an optical fiber.

Spectral width

A full width half maximum (FWHM) measurement of a LED or laser light source to determine its optical width.

Speed of light

2.998×10^8 meters per second measured in a vacuum.

Splice

The mechanical or fusion means of joining two fibers together with a minimal loss and reflectance.

Splice closure

An inline or butt style cable and fiber management product with a dome or clamshell configuration that environmentally protects and houses optical splices. Splice closures can also hold connectors and optical splitters. Telcordia GR-771 specifies mechanical requirements and environmental specifications and tests.

Splice panel

A rack or wall-mounted panel for organizing or splicing cables. The panel holds splice trays, secures the cable, grounds any metallic members, and stores buffer tubes, fibers, and splices.

Splice protector

A device placed over a fusion splice to provide mechanical strength and protection to allow easy handling of the splice for organization in a splice tray or other storage. Two types are the heat shrink protector and the butterfly.

Splice tray

A protective tray that holds spliced fibers for slack and protection. A tray or other device used for the permanent storage of mechanical or fusion optical splices.

Splicing

Permanent joining of identical or similar fiber ends without a connector.

Splitter

A fiber device that optically splits signals. The splitters used in a PON outside plant network are optical splitters that distribute optical signals from the OLT into the ONTs. Splitters used in FTTx installations are specified by the ITU G.671 standard as wavelength independent couplers (WIC), which provide the same attenuation regardless of wavelength or direction.

ST connector

A straight tip, keyed bayonet with 2.5 mm ferrules. Available in ST I or ST II styles.

Star coupler

An optical splitter in which many fibers have their signals mixed at a single optical element. The mixed signals are then transmitted back through all the fibers. The name comes from the geometrical arrangement; all fibers come together at a single point.



Star topology

Also known as a point-to-multipoint (P2MP) topology, the star topology has one hub that connects all users. In FTTH, all PON systems are star topologies. Variations include the distributed star topology, which has two or more splitters cascaded from a single port.

Storage area network (SAN)

A network which links host computers to storage servers and systems.

Strain relief

How a cable's physical load is attached and addressed at the rear of a connector. In fiber optic cable assemblies using a 3-mm cordage, the Aramid yarn is epoxied or crimped to provide the strongest level of strain relief while protecting the cable's internal optical fiber(s).

Stranded cable

In stranded cables, individual color-coded buffer tubes are wrapped or "stranded" around the cable's central strength member.

Subscriber

A premises connected to a FTTH network that uses at least one service on this connection under a commercial contract.

Subscriber line interface circuit (SLIC)

The line card that provides the interface between local loop and telco switching equipment.

Super physical contact (SPC)

The spherical endface polish of a ferrule and fiber that is performed on a polishing machine. Typically 50 dB return loss. Superseded by the UPC polish.

Switched video on demand (SVOD)

Television service provided over an established network but not continuously broadcast, therefore requiring less bandwidth than conventional broadcast systems. Signal transmission is initiated when a subscriber selects a channel, which triggers a request back to the service provider.

Synchronous digital hierarchy (SDH)

A worldwide, high-speed synchronous protocol standard transmitting at up to 10 Gb/s. Known as SONET in North America.

Synchronous optical network (SONET)

ANSI-standard physical interface defined by its optical line rates known as optical carrier (OC) signals, frame format and OAM&P protocol. Adopted by the ITU as SDH.

Synchronous transfer mode (STM)

A transport and switching method that depends on information occurring in regular and fixed patterns with respect to a reference such as a frame pattern.

Synchronous transmission

A transmission method in which data characters are synchronized by timing signals generated at sending and receiving stations (as opposed to start/stop communications). Both stations operate continuously at the same frequency and are maintained in a desired phase relationship. Several codes may be used as long as they utilize the required line control characters. Also called "bi-sync" or "binary synchronous."

Synchronous transport signaling (STS)

The transmission speed of a SONET transmission medium, e.g., OC-48.

T1

A North American data exchange protocol for constant bit rate systems. It operates at 1.544 Mb/s and can handle up to 24 telephone calls or other data. The corresponding European protocol E1 operates at 2.048 Mb/s and handles up to 30 telephone calls or other data.

T3

A faster implementation of T1. Using coaxial cable, T3 allows for data transmission rates of 45 Mb/s and is used for WAN backbones, the Internet backbone and connections from Internet service providers to the Internet backbone.

Take rate

Subscribers divided by homes connected. Expressed as a percentage, it can also be based on each type of service, i.e., take rates for data, video, voice, or triple/quadruple services.

Tap

A coupler in which part of the light carried by one fiber is split off and inserted into another fiber. Essentially the same as a Tee coupler. An example would be a 10/90% optical splitter.

TCP/IP

Transport control protocol/Internet protocol. Originally developed by the U.S. government, this product is the de facto standard for Internet and inter-network communications.

Telcordia Technologies

Formerly known as Bell Communications Research (Bellcore). Originally created at the breakup of the Bell System in 1982, it was given a broad mandate to provide consulting services, R&D, and software development to the RBOCs. Telcordia was privatized in 1996 and later acquired by Ericsson in January 2012.

Telecommunications closet (TC)

A secure enclosed space that houses telecom equipment, cable terminations, and cross-connects. Recognized for backbone and horizontal cable facilities.

Telecommunications Industry Association (TIA)

An organization that participates in setting standards.



Telecommunications outlet (TO)

A single-piece cable termination assembly (typically on the floor or in the wall) that contains one or more modular telecom jacks, e.g., RJ45, coaxial terminators, fiber optic connections. If more than one type of connector is used, it is called a multiuser telecommunications outlet assembly (MUTOA).

Telecommunications space

The area used to house, install, and terminate telecommunications equipment and cable; e.g., telecommunications closets, work areas, and handholes.

Telephony PON (TPON)

A passive optical network, developed by British Telecom, with all or part of its transmission system between telephone switch and subscriber.

Tensile strength

The pull stress that is required to break a given specimen.

Termination

Connection.

Termination tools

Tools used in preparing optical fibers for splicing and/or installation of connectors.

Terminator

An optical plug with the fiber dead ended so that there is no reflectance. Terminators measure component reflectance using the OTDR and also reduce Fresnel reflections at open connector ports.

Threshold

A defined pass or fail value, i.e., the maximum or minimum value of insertion loss in dB or dBm.

Tight buffered cable

A type of cable with internal 900-micron coated fibers, such as breakout and distribution styles. Jacket materials vary but they are normally rated for indoor use to meet plenum, riser, and LSZH requirements.

Time and wavelength division multiplexing (TWDM)

A hybrid of time division multiplexing (TDM) and wavelength division multiplexing (WDM).

Time division multiple access (TDMA)

A data transmission method in which a number of individual transmitters in different locations share a transmission channel, each occupying the channel for a portion of the total time.

Time division multiplexing (TDM)

A digital technique for combining two or more signals into a single stream of data by sharing time.

Topology

Physical and logical layout of a network.

Total internal reflection

100% reflection and 0% transmission of light at the interface of two optical media.

Transmitter

An electronic unit that converts an electrical signal to an optical signal using LEDs or lasers.

Triple play

Voice, video, and data communications.

Triplexer

Commonly known as a passive WDM, this transceiver package performs three multiplexing or demultiplexing functions.

Tunable laser

A laser that can change wavelength. Applications include research, OTDRs, and protection in transmission systems.

U-band

The "ultra long" DWDM transmission band, occupying the 1625-1675 nm wavelength range.

Ultra high definition television (UHDTV)

The highest bandwidth applications for video are the new UHDTV sets just now entering production in the broadcast and Pro A/V industries. *See 4K HDTV and 8K HDTV.*

Ultra physical contact (UPC)

The spherical endface polish of a ferrule and fiber that is performed on a polishing machine to reduce reflections. Typically 55 dB return loss.

Unbundled network element (UNE)

Locally-owned media and components of an established telephone network.

Uninterruptible power supply (UPS)

An auxiliary power unit providing continuous power to a telephone system in case commercial power is lost.

Unitube cable

This type of cable has a large central tube in which the fibers are grouped using color-coded binder thread. Unitube cables are physically smaller than stranded-type cables. Also known as central tube or LXE cable.

User network interface (UNI)

The user end of an access network, similar to an ONU but not necessarily optical.

Variable optical attenuator (VOA)

A fiber system attenuator with adjustable attenuation; often used to test system performance by increasing attenuation until the system fails.

Vault

Storage product for excess cable slack and splice case.



Vertical-cavity surface-emitting laser (VCSEL)

A high-speed, low-cost laser operating at the 850-nm wavelength for applications such as Gigabit Ethernet where the modulation rate of current LEDs is insufficient.

Video

Exchange of visual material by use of IP (IPTV), RF (carried via a separate optical wavelength, overlay video), or other encoding and transport protocols.

Video on demand

A video service that allows users to select a program and begin viewing it at any time. It can allow VCR-like playback control.

Video over IP

The transmission of video programming over an IP network. If the source is digital, it is encapsulated into IP packets. Otherwise, it is digitized and usually compressed. It can then be converted back to analog by equipment at the customer's premises or viewed on a digital television.

Visible light

Electromagnetic wavelengths, ranging from 380-770 nm, that are visible to the human eye.

Voice

Exchange of bidirectional, real-time, full-duplex, human conversations via IP, encoding, or transport protocols.

Voice over IP (VoIP)

The transmission of telephone calls over an IP network.

Waveguide

An older term for optical fiber; a dielectric material structure able to support and propagate one or more modes.

Waveguide dispersion

Dispersion caused by the difference in the speed of light of the core and the cladding in single-mode fibers. Waveguide dispersion also changes with wavelength as the size of the mode field diameters increases with wavelength.

Wavelength

The optical term for frequency. Fiber optics generally uses the 850 nm, 1300/1310 nm, 1550 nm, and 1625 nm wavelengths for transmission.

Wavelength division multiplexing (WDM)

Combining two or more optical signals for transmission over a common optical path, usually a single fiber. WDM devices have a channel wavelength spacing greater than or equal to 50 nm. They typically separate a channel in one conventional transmission window (e.g., 1310 nm) from another (e.g., 1550 nm). Types include wide WDM, coarse WDM, and dense WDM.

Wavelength independent coupler (WIC)

Defined in ITU G.671 as an optical splitter that provides the same attenuation regardless of wavelength or direction.

WDM coupler

A passive device designed to either (a) optimally combine light of multiple predetermined wavelengths into a single core; or (b) optimally sort and segment those wavelengths and couple them separately into output fiber cores.

WDM-PON

Specified by the ITU-T G.989 document, a wavelength division multiplexing passive optical network is a next generation (NG2) network. The G.989 document identifies two variations of WDM-PON: point-to-point (P2P) and time and wavelength division multiplexing (TWDM). WDM-PON has new wavelength assignments that allow coexistence with legacy and NG-PON 10 gigabit systems. Wavelengths are assigned using standardized DWDM wavelength channels. Depending on the design, optical filters can be placed in the OSP or use ONTs with tunable optics.

Wide area network (WAN)

An integrated data network linking metropolitan or local networks over common carrier facilities.

Work area (WA)

A building space where the occupants may interact with telecommunications terminal equipment (computers, faxes, phones, etc.). A media or telecommunications outlet would be used here for duplex fiber terminations or, in the case of multiple users, a MUTOA outlet.

XG-PON

10 Gigabit passive optical networks covered under the ITU-T G.987 for telephony-based optical networks.

Yield

The percentage of terminations that pass specifications and are good the first time. The higher the yield (e.g., 95%), the greater the installed cost benefit.

Zipcord

A separable, two-fiber, breakout-style cable with a diameter (per buffer) of 1.6 mm (mini Zipcord), 2.5 mm, or 3.0 mm (standard cable assembly cordage).



Student Notes

Acronyms

3DTV	Three dimensional television.	BLEC	Building local exchange carrier.
μm	Micron.	BOSA	Bidirectional optical subassembly.
ABF	Air blown fiber.	B-PON	Broadband passive optical network.
ADM	Add/drop multiplexer.	BX	Single fiber designation for Ethernet.
ADSL	Asymmetric digital subscriber line.	CAP	Competitive access provider.
ADSS	All-dielectric self-supporting.	CAPEX	Capital expenditures.
AE	Active Ethernet.	CATV	Community antenna television.
AF	Assured forwarding.	CCTV	Closed circuit television.
AGC	Automatic gain control.	CD	Chromatic dispersion.
AM	Amplitude modulation.	CEC	Canadian Electrical Code.
AN	Access network, or access node.	CEV	Controlled environmental vault.
ANSI	American National Standards Institute.	CIR	Cable index of refraction.
AOC	Active optical cable.	CLEC	Competitive local exchange carrier.
AON	All-optical network.	CM	Cable modem.
APC	Angled physical contact.	CMTS	Cable modem termination system.
APD	Avalanche photodiode.	CNR	Carrier-to-noise ratio.
APL	Allowable path loss.	CO	Central office.
APON	Asynchronous transfer mode PON.	CODEC	Coder/decoder.
APS	Automatic protection switching.	CPE	Customer premises equipment.
APVD	Advanced plasma and vapor deposition.	CRC	Cyclic redundancy check.
ARPU	Average revenue per user.	CSA	Canadian Standards Organization.
ASOF	Application-specific optical fibers.	CSM	Central strength member.
ASQ	American Society for Quality.	CSMA/CD	Carrier sense multiple access / collision detection.
ATM	Asynchronous transfer mode.	CSO	Composite second order.
AWG	Arrayed waveguide grating.	CTB	Composite triple beat.
b/s	Bits per second. Also bit/s or bps.	CTR	Common telecommunications room.
BE	Best effort.	CW	Center wavelength, or continuous wave.
BER	Bit error rate.	CWDM	Coarse wavelength division multiplexing.
BERT	Bit error rate tester.	DAS	Distributed antennae system.
Bidi	Bidirectional.	dB	Decibel.
BIF	Bend-insensitive fiber.	DBA	Dynamic bandwidth allocation.
BI-MMF	Bend-insensitive multimode fiber.	DBFA	Dual-band fiber amplifier.
B-ISDN	Broadband integrated services digital network.	dBm	Decibels relative to one milliwatt.



- DBS** Digital broadcast satellite.
- DCF** Dispersion-compensating fiber.
- DEL** Density economical location.
- DEMUX** Demultiplexer.
- DFB** Distributed feedback (laser).
- DGD** Differential group delay.
- DGE** Dynamic gain equalizer.
- DH1** Digital signal hierarchy, level 1.
- DH3** Digital signal hierarchy, level 3.
- DHCP** Dynamic host configuration protocol.
- DIB** Dual-insulated buffer.
- DIP** Dual inline package.
- DLC** Digital loop carrier.
- DMD** Differential mode delay.
- DML** Directly-modulated laser.
- DOCSIS** Data-Over-Cable-Service Interface Specification.
- DOPL** Differential optical path loss.
- DPON** DOCSIS passive optical network.
- DPSK** Differential phase-shift keying.
- DPSS** Diode-pumped solid-state.
- DQPSK** Differential quadrature phase shift keying.
- DS** Downstream, or digital signal.
- DSF** Dispersion-shifted fiber.
- DSG** DOCSIS set-top gateway.
- DSL** Digital subscriber line.
- DSLAM** Digital subscriber loop access multiplexer.
- DSP** Digital signal processing.
- DTI** DOCSIS timing interface.
- DTV** Digital television.
- DWDM** Dense wavelength division multiplexing.
- DWS** Dynamic wave slicing.
- E/O** Electrical to optical.
- ECSA** Exchange Carriers Standards Association.
- EDA** Equipment distribution area.
- EDFA** Erbium-doped fiber amplifier.
- EDTV** Expanded high definition television.
- EF** Expedited forwarding, or entrance facility.
- EFM** Ethernet in the First Mile.
- ELEC** Enterprise local exchange carrier.
- EMB** Effective modal bandwidth.
- EMC** Emergency management center.
- EMD** Equilibrium modal distribution.
- EMI** Electromagnetic interference.
- EML** Element management layer.
- EMP** Electromagnetic pulse.
- ENMS** Enterprise network management system.
- EP2P** Ethernet over P2P in IEEE 802.3ah.
- EPON** Ethernet passive optical network.
- ER** Equipment room.
- ERK** Emergency restoration kit.
- ESL** Estimated splice loss.
- ETSI** European Telecommunications Standards Institute.
- EVC** Equivalent voice channels.
- FAT** Fiber access terminal.
- FBG** Fiber Bragg grating.
- FBT** Fused biconical taper.
- FC** Fiber connector, or frame control.
- FCAPS** Fault configuration accounting performance security.
- FCC** Federal Communications Commission.
- FCIA** Fibre Channel Industry Association.
- FDB** Fiber demarcation box.
- FDDI** Fiber distributed data interface.
- FDF** Fiber distribution frame.
- FDH** Fiber distribution hub.
- FDM** Frequency division multiplexing.
- FDMA** Frequency division multiple access.
- FDT** Fiber distribution terminal.
- FDU** Fiber distribution unit.
- FEC** Fiber entrance cabinet, or forward error correction.
- FET** Field effect transistor.
- FFS** For future study.



FILM	Fiber in the last mile.	GMII	Gigabit media independent interface.
FIT	Factory installed termination.	G-PON	Gigabit passive optical network.
FITL	Fiber in the loop.	GR	Generic Requirements.
FM	Frequency modulation.	GRIN	Gradient index (lens).
FOCIS	Fiber optic connector intermateability standard.	HAN	Home area network.
FOTP	Fiber optic test procedure.	HASB	High air-speed blown (fiber).
FOTR	Fiber optic transceiver.	HC	Horizontal cross-connect.
FOTS	Fiber optic transmission system.	HDA	Horizontal distribution area.
FP	Fabry-Perot (laser).	HDLC	High-level data link control.
FSAN	Full Service Access Network.	HDMI	High definition multimedia interface.
FSB	Fiber splitter box.	HDPE	High-density polyethylene.
FSWDM	Full spectrum wavelength division multiplexing.	HDSL	High bit rate digital subscriber line.
FTTA	Fiber to the antenna.	HDTV	High definition television.
FTTB	Fiber to the building, or business.	HFC	Hybrid fiber coax.
FTTC	Fiber to the curb, or customer.	HFOC	Hardened fiber-optic connector.
FTTCell	Fiber to the cell tower.	HHP	Households passed.
FTTD	Fiber to the desk.	HMFOC	Hardened multifiber optic connector.
FTTH	Fiber to the home.	HRC	Harmonic related carriers.
FTTN	Fiber to the node.	HVAC	Heating, ventilation, and air conditioning.
FTTO	Fiber to the office.	HVAD	Hybrid vapor axial deposition.
FTTP	Fiber to the premises.	IC	Integrated circuit, or intermediate cross-connect.
FTTx	Fiber to the user.	ICCF	Interexchange Carrier Compatibility Forum.
FWHM	Full width half maximum.	ICEA	Insulated Cable Engineers Association.
FWM	Four wave mixing.	ICMP	Internet control message protocol.
GaAsP	Gallium arsenide phosphide.	IDC	Indoor drop cables.
GbE	Gigabit Ethernet.	IDF	Intermediate distribution frame.
Gb/s	Gigabits per seconds. Also Gbps or Gbit/s.	IEC	International Electrotechnical Commission.
GBIC	Gigabit interface converter.	IEEE	Institute of Electrical and Electronic Engineers.
GEL	Geographical economical location.	IETF	Internet Engineering Task Force.
GEM	G-PON encapsulation method.	IFC	Intra fiber cabling.
GEAPON	Gigabit Ethernet passive optical network.	IFDH	Indoor fiber distribution hub.
GFF	Gain flattening filter.	IL	Insertion loss.
GFP	Generic framing procedure.	ILD	Injection laser diode.
GIS	Graphic information services.	ILEC	Incumbent local exchange carrier.
GLB	Grade level box.	ILU	Indoor living unit.



InGaAsP	Indium gallium arsenide phosphide.	MCVD	Modified chemical vapor deposition.
IP	Internet protocol.	MDA	Main distribution area.
IPA	Isopropyl alcohol.	MDF	Main distribution frame.
IP-SDV	Internet protocol-switched digital video.	MDI	Medium dependant interface.
IPTV	Internet protocol television.	MDPE	Medium-density polyethylene.
IPv4	Internet protocol, version 4.	MDU	Multiple dwelling unit, or multifamily dwelling unit.
IPv6	Internet protocol, version 6.	MEF	Metro Ethernet Forum.
IOR	Index of refraction.	MEM	Micro-electro-mechanical.
IRC	Incremental related carriers.	MEMS	Micro-electro-mechanical system.
ISDN	Integrated services digital network.	MFD	Mode-field diameter.
ISO	International Standards Organization.	MFT	Multifiber terminal.
ISP	Internet service provider.	MFU	Multiple family unit.
ITU	International Telecommunications Union.	MIB	Management information base.
ITU-T	International Telecommunications Union – Telecommunications standards.	minEMBc	Minimum calculated effective modal bandwidth.
IVD	Inside vapor deposition.	MLM	Multilongitudinal mode (laser).
IXC	Interexchange carrier.	MMF	Multimode fiber.
kb/s	Kilobits per second.	MMTA	Multimedia Telecommunications Association.
km	Kilometer.	MPD	Mode power distribution.
LAN	Local area network.	MPEG	Moving Pictures Experts Group.
LATA	Local access and transport area.	MPLS	Multiprotocol label switching.
LCP	Local convergence point.	MPO	Multifiber push-on connector.
LD	Laser diode.	MRCL	Maximum rated cable load.
LEC	Local exchange carrier.	MSB	Most significant bit.
LED	Light-emitting diode.	MSDS	Material safety data sheet.
LID	Local injection and detection.	MSO	Multiple system operator.
LSA	Least square approximation.	MSP	Managed service provider.
LSB	Least significant bit.	MST	Multipoint service terminal.
LSZH	Low smoke zero halogen.	MSTP	Multiservice transport platform.
LTGF	Loose tube gel filled.	MTBF	Mean time between failure.
LWP	Low water peak.	MTDC	Multitenant data center.
LX	Dual fiber designation for Ethernet.	MTP	Multiple termination plug.
MAC	Media access control.	MT-RJ	Multiple termination RJ connector.
MAN	Metropolitan area network.	MTT	Multitask technician.
Mb/s	Megabits per second. Also Mbps or Mbit/s.	MTU	Multiple tenant unit, or multiterminal unit.
MC	Main cross-connect.		
M-CMTS	Modular cable modem termination system.		



MUTOA	Multiuser telecommunications outlet assembly.	OC-3e	Optical carrier, level 3 concatenated.
MUX	Multiplexer.	OCDMA	Optical code division multiple access.
NA	Numerical aperture.	OD	Outside diameter.
NAP	Network access point.	ODE	Outdoor distribution enclosure.
NCTA	National Cable and Telecommunications Association.	ODN	Optical distribution network.
NEBS	Network equipment building system.	ODSI	Optical domain service interconnect.
NEC	National Electrical Code.	ODU	Optical demultiplexer unit.
NEMA	National Electrical Manufacturers Association.	OE	Optical-to-electrical.
NESC	National Electrical Safety Code.	OEE	Optical entrance enclosure.
NFPA	National Fire Protection Association.	OEIC	Optoelectronic integrated circuit.
NG	Next generation.	OEM	Original equipment manufacturer.
NGA	Next generation access.	OEO	Optical to electrical to optical.
NGDLC	Next generation digital loop carrier.	OFCP	Optical fiber conductive plenum.
NGOA	Next generation optical access.	OFCR	Optical fiber conductive riser.
NGI	Next generation Internet.	OFCS	Optical fiber communication system.
NG-PON	Next generation PON.	OFDM	Orthogonal frequency division multiplexing.
NIST	National Institute of Standards and Technology.	OFDMA	Orthogonal frequency division multiple access.
NMS	Network management system.	OFL	Overfilled launch.
NOC	Network operations center.	OFNP	Optical fiber nonconductive plenum.
NPC	No-polish connector.	OFNR	Optical fiber nonconductive riser.
NRZ	Nonreturn to zero.	OFSTP	Optical fiber system test procedures.
NT	Network terminal.	OI	Optical isolator.
NTSC	National Television Standards Committee.	OLS	Optical line system.
NZDS	Nonzero dispersion-shifted fiber.	OLT	Optical line terminal.
O/E	Optical to electrical.	OLTS	Optical loss test set.
OADM	Optical add/drop multiplexer.	OMA	Optical modulation amplitude.
OAM	Operations, administration and maintenance.	OMCC	Optical network unit management and control channel.
OAM&P	Operations, administration, maintenance and provisioning.	OMCI	Optical network terminal management and control interface.
OAN	Optical access networking.	OMU	Optical multiplexer unit.
OAS	Optical access switch.	ONT	Optical network terminal.
OAU	Optical access units.	ONU	Optical network unit.
OC	Optical carrier.	OOB	Out of band.
OC-3	Optical carrier, level 3.	OOO	Optical-optical-optical.
		OPEX	Operational expenditures.
		OPGW	Optical power ground wire.



OPM	Optical power meter.	PLOAM	Physical layer operations, administration, and maintenance.
OPS	Optical protection switch.	PMD	Polarization mode dispersion, or physical medium dependent layer.
ORL	Optical return loss.	PM-QPSK	Polarization multiplexed quadrature phase shift keying.
OS	Operating system.	POF	Plastic optical fiber.
OSA	Optical spectrum analyzer; optical subassembly; Optical Society of America.	PON	Passive optical network.
OSC	Optical supervisory channel.	POP	Point of presence.
OSHA	Occupational Safety and Health Administration.	POTP	Passive optical transport platform.
OSI	Open system interconnection.	POTS	Plain old telephone service.
OSNR	Optical signal-to-noise ratio.	PPD	Partial packet discard.
OSP	Outside plant.	PPP	Point-to-point protocol.
OSS	Operational support system.	PPV	Pay-per-view.
OTDM	Optical time-division multiplexing.	PR	Power budget, symmetric rate.
OTDR	Optical time-domain reflectometer.	PRS	Primary reference source.
OTN	Optical transport network.	PRX	Power budget, asymmetric rate.
OTU	Optical translator unit.	ps	Picosecond.
OVD	Outside vapor deposition.	PSTN	Public switched telephone network.
OXC	Optical cross-connect.	PU	Polyurethane.
P2MP	Point-to-multipoint.	PUD	Public utility district.
P2P/PtP	Point-to-point.	PX	Designation for an Ethernet PON system.
PAS	Profile alignment system.	PXC	Photonic cross-connect.
PAU	PON access unit.	QAM	Quadrature amplitude modulation.
PBX	Private branch exchange.	QDM	Double-band amplitude modulation.
PC	Physical contact.	QoS	Quality of service.
PCM	Pulse code modulation.	QPSK	Quadrature phase-shift keying.
PCU	PON control unit.	RADSL	Rate adaptive digital subscriber line.
PCVD	Plasma activated chemical vapor deposition.	RBHC	Regional bell holding company.
PDC	Polarization dependence of the center wavelength.	RBOC	Regional Bell operating company.
PDL	Polarized dispersion loss.	RBS	Rated breaking strength.
PDU	Protocol data unit.	RCVR	Receiver.
PE	Polyethylene.	RE	Reach extender.
PHY	Physical layer.	RF	Radio frequency.
PIN	Positive intrinsic negative.	RFC	Request for comments.
PIN FET	Positive-intrinsic-negative field-effect transistor.	RFI	Radio frequency interference.
PLC	Planar lightwave circuit.	RFoG	Radio frequency over glass.
		RFTS	Remote fiber test system.



RIN	Relative intensity noise.	SNI	Service node interface, or standard network interface.
RM	Receive module.	SNMP	Simple (or signalling) network management protocol.
RMS	Root mean square.	SNR	Signal-to-noise ratio.
ROADM	Reconfigurable optical add/drop multiplexer.	SOA	Semiconductor optical amplifier.
ROSA	Receiver optical subassembly.	SOHO	Small office/home office.
ROW	Rights of way.	SONET	Synchronous optical network.
RPR	Resilient packet ring.	SPC	Super physical contact.
RT	Remote terminal.	SPIE	Society of Photographic Instrumentation Engineers.
RTU	Remote test unit.	SRS	Stimulated Raman scattering.
RU	Rack unit.	SSB	Single side band.
Rx	Receive.	STB	Set-top box.
RZ	Return to zero.	STM	Synchronous transfer mode, or synchronous transport module.
SA	Serving area.	STS	Synchronous transport signaling.
SAN	Storage area network.	SVC	Switched virtual circuit.
SAP	Service access point.	SVOD	Switched video on demand.
SBS	Stimulated Brillouin scattering.	T1	T-carrier level 1.
SCADA	Supervisory control and data acquisition.	T3	T-carrier level 3.
SCTE	Society of Cable Telecommunications Engineers.	TAXI	Transparent asynchronous transmitter receiver interface.
SDH	Synchronous digital hierarchy.	TC	Telecommunications closet, or transmission convergence.
SDS	Switched digital service.	TCL	Transmission convergence layer.
SDSL	Single-pair symmetrical digital subscriber line.	T-CONT	Transmission container.
SDTV	Standard high definition television.	TCP/IP	Transport control protocol/Internet protocol.
SDV	Switched digital video.	TDM	Time division multiplexing.
SFF	Small form factor.	TDMA	Time division multiple access.
SFP	Small form-factor pluggable.	TE	Telecommunications enclosure.
SIEPON	Service interoperability in Ethernet passive optical networks.	Telco	Telephone company.
SLA	Service level agreement.	TIA	Telecommunications Industry Association.
SLED	Surface-emitting LED.	TO	Telecommunications outlet.
SLIC	Subscriber line interface circuit.	TOSA	Transmitter optical subassembly.
SLM	Single longitudinal mode (laser).	TPON	Telephony passive optical network.
SMDS	Switched multimegabit data service.	TR	Telecommunications room.
SMF	Single-mode fiber.	TSB	Technical service bulletin.
SMPTE	Society of Motion Picture and Television Engineers.	TWDM	Time and wavelength division multiplexing.
SMS	Service management system.		



Tx	Transmit.	WHMIS	Workplace Hazardous Material Information System.
UBR	Unspecified bit rate.	WIC	Wavelength independent coupler.
UHDTV	Ultra high definition television.	WIMAX	Worldwide interoperability for microwave access.
UL	Underwriter's Laboratories.	WSS	Wavelength selectable switch.
ULC	Underfilled launch condition.	WSXC	Wavelength-selective cross-connect.
UNE	Unbundled network element.	WWDM	Wide wavelength division multiplexing.
UNI	User network interface.	WXC	Wavelength cross-connect.
UPC	Ultra physical contact.	X/S	Interference/optical power of Basic band.
UPS	Uninterruptible power supply.	xDSL	Generic digital subscriber line.
US	Upstream.	XFP	10 Gigabit small form factor pluggable.
UTP	Unshielded twisted pair.	XGEM	XG-PON encapsulation method.
UV	Ultraviolet.	XGMII	10 Gigabit media independent interface.
VAD	Vapor axial deposition.	XG-PON	10 Gigabit passive optical network.
VBR	Variable bit rate.	XGS-PON	10 Gigabit-capable symmetric passive optical network.
VC	Virtual channel, or virtual circuit.	XGTC	10 Gigabit transmission convergence.
VCC	Virtual circuit connection.	XMD	10 Gigabit miniature device.
VCSEL	Vertical-cavity surface-emitting laser.	XPM	Cross phase modulation.
VDSL	Very high bit-rate digital subscriber line.	ZDA	Zone distribution area.
VFC	Voice frequency channels.	ZWP	Zero water peak.
VOA	Variable optical attenuator.		
VOD	Video on demand.		
VoIP	Voice over Internet protocol.		
VP	Virtual path.		
VPC	Virtual path connection.		
VPCI	Virtual path connection identifier.		
VPN	Virtual private network.		
VPON	Video passive optical network.		
VSB	Vestigial sideband.		
VT	Virtual tributary.		
VTG	Virtual tributary group.		
WA	Work area.		
WAN	Wide area network.		
WA-PON	Wavelength agile passive optical network.		
WBF	Wavelength blocking filter.		
WDM	Wavelength division multiplexing.		
WDM-PON	Wavelength division multiplexing passive optical network.		

